APPLIED

Pharmacotherapy

AN EASY APPROACH TO THE CONCEPTUAL KNOWLEDGE OF CLINICAL PHARMACEUTICAL PRACTICE

2nd Edition

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CLINICAL PHARMACEUTICAL PRACTICE

APPLIED PHARMACOTHERAPY

1st Edition

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1st Edition January 2009
2nd Edition January, 2014

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Approved/ Acknowledged by:

PHARMACIST FEDERATION
Registered under Society Registration Act 1960
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An organization to provide quality literary and academic materials
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NOTICE

The therapy plans and clinical profiles of therapeutical agents are being changed every day. Pharmaceutical research and clinical trails have sharply broadened our knowledge and making more sophisticated alterations in treatment protocols. The author, contributors and publisher of this manuscript have checked the informations with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standard accepted at the time of publication. However, in view of the possibility of human error or change in latest clinical research data, neither the author nor the publisher nor any other party who has been involved in the preparation or publication of this work warrants that the information contain herein is in every respect accurate or compete, and they disclaim all responsibility for any error or omissions or for the results obtained from use of the information contained in this work. The students, researchers and readers are encouraged to confirm the information contains herein and this recommendation is of particular importance in connection with newer or infrequently used drugs.

Chapter 1.

PHARMACY
Introduction, History, Types and Modern Issues

Pharmacy profession linked with other discipliens and is charged with ensuring the safe and effective use of medication. It,s more traditional roles i.e. compounding, dispensing, patietn caring, reviewing medications and providing drug information has made it more significant. Pharmacists, therefore, are the experts on drug therapy and are the primary health professionals who optimize medication use to provide patients with positive health outcomes. The word pharmacy is derived from its root word pharma that offered general medical advice and a range of services. In its investigation, the work of the pharma may be regarded as a precursor of the modern sciences of chemistry and pharmacology and scientific methods of formulation. This chapter cover all the basic principles of pharmaceutical sciences i.e. history, types, Modern issues, pharmacy associations and pharmacy schools/ institutions e.t.c.

Chapter 1.

PHARMACY

INTRODUCTION, HISTORY, TYPES AND MODERN ISSUES

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PHARMACY:

Pharmacy is an explicit part of the health profession that links the health sciences with the clinical and chemical sciences. It is charged with ensuring the safe and effective use of medication. The scope of pharmacy practice includes more traditional roles such as compounding and dispensing medications, and it also includes more modern services related to patient care, including clinical services, reviewing medications for safety and efficacy, and providing drug information. Pharmacists, therefore, are the experts on drug therapy and are the primary health professionals who optimize medication use to provide patients with positive health outcomes. The term is also applied to an establishment used for such purposes. The first pharmacy in Europe (still working) was opened in 1241 in Trier, Germany.

The word pharmacy is derived from its root word pharma which was a term used since the 1400–1600's. In addition to pharma responsibilities, the pharma offered general medical advice and a range of services that are now performed solely by other specialist practitioners, such as surgery and midwifery. The pharma (as it was referred to) often operated through a retail shop which, in addition to ingredients for medicines, sold tobacco and patent medicines. The pharmas also used many other herbs not listed.

In its investigation of herbal and chemical ingredients, the work of the pharma may be regarded as a precursor of the modern sciences of chemistry and pharmacology, prior to the formulation of the scientific method.

DISCIPLINES:

The field of Pharmacy can generally be divided into three primary disciplines:

- Pharmaceutics
- Medicinal chemistry
- Pharmacognosy
- Pharmacology and
- Pharmacy practice

The boundaries between these disciplines and with other sciences, such as biochemistry, are not always clear-cut; and often, collaborative teams from various disciplines research together.

Pharmacology is sometimes considered a fourth discipline of pharmacy. Although pharmacology is essential to the study of pharmacy, it is not specific to pharmacy. Therefore it is usually considered to be a field of the broader sciences.

Other specializations in pharmacy practice recognized by the Pharmaceutical Specialties include: cardiovascular, infectious disease, oncology, pharmacotherapy, nuclear, nutrition, and psychiatry. The professional bodies for certification in pharmacy certifies pharmacists in pharmacy practice, i.e. The American Board of Applied Toxicology certifies pharmacists and other medical professionals in applied toxicology.

Pharmacists are highly-trained and skilled healthcare professionals who perform various roles to ensure optimal health outcomes for their patients. Many pharmacists are also small-business owners, owning the pharmacy in which they practice.

Pharmacists are represented internationally by the International Pharmaceutical Federation (FIP). They are represented at the national level by professional organizations such as the Royal Pharmaceutical Society of

Great Britain (RPSGB), the Pharmacy Guild of Australia (PGA), the Pakistan Pharmacists Society (PPS) and the American Pharmacists Association

In some cases, the representative body is also the registering body, which is responsible for the ethics of the profession.

HISTORY OF PHARMACY

Paleopharmacological studies attest to the use of medicinal plants in pre-history.

The earliest known compilation of medicinal substances was the *Sushruta Samhita*, an Indian Ayurvedic treatise attributed to Sushruta in the 6th century BC. However, the earliest text as preserved dates to the 3rd or 4th century AD.

Many Sumerian (late 6th millennium BC - early 2nd millennium BC) cuneiform clay tablets record prescriptions for medicine.

Ancient Egyptian pharmacological knowledge was recorded in various papyri such as the *Ebers Papyrus* of 1550 BC, and the *Edwin Smith Papyrus* of the 16th century BC.

The earliest known Chinese manual on materia medica is the *Shennong Bencao Jing* (*The Divine Farmer's Herb-Root Classic*), dating back to the 1st century AD. It was compiled during the Han dynasty and was attributed to the mythical Shennong. Earlier literature included lists of prescriptions for specific ailments, exemplified by a manuscript "Recipes for 52 Ailments", found in the Mawangdui tomb, sealed in 168 BC. Further details on Chinese pharmacy can be found in the Pharmacy in China article.

The Greek physician Pedanius Dioscorides is famous for writing a five volume book in his native Greek Περί ύλης ιατρικής in the 1st century AD. The Latin translation *De Materia Medica* (*Concerning medical substances*) was used a basis for many medieval texts, and was built upon by many middle eastern scientists during the Islamic Golden Age. The title coined the term *materia medica*.

In Japan, at the end of the Asuka period (538-710) and the early Nara period (710-794), the men who fulfilled roles similar to those of modern pharamacists were highly respected. The place of pharmacists in society was expressly defined in the Taihō Code (701) and re-stated in the Yōrō Code (718). Ranked positions in the pre-Heian Imperial court were established; and this organizational structure remained largely intact until the Meiji Restoration (1868). In this highly stable hierarchy, the pharmacists -- and even pharmacist assistants -- were assigned status superior to all others in health-related fields such as physicians and acupuncturists. In the Imperial household, the pharmacist was even ranked above, the two personal physicians of the Emperor.

In Baghdad the first pharmacies were established in 754 under the Abbasid Caliphate during the Islamic Golden Age. By the 9th century, these pharmacies were state-regulated.

The advances in made in the Middle East in botany and chemistry led medicine in medieval Islam substantially to develop pharmacology. Muhammad Ibn Zakarīya Rāzi (Rhazes) (865-915), for instance, acted to promote the medical uses of chemical compounds. Abu al-Qasim al-Zahrawi (Abulcasis) (936-1013) pioneered the preparation of medicines by sublimation and distillation. His *Liber servitoris* is of particular interest, as it provides the reader with recipes and explains how to prepare the samples from which were compounded the complex drugs then generally used. Sabur Ibn Sahl (d 869), was, however, the first physician to initiate pharmacopoedia, describing a large variety of drugs and remedies for ailments. Al-Biruni (973-1050) wrote one of the most valuable Islamic works on pharmacology entitled *Kitab al-Saydalah* (*The Book of Drugs*), where he gave detailed knowledge of the properties of drugs and outlined the role of pharmacy and the functions and duties of the pharmacist. Ibn Sina (Avicenna), too, described no less than 700 preparations, their properties, mode of action and their indications. He devoted in fact a whole volume to simple drugs in *The Canon of Medicine*. Of great impact were also the works by al-Maridini of Baghdad and Cairo, and Ibn al-Wafid (1008-1074), both of which were printed in Latin more than fifty times, appearing as *De Medicinis universalibus et particularibus* by mice' the younger, and the *Medicamentis simplicibus* by `Abenguefit'. Peter of Abano (1250-1316) translated and added a supplement to the work of al-Maridini under the title *De Veneris*. Al-Muwaffaq's contributions in the field are also pioneering. Living in the 10th century, he wrote *The foundations of the true properties of Remedies*, amongst others describing arsenious oxide, and being acquainted with silicic acid. He made clear distinction between sodium carbonate and potassium carbonate, and drew attention to the poisonous nature of copper compounds, especially copper vitriol, and also lead compounds. He also describes the distillation of seawater for drinking.

In Europe pharmacy-like shops began to appear during the 12th century. In 1240 emperor Frederic II issued a decree by which the physician´s and the apothecary´s professions were separated.

TYPES OF PHARMACY PRACTICE AREAS

Pharmacists practice in a variety of areas including retail, hospitals, clinics, nursing homes, drug industry, and regulatory agencies. Pharmacists can specialize in various areas of practice including but not limited to: hematology/oncology, infectious diseases, ambulatory care, nutrition support, drug information, critical care, pediatrics, etc.

A **pharmacy** (commonly the **chemist** in Australia, New Zealand and the UK; or **drugstore** in North America; **retail pharmacy** in industry terminology; or Apothecary, historically) is the place where most pharmacists practice the profession of pharmacy. It is the community pharmacy where the

dichotomy of the profession exists—health professionals who are also retailers.

Community pharmacy

Apothecary's shop (1850).

19th century Italian pharmacy

Modern pharmacy in Norway

Community pharmacies usually consist of a retail storefront with a dispensary where medications are stored and dispensed. The dispensary is subject to pharmacy legislation; with requirements for storage conditions, compulsory texts, equipment, *etc.*, specified in legislation. Where it was once the case that pharmacists stayed within the dispensary compounding/dispensing medications; there has been an increasing trend towards the use of trained pharmacy technicians while the pharmacist spends more time communicating with patients.

A Canadian Safeway Pharmacy

All pharmacies are required to have a pharmacist on-duty at all times when open. In many jurisdictions, it is also a requirement that the owner of a pharmacy must be a registered pharmacist (R.Ph.). This latter requirement has been revoked in many jurisdictions, such that many retailers (including supermarkets and mass merchandisers) now include a pharmacy as a department of their store.

Likewise, many pharmacies are now rather grocery store-like in their design. In addition to medicines and prescriptions, many now sell a diverse arrangement of additional household items such as cosmetics, shampoo, office supplies, confectionary, and snack foods.

Hospital pharmacy

Pharmacies within hospitals differ considerably from community pharmacies. Some pharmacists in hospital pharmacies may have more complex clinical medication management issues whereas pharmacists in community pharmacies often have more complex business and customer relations issues.

Because of the complexity of medications including specific indications, effectiveness of treatment regimens, safety of medications (i.e., drug interactions) and patient compliance issues (in the hospital and at home) many pharmacists practicing in hospitals gain more education and training after pharmacy school through a pharmacy practice residency and sometimes followed by another residency in a specific area. Those pharmacists are often referred to as clinical pharmacists and they often specialize in various disciplines of

pharmacy. For example, there are pharmacists who specialize in hematology/oncology, HIV/AIDS, infectious disease, critical care, emergency medicine, toxicology, nuclear pharmacy, pain management, psychiatry, anticoagulation clinics, herbal medicine, neurology/epilepsy management, pediatrics, neonatal pharmacists and more.

Hospital pharmacies can usually be found within the premises of the hospital. Hospital pharmacies usually stock a larger range of medications, including more specialized medications, than would be feasible in the community setting. Most hospital medications are unit-dose, or a single dose of medicine. Hospital pharmacists and trained pharmacy technicians compound sterile products for patients, including total parenteral nutrition (TPN), and other medications given intravenously. This is a complex process that requires adequate training of personnel, quality assurance of products, and adequate facilities. Several hospital pharmacies have decided to outsource high risk preparations and some other compounding functions to companies who specialize in compounding.

Clinical pharmacy

Clinical pharmacists provide a direct patient care service that optimizes the use of medication and promotes health, wellness, and disease prevention. Clinical pharmacists care for patients in all health care settings but the clinical pharmacy movement initially began inside Hospitals and clinics. Clinical pharmacists often collaborate with Physicians and other healthcare professionals to improve pharmaceutical care. Clinical pharmacists are now an integral part of the interdisciplinary approach to patient care. They work collaboratively with physicians, nurses and other healthcare personnel in various medical and surgical areas. They often participate in patient care rounds and drug product selection. In most hospitals in the United States, potentially dangerous drugs that require close monitoring are dosed and managed by clinical pharmacists.

Compounding pharmacy

Compounding is the practice of preparing drugs in new forms. For example, if a drug manufacturer only provides a drug as a tablet, a compounding pharmacist might make a medicated lollipop that contains the drug. Patients who have difficulty swallowing the tablet may prefer to suck the medicated lollipop instead.

Compounding pharmacies specialize in compounding, although many also dispense the same non-compounded drugs that patients can obtain from community pharmacies.

Consultant pharmacy

Consultant pharmacy practice focuses more on medication regimen review (i.e. "cognitive services") than on actual dispensing of drugs. Consultant pharmacists most typically work in nursing homes, but are increasingly branching into other institutions and non-institutional settings. Traditionally consultant pharmacists were usually independent business owners, though in the United States many now work for several large pharmacy management companies (primarily Omnicare, Kindred Healthcare and PharMerica). This trend may be gradually reversing as consultant pharmacists begin to work directly with patients, primarily because many elderly people are now taking numerous medications but continue to live outside of institutional settings. Some community pharmacies employ consultant pharmacists and/or provide consulting services.

The main principle of consultant pharmacy is Pharmaceutical care developed by Hepler and Strand in 1990.

Internet pharmacy

Since about the year 2000, a growing number of Internet pharmacies have been established worldwide. Many of these pharmacies are similar to community pharmacies, and in fact, many of them are actually operated by brick-and-mortar community pharmacies that serve consumers online and those that walk in their door. The primary difference is the method by which the medications are requested and received. Some customers consider this to be more convenient and private method rather than traveling to a community drugstore where another customer might overhear about the drugs that they take. Internet pharmacies (also known as Online Pharmacies) are also recommended to some patients by their physicians if they are homebound.

While most Internet pharmacies sell prescription drugs and require a valid prescription, some Internet pharmacies sell prescription drugs without requiring a prescription. Many customers order drugs from such pharmacies to avoid the "inconvenience" of visiting a doctor or to obtain medications which their doctors were unwilling to prescribe. However, this practice has been criticized as potentially dangerous, especially by those who feel that only doctors can reliably assess contraindications, risk/benefit ratios, and an individual's overall suitability for use of a medication. There also have been reports of such pharmacies dispensing substandard products.

Of particular concern with internet pharmacies is the ease with which people, youth in particular, can obtain controlled substances (e.g., Vicodin, generically known as hydrocodone) via the internet without a prescription issued by a doctor/practitioner who has an established doctor-patient relationship. There are many instances where a practitioner issues a prescription, brokered by an internet server, for a controlled substance to a "patient" s/he has never met. In the United States, in order for a prescription for a controlled substance to be valid, it must be issued for a legitimate medical purpose by a licensed practitioner acting in the course of legitimate doctor-patient relationship. The filling pharmacy has a corresponding responsibility to ensure that the prescription is valid. Often, individual state laws outline what defines a valid patient-doctor relationship.

Canada is home to dozens of licensed Internet pharmacies, many which sell their lower-cost prescription drugs to U.S. consumers, who pay the world's highest drug prices. In recent years, many consumers in the US and in other countries with high drug costs, have turned to licensed Internet pharmacies in India, Israel and the UK, which often have even lower prices than in Canada.

In the United States, there has been a push to legalize importation of medications from Canada and other countries, in order to reduce consumer costs. While in most cases importation of prescription medications violates Food and Drug Administration (FDA) regulations and federal laws, enforcement is generally targeted at international drug suppliers, rather than consumers. There is no known case of any U.S. citizens buying Canadian drugs for personal use with a prescription, who has ever been charged by authorities.

Veterinary pharmacy

Veterinary pharmacies, sometimes called *animal pharmacies* may fall in the category of hospital pharmacy, retail pharmacy or mail-order pharmacy. Veterinary pharmacies stock different varieties and different strengths of medications to fulfill the pharmaceutical needs of animals. Because the needs of animals as well as the regulations on veterinary medicine are often very different from those related to people, veterinary pharmacy is often kept separate from regular pharmacies.

Nuclear pharmacy

Nuclear pharmacy focuses on preparing radioactive materials for diagnostic tests and for treating certain diseases. Nuclear pharmacists undergo additional training specific to handling radioactive materials, and unlike in community and hospital pharmacies, nuclear pharmacists typically do not interact directly with patients.

Military pharmacy

Military pharmacy is an entirely different working environment due to the fact that technicians perform most duties that in a civilian sector would be illegal. State laws of Technician patient counseling and medication checking by a pharmacist do not apply.

Pharmacy informatics

Pharmacy informatics is the combination of pharmacy practice science and applied information science. Pharmacy informaticist's work in many practice areas of pharmacy, however, they may also work in information technology departments or for healthcare information technology vendor companies. As a practice area and specialist domain, pharmacy informatics is growing quickly to meet the needs of major national and international patient information projects and health system interoperability goals. Pharmacists are well trained to participate in medication management system development, deployment and optimization.

MODEREN PHARMACEUTICAL ISSUES

SEPARATION OF PRESCRIBING FROM DISPENSING

In most jurisdictions (such as the United States), pharmacists are regulated separately from physicians. Specifically, the legislation stipulates that the practice of prescribing must be separate from the practice of dispensing. These jurisdictions also usually specify that *only* pharmacists may supply scheduled pharmaceuticals to the public and that pharmacists cannot form business partnerships with physicians or give them "kickback" payments. However, the American Medical Association (AMA) Code of Ethics provides that physicians may dispense drugs within their office practices as long as there is no patient exploitation and patients have the right to a written prescription that can be filled elsewhere. 7 to 10 percent of American physician's practices reportedly dispense drugs on their own.

In other jurisdictions (particularly in Asian countries such as China, Hong Kong, Malaysia, and Singapore), doctors are allowed to dispense drugs themselves and the practice of pharmacy is sometimes integrated with that of the physician, particularly in traditional Chinese medicine.

In Canada it is common for a medical clinic and a pharmacy to be located together and for the ownership in both enterprises to be common, but licensed separately.

The reason for the majority rule is the high risk of a conflict of interest. Otherwise, the physician has a financial self-interest in "diagnosing" as many conditions as possible, and in exaggerating their seriousness, because he or she can then sell more medications to the patient. Such self-interest directly conflicts with the patient's interest in obtaining cost-effective medication and avoiding the unnecessary use of medication that may have side-effects. This system reflects much similarity to the checks and balances system of the U.S. and many other governments.

A campaign for separation has begun in many countries and has already been successful (like in Korea). As many of the remaining nations move towards separation, resistance and lobbying from dispensing doctors who have pecuniary interests may prove a major stumbling block (e.g. in Malaysia).

THE FUTURE OF PHARMACY

In the coming decades, pharmacists are expected to become more integral within the health care system. Rather than simply dispensing medication, pharmacists will be paid for their patient care skills.

This shift has already commenced in some countries; for instance, pharmacists in Australia receive remuneration from the Australian Government for conducting comprehensive Home Medicines Reviews. In the United Kingdom, pharmacists (and nurses) who undertake additional training are obtaining prescribing rights. They are also being paid for

by the government for medicine use reviews. In the United States, pharmaceutical care or Clinical pharmacy has had an evolving influence on the practice of pharmacy. Moreover, the Doctor of Pharmacy (Pharm.D.) degree is now required before entering practice and many pharmacists now complete one or two years of residency or fellowship training following graduation. In addition, consultant pharmacists, who traditionally operated primarily in nursing homes are now expanding into direct consultation with patients, under the banner of "senior care pharmacy.

PHARMACY EDUCATION

Bachelor of Pharmacy:

In Australia, the BPharm degree is awarded following a four-year undergraduate pharmacy program. Australian undergraduate pharmacy courses were previously three years, but were increased to four years during the 1990s with an increased emphasis on pharmacy practice education. During the early 2000s, two-year postgraduate Master of Pharmacy courses were established by many universities, but to date these have accounted for a relatively minor proportion of pharmacy graduates.

All BPharm programs in Australia are accredited by the New Zealand and Australian Pharmacy Schools Accreditation Committee (NAPSAC). Programs provide training in fields including: pharmacology, chemistry, pharmaceutical chemistry, pharmacy practice (including pharmacotherapeutics, disease state management, etc), pharmaceutics, ethics, pharmacy law, pharmacy management, physiology, anatomy, biochemistry, kinetics, and compounding medications.

As with most honours degrees at Australian universities, the awarding of a Bachelor of Pharmacy (Honours) (abbreviated BPharm(Hons)) is based on the completion of original research and a high-level of academic performance. All other graduates are awarded a pass degree. Unlike most Honours degrees in Australia, an additional year of study is not required for a BPharm(Hons) as most universities integrate research and coursework in the fourth year of BPharm(Hons) programs.

In 2003, The University of Sydney began offering a four-year Bachelor of Pharmacy (Rural) (abbreviated BPharm (Rural)) program at its Orange campus. It was designed to address the continuing shortage of pharmacists in rural areas and placed greater emphasis on rural aspects of pharmacy practice. Since most of the units-of-study were common to both the BPharm and BPharm (Rural), many of the lectures were delivered by academics at the main campus in Sydney with a live video broadcast to students at Orange.

The program was not offered in 2005, following the transfer of Orange campus to Charles Sturt University. Following a review, a new BPharm (Rural) program was offered from 2006 onwards at the university's main campus (Camperdown/Darlington campus).

Master of Pharmacy (**MPharm** or **MPharm Hons.**)

A Master of Pharmacy (abbreviated MPharm or MPharm Hons.) is an undergraduate academic degree in the field of pharmacy. In many countries, it has superseded a Bachelor of Pharmacy (BPharm) as the prerequisite for registration to practise as a pharmacist. It may also refer to a postgraduate coursework or research degree in the field of pharmacy.

Master of Pharmacy (MPharma)in India is offered as post graduate (graduate) course after completion of BPharma degree.The MPharma course is normally of two years duration. The course focuses on specialisation in the field of pharmacy.The MPharma courses are offered by pharmacy colleges affiliated to universities or by autonomous colleges .

In Australia, prior to 2004, MPharm was a postgraduate research degree. In 2004, the University of Newcastle introduced a two-year postgraduate MPharm coursework program, to provide an accelerated route for graduates of undergraduate science or medical science degrees to gain qualification for registration to practise as pharmacists. Following the commencement of the MPharm program at the University of Newcastle, other universities across Australia also began offering MPharm coursework programs.

Doctor of Pharmacy

In Canada the PharmD program is offered in both English and French. Currently in Canada the PharmD program is a post-baccalaureate program. Students enrolled in the program must have graduated from a CCAPP (Canadian Council for Accreditation of Pharmacy Programs) or an ACPE (American Council of Pharmaceutical Education) school with an accredited teaching program or must have passed the PEBC (Pharmacy Examining Board of Canada) Evaluating and Qualifying examinations.

In the United States, the PharmD. (Doctor of Pharmacy) degree is a professional degree that prepares the graduate for pharmacy practice.

Traditionally in the United States, the bachelor's degree in pharmacy was the first-professional degree for pharmacy practice. However, in 1990, the American Association of Colleges of Pharmacy (AACP) mandated that a doctor of pharmacy degree would be the new first-professional degree.

In France, pharmacy studies can only be accessed through a competitive examination ("concours", with *numerus clausus*) happening at the end of the first year, similarly to Medicine studies. Most candidates hold a Scientific Baccalaureate from the equivalent to high schools (lycée). In case of failure, it is possible to retry once (twice in extremely rare cases). Yearly success rate depends on the university's current *numerus clausus* and the number or registered students, ranging from

10 to 40% bearing in mind that second-time participants are three to four times more likely to succeed than students trying for the first time.
The studies last a minimum of 6 years, or 9 years for students choosing hospital pharmacy or clinical biology. It is a residency accessible through another competitive exam, even more selective. It lasts four years and give an another diploma of specialist like in medicine (DES for "diplôme d'études spécialisées") . Students must specialise when entering the 5th year, and choose between dispensing pharmacy, pharmaceutical industry or hospital internship. In any case, a 12-month part-time hospital externship is mandatory during the 5th year, although some flexibility is possible for students choosing industry.
6th year for industry is generally dedicated to further specialisation with a former diplôme d'études supérieures spécialisées (DESS)/Professional Master's degree or a former diplôme d'études approfondies (DEA)/Research Master's degree.
State diploma for the Doctorate of Pharmacy, Pharm D., is granted to pharmacists after they have completed a thesis (experimental or bibliographic).

In France, since the harmonization of European Union in September 2005, the student who chooses the industry/research orientation have a 6 month period of part time hospital externship, and 3 to 6 month of full time training in a pharmaceutical industry or a research lab.

It is also possible to defend a research thesis for preparing a Ph.D.

In the United Kingdom the PharmD is a relatively new postgraduate doctorate degree open to qualified pharmacists. It is offered by the University of Bradford, taking place over 3 years of clinical practice followed by 2 years of research. It is also offered by the University of Portsmouth and the University of Derby.

Started in 2001 at KAU, then in 2005 at Ibn-Sina University, then 2006 at KFU, then 2007 at Qassim University. In 2008, KSU College of Pharmacy at Riyadh, College of Pharmacy at Kharj, and Taif University started their PHARM-D programs.

The degree duration in Saudi Arabia is six years in total including one academic year clinical rotations.

According to the Saudi Commission for Health Specialties (SCFHS), if a student graduated from a (minimum six years) PHARM-D degree, the graduate have the chance to further develop himself. This can be achieved by taking Accredited Residency Training Program that is at least one year long (total seven years minimum). Upon successfully completing both the Residency program and the PHARM-D, the graduate can apply for Professional Equivalent (only equivalent in practice) to the Master degree in Pharmacy.

In india D Pharm (2 years course) is the minimum qualification required to be a registered as pharmacist. B Pharm (4 years course) course is offered in various Universities since long time. Recently Pharmacy Council of India permitted few universities to start Pharm D (5 years + 1 year internship in a hospital) course starting from October 2008 to enable the new graduates to pursue their career abroad if necessary. The PCI had cleared proposals for starting the six-year Pharm D course in six colleges of Andhra Pradesh, seven in Karnataka, seven in Tamil Nadu, one each in Kerala, Madhya Pradesh, and Maharashtra. Many more colleges are expected to get approval from PCI in next academic year.
And also pharmacy council of India permitted few universities to start pharm D (post baccalaureate)course (2 years + 1 year internship in a 300 bedded hospital)for B pharmacy graduates.
To this effect government of India published in the gazette of India,no 19,part 3,section 4 on 10th MAY 2008.
In pharm.D..the advantage was we need not to clear the entrance to abroad countries like naplex..etc...there ia an direct entry to gulf countries with Pharm.D degree...
In Pakistan, the PharmD. (Doctor of Pharmacy) degree is a professional degree that prepares the graduate for pharmacy practice, in Pakistan also.
Traditionally in Pakistan, the bachelor's degree in pharmacy was the first-professional degree for pharmacy practice. However, in 2003, the Pakistan Pharmacy Council mandated that a doctorate in pharmacy would be the new first-professional degree.
The PharmD in Pakistan is a professional basic degree consisting of 5 years. Most universities in Pakistan are offering the PharmD program such as Karachi University; Dow College of Pharmacy, Hamdard University, Baqai University, Federal Urdu University, The University of Punjab,The University Of Lahore,University of Balochistan, Gomal University,The Islamia university of Bhawalpur, etc.The qualified institutes are recognized by the Pakistan Pharmacy Council. Provincial Pharmacy councils of Punjab, Sindh, NWFP and Balochistan issue Pharmacist Licenses (RPh)

EVIDENCE-BASED PHARMACY IN DEVELOPING COUNTRIES

Pharmaceutical services in developing countries face particular challenges that are significantly different from those faced by pharmacists in the so-called developed world.
Medicines that are normally restricted to prescription in the developed world may be readily available on general sale in developing countries, while other extremely useful medicines such as morphine for severe pain may not be available at all or in such small quantities as to be effectively unobtainable. Many patients will not be able to afford all their prescribed medicines and so must choose which ones to buy. Doctors are supposed to make patients better, so often use irrational choices to achieve a cure. An example of this is prescribing several antibiotics for a single condition or prescribing injections where oral medication is sufficient. The quality of

medicines may be substandard or even dangerous. In the early 1990s, children in South Asia died as a result of consuming paracetamol elixir which contained ethylene glycol instead of propylene glycol. In addition, medicines may be poorly or inappropriately stored, thus rendering them useless at the time of sale or consumption.
Local and foreign pharmaceutical industry pressure, advertizing and incentives may lead to irrational choices. Doctors can be offered large inducements to promote and prescribe certain medicines. On the other hand, patients may request the contraceptive agent that is advertised on the neon signs in the city center or may believe that the famous brand name is bound to work better than a good-quality generic equivalent.

ONLINE PHARMACY

Since about the year 2000, hundreds of online pharmacies have begun operating over the internet. Many such pharmacies are, in some ways, similar to community pharmacies; the primary difference is the method by which the medications are requested and received. Some customers consider this to be more convenient than traveling to a community drugstore.

While many internet pharmacies sell prescription drugs only with a prescription, some do not require a pre-written prescription. In some countries, this is because prescriptions are not required. Some customers order drugs from such pharmacies to avoid the inconvenience of visiting a doctor or to obtain medications which their doctors were unwilling to prescribe. Many of these websites employ their own in house physicians to review the medication request and write a prescription accordingly. Some websites offer medications without a prescription or a doctor review. This practice has been criticized as potentially dangerous, especially by those who feel that only doctors can reliably assess contraindications, risk/benefit ratios, and the suitability of a medication for a specific individual. Pharmacies offering medication without a prescription and doctor review or supervision are sometimes fraudulent. In the United States, there has been a push to legalize importation of medications from Canada and several European countries, in order to reduce consumer costs. Although importation of prescription medication usually violates Food and Drug Administration (FDA) regulations and federal laws, enforcement is generally targeted at international drug suppliers, rather than consumers. Often Americans purchase lower-cost foreign drugs by driving to Canadian or Mexican pharmacies, buying their medications when traveling abroad on vacation, or, buying from foreign pharmacies that ship their orders via mail.

PHARMACOGENETICS

The terms pharmacogenomics and pharmacogenetics tend to be used interchangeably, and a precise, consensus definition of either remains elusive. Pharmacogenetics is generally regarded as the study or clinical testing of genetic variation that gives rise to differing response to drugs, while pharmacogenomics is the broader application of genomic technologies to new drug discovery and further characterization of older drugs. Pharmacogenetics considers one or at most a few genes of interest, while pharmacogenomics considers the entire genome.

PHARMACOGENOMICS

Pharmacogenomics is the branch of pharmacology which deals with the influence of genetic variation on drug response in patients by correlating gene expression or single-nucleotide polymorphisms with a drug's efficacy or toxicity. By doing so, pharmacogenomics aims to develop rational means to optimise drug therapy, with respect to the patients' genotype, to ensure maximum efficacy with minimal adverse effects. Such approaches promise the advent of "personalized medicine"; in which drugs and drug combinations are optimised for each individual's unique genetic makeup.

Pharmacogenomics is the whole genome application of pharmacogenetics, which examines the single gene interactions with drugs.

PHARMACONOMIST

Pharmaconomist (Danish: *farmakonom*) means expert in pharmaceuticals. Pharmaconomists are a pharmaceutical professional group in Denmark, Greenland and Faroe Islands with a 3 year higher tertiary education.

The majority of the pharmaconomists works at community pharmacies (chemists' shops or drugstores) and at hospital pharmacies and hospitals. Some pharmaconomists work within the chemical industry, the pharmaceutical industry and in medical or clinical laboratories.

Other pharmaconomists teach pharmacy students and pharmaconomy students at colleges or universities.

Pharmaconomists are also employeed by the Danish Ministry of Interior and Health, The Danish Medicines Agency and The Danish Pharmaceutical Association.

Some pharmaconomists do work as pharmaceutical consultants.

Difference between a* pharmaconomist *and a* pharmacist*?

There are two different professional groups with pharmaceutical education in Denmark:

Pharmaconomists (with a 3 year higher tertiary education)

Pharmacists (with a 5 year higher tertiary education)

Due to his or her higher education as a health professional, the pharmaconomist has by law the same independent competence in all Danish pharmacies as a pharmacist — i.e. for example to dispense and check medical prescriptions, to counsel and advise patients/customers about the use of medicine/pharmaceuticals and to dispense, sell and provide

information about medical prescriptions and about prescription medicine and over-the-counter medicine (OTC).

The pharmaconomist also undertakes specialist and managerial operation of pharmacies and undertakes managerial duty service.

The only difference by law is that only a pharmacist may *own* a Danish pharmacy — i.e. become a pharmacy manager.

Like pharmacist, pharmaconomists can work as deputy pharmacy managers or as chief pharmaconomists.

PHARMACOGENETICS AND ADVERSE DRUG REACTIONS

Much of current clinical interest is at the level of pharmacogenetics, involving variation in genes involved in, drug metabolism with a particular emphasis on improving drug safety. The wider use of pharmacogenetic testing is viewed by many as an outstanding opportunity to improve prescribing safety and efficacy. Driving this trend are the 106,000 deaths and 2.2 Million serious events caused by adverse drug reactions in the US each year (Lazarou 1998). As such ADRs are responsible for 5-7% of hospital admissions in the US and Europe, lead to the withdrawal of 4% of new medicines and cost society an amount equal to the costs of drug treatment (Ingelman-Sundberg 2005). Comparisons of the list of drugs most commonly implicated in adverse drug reactions with the list of metabolizing enzymes with known polymorphisms found that drugs commonly involved in adverse drug reactions were also those that were metabolized by enzymes with known polymorphisms (see Phillips, 2001).

Pharmacogenetic history reveal the first observations of genetic variation in drug response date from the 1950s, involving the muscle relaxant suxamethonium chloride, and drugs metabolized by N-acetyltransferase. One in 3500 Caucasians has less efficient variant of the enzyme (butyrylcholinesterase) that metabolizes suxamethonium chloride. As a consequence, the drug's effect is prolonged, with slower recovery from surgical paralysis. Variation in the N-acetyltransferase gene divides people into "slow acetylators" and "fast acetylators", with very different half-lives and blood concentrations of such important drugs as isoniazid (antituberculosis) and procainamide (antiarrhythmic). As part of the inborn system for clearing the body of xenobiotics, the cytochrome P450 oxidases (CYP450) are heavily involved in drug metabolism, and genetic variations in CYP450s affect large populations. One member of the CYP450 superfamily, CYP2D6, now has over 75 known allelic variations, some of which lead to no activity, and some to enhanced activity. An estimated 29% of people in parts of East Africa may have multiple copies of the gene, and will therefore not be adequately treated with standard doses of drugs such as the painkiller codeine (which is activated by the enzyme).

PHARMACY SYMBOLS

The two symbols most commonly associated with pharmacy are the mortar and pestle and the ℞ (*recipere*) character, which is often written as "rx" in typed text. The show globe was also used in English speaking countries until the early 20th century. Pharmacy organizations often use other symbols, such as the Bowl of Hygieia, conical measures, and caduceuses in their logos.
Other symbols are common in different countries: the green Greek cross in France, Argentina, the United Kingdom, Belgium, and Spain, the increasingly-rare Gaper in The Netherlands, and a red stylized letter A in Germany and Austria (from *Apotheke*, the German word for pharmacy, from the same Greek root as the English word 'apothecary').

LIST OF PHARMACY ASSOCIATIONS

The following is a list of organizations for professionals involved in the practice of pharmacy. Such organizations are typically professional societies, as opposed to trade associations.

International/Multinational
Pharmaceutical Group of the European Union (PGEU)
European Pharmaceutical Union (EPU)
International Pharmaceutical Federation (FIP)
European Association of Hospital Pharmacists (EAHP)
European Society of Clinical Pharmacy (ESCP)
International Pharmaceutical Students' Federation (IPSF)
European Pharmaceutical Student's Association (EPSA)
American Chinese Pharmaceutical Association (ACPA)
International Society for the History of Pharmacy (ISHP)

Australia
Pharmacy Guild of Australia (PGA)
Australian College of Pharmacy Practice and Management (The College)
Pharmaceutical Society of Australia (PSA)
Young Pharmacists' Group (YPG)
National Australian Pharmacy Students' Association (NAPSA)
Society of Hospital Pharmacists of Australia (SHPA)

Canada
Canadian Pharmacists Association (CPhA)

Canadian Society of Hospital Pharmacists (CSHP)
Canadian International Pharmacy Association (CIPA)
The Canadian Association of Pharmacy Students and Interns (CAPSI)
Canadian College of Clinical Pharmacy (CCCP)
National Association of Pharmacy Regulatory Authorities (NAPRA)
Pharmacy Examining Board of Canada/Bureau des examinateurs en pharmacie du Canada
Alberta Pharmacists' Association (RxA)
Alberta College of Pharmacists (ACP)
British Columbia Pharmacy Association (BCPhA)
International Pharmacy Association of British Columbia (IPABC)
British Columbia College of Pharmacists (BCCP)
Manitoba Society of Pharmacists (MSP)
Manitoba International Pharmacists Association (MIPA)
Manitoba Pharmaceutical Association (MPhA)
New Brunswick Pharmacists' Association/Association des Pharmaciens du Nouveau-Brunswick
New Brunswick Pharmaceutical Society/Ordre des Pharmaciens du Nouveau-Brunswick
Pharmacists' Association of Newfoundland and Labrador (PANL)
Newfoundland & Labrador Pharmacy Board (NLPB)
Pharmacy Association of Nova Scotia (PANS)
Nova Scotia College of Pharmacists (NSCP)
Ontario Pharmacists' Association (OPA)
Ontario College of Pharmacists (OCP)
Ordre des Pharmaciens du Québec (OPQ)
Prince Edward Island Pharmacists Association
Prince Edward Island Pharmacy Board (PEIPB)
Pharmacists' Association of Saskatchewan (PAS)
Saskatchewan College of Pharmacists (SCP)

France
Ordre National des Pharmaciens
Association Nationale des Etudiants en Pharmacie de France (ANEPF)

Germany
Association of German Hospital Pharmacists (ADKA)

India
Pharmacy Council of India

Malaysia
Malaysian Pharmaceutical Society (MPS)

Pakistan
Pakistan Pharmacist Federtion (PPF-Rgd.)
Pakistan Pharmacists Society (PPS)
Pakistan Pharmacist Association (PPA- Rgd)

United Kingdom
The Academy of Pharmaceutical Sciences
Association of the British Pharmaceutical Industry
British Oncology Pharmacy Association
British Pharmaceutical Students' Association
British Society for the History of Pharmacy
Centre for Pharmacy Postgraduate Education (CPPE)
Company Chemists' Association
Guild of Healthcare Pharmacists
Institute of Pharmacy Management International
National Association of Woman Pharmacists
National Pharmacy Association
Pharmaceutical Services Negotiating Committee
Pharmacists' Defence Association
The Pharmacy Community Care Liaison Group
Primary Care Pharmacists' Association
Royal Pharmaceutical Society of Great Britain (RPSGB)
United Kingdom Clinical Pharmacy Association
United Kingdom Psychiatric Pharmacy Group
Veterinary Pharmacists Group Education
Young Pharmacists Group

United States

Academy of Managed Care Pharmacy
American College of Clinical Pharmacy (ACCP)
American Pharmacists Association (APhA)
American Society of Consultant Pharmacists (ASCP)
American Society of Health-System Pharmacists (ASHP)
American Society of Medication Safety Officers (ASMSO)
National Community Pharmacists Association(NCPA)
National Independent Pharmacy Coalition (NIPC)
National Pharmaceutical Association NPhA
North Carolina Association of Pharmacists (NCAP)
Pediatric Pharmacy Advocacy Group (PPAG)

LIST OF PHARMACY SCHOOLS

From late 2008 regularly updated information on pharmacy schools will be accessible from the Avicenna Directories: the Global Directories of Education Institutions for Health Professions.

Australia

Australian College of Pharmacy Practice and Management
Charles Sturt University - School of Biomedical Science
Curtin University of Technology - School of Pharmacy
Griffith University - School of Pharmacy
James Cook University - School of Pharmacy
La Trobe University - School of Pharmacy
Monash University - Victorian College of Pharmacy
Murdoch University - School of Pharmacy
Queensland University of Technology - School of Life Science, Faculty of Science
University of Queensland - School of Pharmacy
University of South Australia - School of Pharmacy and Medical Sciences
University of Sydney - Faculty of Pharmacy
University of Tasmania - Tasmanian School of Pharmacy
University of Newcastle - School of Biomedical Sciences, Discipline of Pharmacy and Experimental Pharmacology

Belgium

University of Antwerp - Department of Pharmaceutical Sciences
Université Libre de Bruxelles - Institute of Pharmacy
Vrije Universiteit Brussel - Faculty of Medicine and Pharmacy
Ghent University - Laboratory of Pharmaceutical Technology
Catholic University of Leuven - Faculty of Pharmaceutical Sciences
Catholic University of Leuven - School of Pharmacy and Pharmaceutical Science

Canada

Dalhousie University - College of Pharmacy
Memorial University of Newfoundland - School of Pharmacy
Université de Montréal - Faculté de pharmacie
Université Laval - Faculté de pharmacie
University of Alberta - Faculty of Pharmacy & Pharmaceutical Sciences
University of British Columbia - Faculty of Pharmaceutical Sciences
University of Manitoba - Faculty of Pharmacy
University of Saskatchewan - College of Pharmacy and Nutrition
University of Toronto - Leslie Dan Faculty of Pharmacy
University of Waterloo - School of Pharmacy

France

Auvergne University - Faculty of Pharmacy
Paris Descartes University - Faculty of Pharmacy
University of Bordeaux - Faculty of Pharmacy
University of Caen Lower Normandy - Faculty of Pharmacy
University Claude Bernard - Institute of Pharmaceutical and Biological Sciences
University of Franche-Comte - School of Pharmacy
University of Joseph Fourier - Faculty of Pharmacy
University of Lille 2 - Faculty of Pharmacy
University of Limoges - Faculty of Pharmacy
Louis Pasteur University - Strasbourg 1 - Faculty of Pharmacy
University of the Mediterranean - Faculty of Pharmacy
University of Montpellier - Faculty of Pharmacy
University of Nancy 1 - Faculty of Pharmacy
University of Nantes - Faculty of Pharmacy
University Paris-Sud 11 - Faculty of Pharmacy
University of Picardie Jules Verne - Faculty of Pharmacy
University of Poitiers - School of Pharmacy
University of Reims - Faculty of Pharmacy
University of Rouen - School of Pharmacy
University of Toulouse 3 - Faculty of Pharmaceutical Sciences

Germany

Free University of Berlin - Faculty of Pharmacy
Humboldt University of Berlin - Institute of Pharmacy
University of Bonn - Faculty of Pharmacy
Technical University of Braunschweig - Institute of Pharmaceutical Technology
University of Düsseldorf - Faculty of Pharmacy
University of Erlangen-Nuremberg - Institute of Pharmacy and Food Chemistry
Johann Wolfgang Goethe University Frankfurt am Main - Department of Pharmacy
University of Freiburg - Faculty of Chemistry and Pharmacy
University of Greifswald - Institute of Pharmacy
University of Halle-Wittenberg - College of Phamacy
University of Hamburg - Pharmacy Institute
University of Heidelberg - Faculty of Pharmacy
University of Kiel - Institute of Pharmacy
University of Leipzig - Institute of Pharmacy
University of Mainz - Institute of Pharmacy
University of Marburg - Department of Pharmacy
Ludwig Maximilian University of Munich - Institute of Pharmacy
University of Münster - Faculty of Chemistry and Pharmacy
University of Regensburg - Institute of Pharmacy
Saarland University - Faculty of Pharmacy
University of Tübingen - Institute of Pharmacy
University of Würzburg - Institute of Pharmacy

Malaysia

University of Malaya - Department of Pharmacy, Faculty of Medicine. Official website:http://www.um.edu.my
Universiti Kebangsaan Malaysia - Department of Pharmacy. Official website:under maintenance
Universiti Sains Malaysia - School of Pharmaceutical Sciences. Official website:http://www.pha.usm.my
International Islamic University Malaysia - Kulliyyah of Pharmacy. Official website:http://pharmacy.iium.edu.my/
Universiti Teknologi MARA - Faculty of Pharmacy. Official website: http://www.pharmacy.uitm.edu.my/
Island College of Technology - Department of Pharmacy
Cyberjaya University College of Medical Sciences - Faculty of Pharmacy (BPharm)
UCSI University-Faculty of Medical Sciences,School of Pharmacy

Pakistan

The Islamia University of Bahawalpur, Faculty of Pharmacy
Hajvery University, Lahore
Lahore college for women university,lahore-department of pharmacy
University of Sindh,Jamshoro - Faculty of Pharmacy
Riphah International University,-Department of pharmacy
The University of Lahore,Lahore - Department of pharmacy
Bahauddin Zakariya University,Multan - Faculty of Pharmacy
University of the Punjab,Lahore - College of Pharmacy
University of Karachi,Karachi - Faculty of Pharmacy
University of Balochistan,Quetta - Faculty of Pharmacy
University of Peshawar, Peshawar - Faculty of Pharmacy
Gomal University, D.I. Khan - Faculty of Pharmacy
University of Malakand, chakdara lower dir - Faculty of Pharmacy

Kohat University of Science and Technology, KOHAT - Faculty of Pharmacy
Baqai Medical University, Karachi - Baqai Institute of Pharmaceutical Sciences
Hamdard University, Karachi - Faculty of Pharmacy
University of Sargodha, Sargodha - Department of Pharmacy
University of veterinary sciences, Lahore
University of Faisalabad, Faisalabad
G.C. University, Faisalabad

Saudi Arabia

King Saud University - Faculty of Pharmacy
King Faisal University - Faculty of Pharmacy (Ph-D) Pharm-D
King Abdulaziz University - Faculty of Pharmacy

United Kingdom

Aston University - School of Life and Health Sciences
University of Bath - Department of Pharmacy and Pharmacology
University of Bradford - School of Life Sciences
University of Brighton - School of Pharmacy and Biomolecular Sciences
University of Central Lancashire - School of Pharmacy and Pharmaceutical Sciences
De Montfort University - School of Pharmacy
University of East Anglia - School of Chemical Sciences and Pharmacy
University of Greenwich/University of Kent - Medway School of Pharmacy
University of Hertfordshire - School of Pharmacy
University of Huddersfield - Division of Pharmacy and Pharmaceutical Sciences
Keele University - School of Pharmacy
Kingston University - Department of Pharmacy
Liverpool John Moores University - School of Pharmacy and Chemistry
University of London - School of Pharmacy, University of London
King's College London - Department of Pharmacy
University of Manchester - School of Pharmacy and Pharmaceutical Sciences
University of Nottingham - School of Pharmacy
University of Portsmouth - School of Pharmacy and Biomedical Sciences
Queen's University Belfast - School of Pharmacy
University of Reading - School of Pharmacy
Robert Gordon University - School of Pharmacy
University of Strathclyde - Strathclyde Institute of Pharmacy and Biomedical Sciences
University of Sunderland - School of Health, Natural and Social Sciences
University of Wales - Welsh School of Pharmacy
University of Wolverhampton - School of Applied Sciences.

Chapter 2.

NATIOANAL AND PROVINCIAL PHARMACY DISCIPLINES, COMMETTEE'S, BOARDS AND OTHER INFORMATION

The Drugs Control Organization, Ministry of Health, Secretariat of Central Licensing and Registration Boards work under the Drugs Act, 1976. The Federal Govt. regulates manufacture, registration, pricing, import and export of drugs. 80% of country's requirement is being met from the drugs manufactured in Pakistan while 20% requirements are being met from import of drugs. At present 30 multinational pharmaceutical organizations are producing their products in Pakistan. 411 units are involved in local pharmaceutical manufacturing. This chapter covers the national and local clinical pharmaceutical issues/ aspects. The data mentioned in this chapter is directly taken from the official source of Federal and Provincial Government. It is also tried to provide the very recently and updated information.

Chapter 2.

NATIONAL AND PROVINCIAL PHARMACY DISCIPLINES, COMMITTEES, BOARDS, AND OTHER INFORMATIONS

- Drug Regulatory Authority of Pakistan (DRAP)
- DRAP's Aims & Objectives
- Divisions of DRAP
- DRAP's LAWS
- DRAP's Services
- Contact of DRAP
- DRAP's Policy Board Members
- Pharmaceutical Profile in Pakistan
- Health facilities
- Drugs facts
- Health days
- Drugs registered during Jan. 1999 to sep. 2004
- Boards and committees
- Drug Courts
- Top Management
- Drugs Laboratories
- National Drug Policy
- Organization chart of ministry of health, Islamabad, Pakistan
- Legislation and Drug Act
- National essential Drugs List (NEDL)
- Drug production
- National industry and export
- Registration of drugs
- Drug pricing
- Drug supply system
- Measures to promote rational drug use
- Human resources development
- Research and development
- Drug control organization
- Pharmacy Council

THE DRUG REGULATORY AUTHORITY OF PAKISTAN (DRAP)

The Drug Regulatory Authority of Pakistan (DRAP) has been established under the DRAP Act 2012 to provide effective coordination and enforcement of the Drugs Act, 1976 (XXXI of 1976) and to bring harmony in inter-provincial trade and commerce of therapeutic goods. Minister of State For National Health Services, Regulation and Coordination supposed to head the DRAP.

Aims & Objectives

1. To provide effective coordination and enforcement of Drugs Act, 1976 for provision of drugs and therapeutic goods that are safe, effective, quality and economical.

2. To bring harmony in interprovincial trade and commerce of drugs and therapeutic goods.

Divisions of DRAP

1. Pharmaceutical Evaluations and Registration Division

   Pharmaceutical Evaluations and Registration Division is responsible for the evaluation, assessment and registration of pharmaceuticals drugs for human beings, animals and to perform other functions connected therewith and assigned by the Board.

2. Drug Licensing Division

   Drug Licensing Division shall be responsible for the licensing of the drugs manufacturing facilities and to perform other functions connected therewith.

3. Quality Assurance and Laboratory Testing Division

   Quality Assurance and Laboratory Testing Divisionshall be responsible for enforcement of current Good Manufacturing Practices under the Act, and for testing or research of drugs and to perform other functions connected therewith. The Division will also perform the functions related to post marketing surveillance and shall be responsible for the evaluation, coordination and monitoring of safety, efficacy and quality of registered drugs and inactive materials including the clinical and toxicological study, drug recalls and with drawls, and to perform other functions connected therewith.

4. Medical Devices and Medicated Cosmetics Division

   Medical Devices and Medicated Cosmetics Division shall be responsible for the assessment, enlistment or registration of medical devices and medicated cosmetics, medicated shampoos and medicated soaps for human beings, animals and to perform other functions connected therewith.

5. Biological Drugs Division

   Biological Drugs Division shall be responsible for the evaluation, assessment, registration and licensing of Biologicals for human beings, animals and to perform other functions connected therewith including all the functions of national control authority for biologicals as required for the prequalification by World Health Organizations of locally manufactured human biological drugs.

6. Controlled Drugs Division

Controlled Drugs Division shall in consultation with the Federal Government be responsible for regulation and allocation of quota of narcotic drugs, psychotropic substances and precursor chemicals and to perform other functions connected therewith.

7. Pharmacy Services Division

   Pharmacy Services Division shall be responsible for the development and promotion of pharmacy services and to perform other functions connected therewith.

8. Health and OTC Products (non-drugs) Division

   Health and OTC Products (non-drugs Division shall be responsible for the assessment, licensing and registration of Alternative Medicines such as Ayurvedic, Chinese, Unani and Homeopathy, enlistment or registration of nutritional products and food supplements for human beings, animals and to perform other functions connected therewith.

9. Costing and Pricing Division

   Costing and Pricing Division shall be responsible for the costing and pricing of therapeutic goods and to perform other functions connected therewith.

10. Budget and Accounts Division

    Budget and Accounts Division shall be responsible for budgetary and financial aspects of the Authority and other daily accounting matters connected therewith or ancillary thereto.

11. Administration, Human Resource and Logistics Division

    Administration, Human Resource and Logistics Division shall be responsible for administration, recruitment, appointment, capacity building and development for the Authority and other matters connected therewith and ancillary there to.

12. Legal Affairs Division

    Legal Affairs shall be responsible for legal aspects of the Authority and other matters connected with Drug Court and other court cases therewith or ancillary thereto.

13. Management Information Services Division

    Management Information Services Division shall be responsible for development of automation of functions using information technology for the Authority and other matters connected therewith and ancillary there to.

Drug Regulatory Authority of Pakistan LAWS

1. Drug Regulatory Authority of Pakistan Act, 2012
2. Drugs Act, 1976
3. Standard Regulatory Orderes (SROs)
4. The Drugs (Labelling and Packing) Rules, 1986
5. The Drugs (Licensing, Registering & Advertising) Rules, 1976
6. The Drugs (Appellate Board) Rules, 1976
7. The Drugs (Research) Rules, 1978
8. The Drugs (Federal Inspectors, Federal Drug Laboratory & Federal Government Analysts) Rules, 1976
9. The Drugs (Imports & Exports) Rules, 1976
10. The Drugs (Specifications) Rules, 1978
11. The Northern Areas Drugs Rules, 1996
12. Pharmacy Act, 1967

Services

REGULATORY SERVICES

1. Drug Registration
2. Biological Registration
3. Medical Devices Registration
4. Health Products Registration
5. Alternative Medicine Registration
6. Licensing of Drug Manufacturing units
7. Licensing of Biological Manufacturing sections and units
8. Licensing of Alternative Medicine manufacturing units

GUIDELINES

cGMP Guidelines

Guidelines for Enlistment and Registration of Alternative Medicines

Guidelines for Licensing of Pharmaceutical Units

CHECKLISTS

Checklists for Inspections of Drugs Manufacturing Premises

Checklists for Inspections of Drugs storage for imported drugs

Checklists for Inspections of Biologicals Manufacturing

APPLICATIONS, FORMS, AND REGULATORY SERVICES

1. Procedure for Registration
2. Procedure for Licensing
3. Guidelines / Standard Operating Procedure for Quota Allocation of Controlled Substances
4. Application Form Grant of a Licence
5. Application Form for Renewal of a Licence
6. Form of Warranty
7. Application for Licence to Manufacture Drug (s) for Experimental Purposes
8. Application Form for Registration of a Drug for Local Manufacture
9. Application Form for Registration of an Imported Drug
10. Application Form for Renewal of Registration of all Kinds of Drugs
11. Statement of Quarterly Production
12. Documents Required for Approval of Post-Registration Variations

13. Check List for Scrutinization of Registration Application / Dossiers
14. Check List for Allocation of Quota of Controlled Substances
15. Application for Price Revision
16. Import Policy for Drugs
17. Activities in Drug Licensing Division from 01-09-2013 to 06-12-2013
18. Minutes of 232nd meeting Central Licensing Board
19. Minutes of 238th meeting of Registration Board
20. Minutes of 239th meeting of Registration Board
21. Minutes of 240th meeting of Registration Board

Contact Us

2nd Floor, Block C, Pakistan Secretariat, Islamabad - 44000, Pakistan. Tel: 092-051-9202566; Fax: 092-051-9205216 Email: contact@dra.gov.pk

Policy Board Members

Composition of the Policy Board of the Drug Regulatory Authority of Pakistan constituted under section 9 of the aforementioned act.

No	Name / Designation	Status
1	Secretary of the concerned Division, (Federal Secretary BS-22)	Chairperson
2	Chief Executive Officer (CEO)	Member
3	Representative of Ministry of Law and Justice not below BPS-20	Member
4	Secretary of the concerned Department Government of the Balochistan	Member
5	Secretary of the concerned Department Government of the Sindh	Member
6	Secretary of the concerned Department Government of the KhyberPakhtunkhwa	Member
7	Secretary of the concerned Department Government of the Punjab	Member
8	Secretary of the concerned Department Government of the Gilgit-Baltistan	Member
9	Representative from Federally Administered Tribal Area	Member
10	Chief Drug Controller, Health Department, Government of Punjab.	Member
11	Drug/ health expert	Member
12	Drug/ health expert	Member
13	Drug/ health expert	Member
14	Drug/ health expert	Member
15	Drug/ health expert	Member

Committees

Following Expert Committees are working for making recommendations to the concerned Boards and Authorities

1. Drug Pricing Committee (DPC) that woks out prices to be granted, reduced or enhanced . It makes recommendations to the Federal Government which may approve, amend or refer back its recommendations for further evaluation.

2. Expert Committee on Veterinary Drugs (ECVD) that woks out registrations of generic veterinary drugs to be granted, deferred or rejected after evaluation of applications for registrations. It makes recommendations to the Drugs Registration Board which may approve, amend or refer back its recommendations for further evaluation.

3. Expert Committee on Biological Drugs (ECBD) that woks out registrations of biological drugs to be granted, deferred or rejected after evaluation of applications for registrations. It makes recommendations to the Drugs Registration Board which may approve, amend or refer back its recommendations for further evaluation.

4. Expert Committee on Medical Devices(ECMD) that woks out registrations of Medical Devices to be granted, deferred or rejected after evaluation of applications for registrations. It makes recommendations to the Drugs Registration Board which may approve, amend or refer back its recommendations for further evaluation

Pharmaceutical Profile in Pakistan

Pakistan meets 80% of its domestic demand of medicines from local production and 20% through imports. The pharmaceuticals market size is Rs. 70 Billion (US $ 1.2 Billion), approximately. The market for pharmaceuticals in Pakistan has been expanding at a rate of around 10 to15% since last few years. Pakistan is also exporting its surplus drugs to a large number of countries particularly to the Asian and African regions with an expanding trade in the newly emerged Central Asian States. About a hundred million strong populations of the Central Asian States, with almost no local manufacture of medicines, offers an attractive market for industries located in Pakistan. Local manufacturers are producing all the major pharmaceutical dosage forms and some special products e.g. immunological, anticancer drugs, anti-diabetics, antidotes and biotechnological products are still being imported, in the finished form. Only few bulk pharmaceutical raw materials are being manufactured locally and most of the pharmaceutical raw materials are being imported in large quantities from different countries of the world. There are five units operating in Pakistan for the Semi Basic Manufacturing of pharmaceutical raw material.

The Drugs Control Organization, Ministry of Health functions mainly as Secretariat of Central Licensing and Registration

Boards under the Drugs Act, 1976. The Drugs Act, 1976 comprises Federal and Provincial subjects. The Federal Govt. regulates manufacture, registration, pricing, import and export of drugs. 80% of country's requirement is being met from the drugs manufactured in Pakistan while 20% requirement are being met from import of drugs.

At present 30 multinational pharmaceutical organizations are producing their products in Pakistan. 411 units are involved in local pharmaceutical manufacturing.

HEALTH FACILITIES

Hospitals	965
Dispensaries	4,916
Basic Health Units	4,872
MCH Centers	1,138
TB Centers	371
First Aid Points:	1,080

DRUGS FACTS

Human Local Drugs	10807
Human Imported Drugs	655
Veterinary Drugs	1122

HEALTH DAYS

Heart Day	30th Sep
TB Day	24th Mar

DRUGS REGISTERED DURING JAN. 1999 TO SEP. 2004

HUMAN DRUGS
Locally Manufactured Drugs

Year	Drugs Registered
1999	731
2000	699
2001	865
2002	3395
2003	2762
Jan, 2004 to July 2004	2373
Total	10807

IMPORTED HUMAN DRUGS

Year	Drugs Registered
1999	255
2000	50
2001	33
2002	90
2003	103
Jan. 2004 to Sep. 2004	124
Total	655

VETERINARY DRUGS

Year	Drugs Registered
1999	203
2000	322
2001	102
2002	193
2003	210
Jan, 2004 to Sep. 2004	92
Total	1122

BOARDS AND COMMITTEES

- Committee for Monitoring Drug Sector
- Expert Committee on Research & Development
- Expert Committee On Advertising
- Price Review Committee
- Quality Control Committee
- Committee on Biological Drugs
- Veterinary Expert Committee
- Drug Appellate Board
- Central Licensing and Registration Board

DRUG COURTS

Nine Drugs Courts has been established by the Federal Government in pursuance of Section 31 of the Drugs Act 1976. Following is the detail of the courts with the Top management:

Chairman, Drug Court
24-Kanpoor Road
Lahore, Punjab

Chairman, Drug Court
Quetta, Balochistan.

Chairman, Drug Court
Faisalabad, Punjab

Chairman, Drug Court
Bahawalpur (Inside Paramedical School)
Bahawalpur, Punjab

Chairman, Drug Court
N.W.F.P., 13-A Qulfa Road
Tehkal Payaz,
Peshawar, NWFP

Registrar
Drug Court
Gujaranwala Division at Lahore, Punjab

Chairman, Drug Court
Karachi, Sindh.

Chairman, Drug Court
Multan, Punjab

District and Session Judge
Chairman, Drug Court
Rawalpindi and Capital Territory Islamabad.

TOP MANAGEMENT

Field Offices of Drugs Control Organization

1. **Deputy Director General (E&M)**
   Building No. 4. Block 'B', S.M.C.H.S.
   Phone No. 92-21-4382979
   92-21-4383079

2. **Deputy Director General (E&M)**
   N.I.N.R.T. Building,
   Lahore.
   Phone No. 92-42-7569552

3. **Officer Incharge / F.I.D.**
   Drugs Controller Administration
   C.G.S. Colony Satellit Town
   Quetta.
   Phone No. 92-81-9211334

4. **Officer Incharge / F.I.D.**
   Drugs Control Administartion
   5th floor Hall No. 609-610
   Benovelent Fund Building
   Peshawar Cantt.
   Phone No. 92-91-9213025

5. **Federal Inspector of Drugs**
   Islamabad
   Phone No. 92-51-9202841

For General Information and complaints:
info@dcomoh.gov.pk

For Reporting Adverse Drugs Reaction:
adr@dcomoh.gov.pk

For Provincial Health Departments:
drugscontroller@dcomoh.gov.pk

DRUGS LABORATORIES

Central and Provincial Drugs Laboratories established under Section 14 of Drug Act. Federal Drugs Testing/ Research Laboratory and institutes may set up, for the purposes of this Act as may be prescribed.
Central Drugs Laboratories
Building No. 4. Block 'B', S.M.C.H.S.
Phone No. 92-21-4382979
92-21-4383079

NATIONAL DRUG POLICY

Pakistan is committed to the goal of Health for all by the year 2000 which was inspired by the principle of social equity. To achieve this, the Government is taking all possible measures in the field of health services at large and drugs in particular. Formulation of the national drug policy thus forms an integral component of its national health policy, purpose of which is to ensure regular availability of essential drugs of acceptable efficacy, safety and quality at affordable prices to all irrespective of their socio-economic status or place of living. Essential Drugs are those which meet the health care needs of the majority of the population. Hence they will help in combating disease and maintaining and improving the health of population. The goal in nutshell is to develop, within the resources of the country potential through the availability of drugs to control common diseases and to alleviate pain and suffering.

LEGISLATION AND DRUG ACT

The Pharmaceutical manufacture and trade in Pakistan is regulated through the Drug Act 1976, And the rules framed there under. This is a fairly comprehensive law. Pakistan was the first amongst the developing countries in the world to have introduced Good Manufacturing Practices as a mandatory requirement. Registrations are granted by the Central Licensing and Registration Boards. The Quality Control system at the federal and provincial levels is supported by the professionally competent drug inspectorates and laboratory services.

In order to ensure availability of safe, effective and quality products at reasonable prices, Pakistan has a fairly modern legislation namely the Drugs Act, 1976. Under this law comprehensive rule have also been framed on various aspects of drug control. The law provides a system of licensing of each manufacturing house and registration of all finished drugs with a view to ensuring efficacy, safety ad quality of the drugs sold in the market. For licensing and registration Central Licensing and Registration Board comprising of experts from the field of medicines and pharmacy are established. Quality Control is ensured through inspection and laboratory services. The law also provides for compliance of Good Manufacturing Practice by the manufacturers, for fixing drug prices and for regulation of imports, export, and sale of drugs. Under this Act, the manufacturing, registering and import/export are regulated by the Federal Government where as the sale is regulated by the Provincial Governments.

These laws have been considered to be fairly modern with correct philosophy for public safety. These laws shall be modified as and when necessary to keep them up-to-date as well as to provide legal basis for the support and implementation of the National Drug Policy.

The manufacture and trade of medicine of traditional systems of medicines are not being properly regulated resulting in problems of public health. These shall therefore be regulated by law with a view to their rationalization, to improve their standards and for the protection of the public from any the health hazard.

NATIONAL ESSENTIAL DRUGS LIST (NEDL)

Preparation of NEDL. The Federal Government and each provincial government until 1993 had their on lists of drugs for purchases for the government institutions and thus there was lack of uniformity in these lists. The concept if graded system

if these lists for various levels of Health Institutions was also not distinctly defined. There was, therefore, an urgent need to prepare a National list of Essential Drugs of Pakistan with graded lists for various levels to be implemented uniformly both at the Federal and Provincial levels. A National Essential Drugs List of Pakistan was thus prepared in 1994 in view of the health needs of the country with the help of specialists organizations in the field of medicines and pharmacy from all over the country. This has already been published and circulated widely throughout the country.

Bulk purchases for Health Institutions. Future bulk purchases of drugs for all government and semi-government health institutions shall be made in accordance with this list. The NEDL has specified the health care levels at which each essential drug is to be used. Effective and well organized operating systems shall be developed for procurement and distribution of such drugs for the population. This shall envisage quantification of the actual needs for drugs and effective logistics for supply. The Essential Drug Concept and the National Essential Drug List will be promoted in the public and private sector. Policy will be geared to increase share of essential drugs in local production and to make such drugs available at affordable prices where-ever needed. Efforts will also be made to promote rationality in essential drug prescribing and use. To encourage this, Drug Information Sheets in line with those of WHO model providing concise, accurate and comprehensive information shall be prepared and widely circulated.

The National Essential Drugs List will be periodically reviewed and revised every year and made more pragmatic by a committee that includes competent specialists in clinical medicine, pharmacology and pharmacy and from other related fields and published. For the selection of essential drugs and for establishing a national program for the use of essential drugs, the guidelines and criteria recommended by the WHO shall be followed. All teaching divisional and district hospitals shall constitute “Pharmacy and Therapeutic Committees” to monitor and promote rational use of drugs in the hospitals. Only generic names will be used for drugs in the NEDL all public sector drug lists, inventory sheets and tender documents.

DRUG PRODUCTION

Pakistan has always been following the policy of encouraging manufacture of drugs within the country. Consequently whereas there was virtually no pharmaceutical manufacturing in Pakistan at the time of its independence in 1947, today about 80% of the drugs market is from local production by some 285 companies including 25 multinationals. However the industry still depends largely on imported raw materials and that there is no assessment of the actual requirement of drugs according to the health needs of the country.

Situational Analysis; In order to have realistic assessment of the real demand of essential drugs corresponding to our health needs with quantification of requirements as far as possible, the Government shall arrange for an in-depth technical, economic, marketing study and critical analysis of the existing situation in this behalf with a view to find ways and means to meet this demand. Measures shall be taken to enhance the formulations, of pharmaceutical products to facilitate the availability of quality drugs at reasonable prices and to bring a high level of self sufficiency in the country, coupled with a gradual up-stream integration in the manufacture of active ingredients thorough exploitation of local flora and fauna, fermentation, synthesis, semi-synthesis, and application of modern method of bio-technology and genetic engineering. These measures will include incentives for transfer of technology and import substitution.

In view of the existing system for creating and stimulating the demand for medicines and their consumption, options shall be exercised to ensure effective quality control, to encourage the rational use of medicines, for the human resources development, as well as for the conduct of operational and applied research studies in order to produce quality medicines of high standards meeting the actual health needs. Pakistan shall try to be self sufficient in the basic manufacture of drugs. Self-reliance in drug manufacture: With a view to creating self reliance in the country by encouraging manufacture of pharmaceuticals raw materials by way of basic/semi-basic manufacture, the incentives shall be given i.e. Concessional rates of import duty and sales tax on the import of plant, machinery equipment which is not produced locally and is required for basic and semi-basic manufacture of drugs. Import of all raw materials, chemicals and other consumables required for the basic / semi-basic manufacture of drugs at Concessional rates of duty and sale tax. Tariff protection against imports as and when the production starts satisfactorily. For the establishment of basic / semi-basic manufacturing plants the loan advanced shall be with a dept equity ratio of 70:30. Adequate tariff protection to the basic / semi basic manufacture shall be extended against import of finished drugs on the merits of each case. In case of general decline in import duty regime, the same level of protective duty shall be maintained as before, both in respect of import of raw materials and the finished drugs.

NATIONAL INDUSTRY AND EXPORT

To encourage exports of drugs, incentive similar to those available to other value added export industries shall be made available. Where a multinational company and a national collaborator partnership splits up, the former shall be permitted either to set up an independent unit or to enter into a joint venture project only with another national company. Where a pharmaceutical company has set up its own manufacturing facilities. It shall be allowed import, if necessary, of products not otherwise manufactured locally, only for a limited period after which the company shall be required to start local manufacture of that product.

An institutional mechanism shall be developed so that the national units are brought at par with the international standards. Transfer of technology shall be encouraged by allowing contract manufacture by a multinational with national companies.

REGISTRATION OF DRUGS

Under the Drug Act, 1976, all finished drugs ready for use are required to be registered through the Drugs Registration Board. Presently some 13000 products are registered including some 10000 locally produced and 3000 imported products.

The registration shall be granted and reviewed on the basis of established criteria of acceptable safety, efficacy, in terms of significant therapeutic value, quality and keeping in view real health needs of the country and the public interest. All irrational, unsafe and obsolete formulations and combinations shall be de-registered. Fixed ratio combinations products will be registered only when the dosage of each ingredient meets the requirements of a defined population group and when the combination has proven advantage over single compounds administered separately in therapeutic effect, safety or compliance.

Drugs or any indication of a drug which are banned for safety reasons either in USA, Canada, European Union, Japan, Australia, China, Switzerland or in the country of origin shall not be allowed sale in Pakistan. The present identification number of drugs shall be rationalized on the basis of various basic entities.

Action has already been initiated to computerize data in respect of drug registrations. The sphere of activity in this field shall be expanded to. Efforts shall be made to compute all necessary information relating to registered products and their procedure for quick retrieval. A more comprehensive drug information system shall be established in the Ministry of Health in each Province in respect of registered drugs with facility of retrieval in relation to medical pharmacological, pharmaceutical and economic aspects.

Information in respect of every registered drugs shall be compiled and published by the Ministry of Health. For products of foreign companies with parent offices abroad, the indications, adverse effects, dosing information etc, that were approved in the country of origin will be accepted. Any other indications would require a separate and detailed justification. In the labellling of drugs the use of generic names with at least the same prominence as brand names and necessary information in national language shall be made as a mandatory requirement. A system for monitoring of adverse reactions shall be established. For the registration of a new drug the fact that the drug is registered in one of certain specified countries (USA, UK, European Union, Switzerland, Japan and China) would be necessary. When a MNC or subsidiary of MNC wishes to manufacture a drug already registered in Pakistan it may be allowed to do this regardless the fact whether it produces the drug in question in its country of origin. The import of drugs, be allowed to ensure availability and fair pricing through competition. Anti-dumping laws shall be enforced in order to prevent dumping when necessary.

DRUG PRICING

Efforts will be made to make availability of much needed drugs at reasonable prices. In doing so the element of price competition between similar products shall also be introduced. The grant of patent protection for drugs shall be only of process and not for the product. Further after the expiry of initial period provided in the law, no extension shall be granted in case of drugs. The patent law shall be amended accordingly. After the expiry of a patent, a fresh pricing exercise shall be undertaken and a maximum of 15% allowance for R&D may be allowed over the international prices for the raw materials. Thus transfer pricing over and above the margin of 15% shall not be allowed the expiry of patent of a product. The pricing formula may be revised on the basis of international competitive prices of raw materials, taking into account the cost of production and reasonable margin of profit. Prices of existing registered drugs which are higher shall be revised on the basis of the revised formula. An annual review shall also be conducted on the basis of feedback from the provincial governments about the actual sales prices. A system for monitoring and evaluation of drug prices shall be developed. Adequate powers shall be made available under the Drug laws for fixing and revising drug prices of both finished drugs and their active ingredient.

DRUG SUPPLY SYSTEM

The drug supply system in both public and private sector is the legacy of the pre-independence era. Efforts shall be made to bring rationality in these systems both at the government level and in the private sector.

Hospital Pharmacy: It will be the policy objective of the Government that the scheme scientific hospital pharmacy shall be introduced in the country both under the Federal and Provincial Governments. In order to provide efficient health care service, hospital pharmacists shall be appointed in all the hospitals of the country at the rate of one pharmacist for each fifty beds. Efforts will be made to increase the availability of qualified pharmacists for this purpose. The Hospital Pharmacy System will be properly organized on scientific lines under the supervision of graduate pharmacists. They will be assigned with specific duties to provide an efficient drug supply system and where possible a limited production of pharmaceuticals. Model Hospital Pharmacies shall be set up in each Federal and Provincial Government teaching hospital in line with the system in any developed country to set an example for the others to follow.

The Federal and Provincial drugs supply system for the hospitals and dispensaries etc. will be modernized and strengthened and will be managed to ensure correct ordering, efficient procurement, proper packaging, storage, distribution

and inventory control with lese waste through deterioration and loss. The system will ensure the availability of essential drugs in health facilities according to their level. Allocated drug schedules for different categories of hospitals and health units will be followed as far as possible. In the public sector the procurement of drugs shall be based on reliable quantification of drug needs. The drugs shall generally be procured under generic names through competitive tenders and a system shall be developed for monitoring supplier performance. The average lead time form order to receipt shall be minimized. The provinces would coordinate and exchange information on costs in order to ensure reasonable purchase prices. All bulk supplies of drugs to health institutions shall be obtained in government approved special packs. All drugs supplied to the health institutions shall be monitored for quality at the time of purchases. The provincial government shall also share the results of their drug testing with Federal Government. Companies supplying any substandard drug shall not only be required to compensate for compensate for the loss and shall be debarred for future supplies but their license for manufacture or as the case may be for sale shall be reviewed and cancelled where necessary.

Community Pharmacy (Retail Pharmacy) : In the Private Sector, a system of scientific retail pharmacy service shall be introduced in a gradual manner and following specific steps shall be taken. As recommended by the WHO, pharmacists shall be made to play their recognized in all activities relating to drugs management supply and distribution. Their services shall be effectively utilized in management of prescription drugs. To implement this, to begin with. The drug sellers / distributors having certain turn-over. Future policy for issuance of drug sales license shall be developed and in view of the size of the community to be served in the catchment area or on the basis of area instead of concentrating on one place. The sale of all potent drugs shall be restricted only on prescription of registered medical practitioner. To begin with all psychoactive drugs, hormonal and steroidal preparations and antibiotics shall be so restricted. In order to maintain uniformity throughout the country the Federal Government being so authorized shall notify such drugs or classes of drugs from time to time. Training Courses for the existing qualified persons on licenses for retail and whole-sale shall be conducted in collaboration with the Pharmacy Council, Pakistan Pharmaceutical Manufacturing Association, Pharmacists Association and Pakistan Chemists and Druggists Association at the district level for their orientation on the modern concepts of pharmacy services.

MEASURES TO PROMOTE RATIONAL DRUG USE

Drug Information Bulletin: The Drugs Act, 1976, provides for regulation of promotional activities of the pharmaceutical industry and to allow correct information to be supplied to the medical profession. From the Government platform, a Drug information Bulletin is issued from time to time to provide unbiased information to the medical profession. This shall be published on regular basis and distributed to all doctors, pharmacists and other health professionals. Apart from providing these with accurate and timely information, the bulletin will endeavor to promote the concept to essential drug and their rational use.

Ethical Criteria for Medical Drug Promotion: The pharmaceutical industry and all other concerned

shall be required to follow the Ethical Criteria for Medical Drug Promotion which has been developed on the basis of WHO guidelines will be to allow sales promotion only through the health institutions though a well defined system as in practice in some other parts of the world. National Formulary: A National Formulary shall be published in a new context so as to serve as reliable prescribing and dispensing guide to all doctors and pharmacists of the country and as an effective teaching aid. Similarly Standard Treatment Guidelines in important areas shall be prepared and published and made available for wider circulation.

Drug Information and A.D.R Monitoring: A computerized Drug Information and poison Centre and a Adverse Drug Reaction Monitoring Centre will be established and provided with a comprehensive library and literature search facilities. On the basis of world-wide information monitoring, these Centers will also undertake post-marketing surveillance studies of newly registered drug products containing newly developed drug substance. These Centers shall also provide regular information on drug to prescribers and pharmacists.

HUMAN RESOURCES DEVELOPMENT

There is an urgent need for development of manpower for an efficient drug supply system and to encourage rational use of Drugs. The government will encourage and support facilities in Medical and Pharmacy Schools to strengthen their curricula in Clinical Pharmacy and Clinical pharmacology, Therapeutics, Hospitals Pharmacy and Pharmaceutical Technology. The curricula shall be revised to include promotion of concept of essential drugs, rational drug use and related subject, e.g., supply management, communication technique and drug utilization studies.

Formal and training curricula for ancillary health workers and nurses will similarly be revised and strengthened. Facilities of foreign training shall be provided to pharmacists working in the Drug Control Organization to keep them abreast of the latest knowledge in the field. In-service training courses in rational use of drugs, drug supply management, communication technique etc., will be organized for pharmacists, medical officer, graduate nurses and ancillary health workers so as to improve skills in their respective areas of activity related to drugs. Refresher and continuous education courses, seminars and lecturers to promote the concept of essential drugs and rational drug use will be organized on a regular basis at the national and provincial levels.

As recommended by WHO, pharmacists shall be made to play their recognized role in all activities relating to drug control, management, supply and distribution. Their services shall be effectively utilized in management of prescription drugs in particular with the objective of their rational use. The teaching curricula for pharmacy student shall be revised to provide adequate training to prepare pharmacists to render efficient health care service with special emphasis on hospital pharmacy and community pharmacy service.

RESEARCH AND DEVELOPMENT

In the field of research, Drugs Act, 1976 requires the manufacturers to contribute a certain percentage of their profit (1 %) towards a Drug Research Fund. These funds will be spent for conducting researches on the development of new drugs and encouraging rational drug therapy.

A comprehensive national drug research program will be jointly developed by the universities and research institutes active in this field according to national health priorities to ensure co ordination and collaboration in drug research.

Preference shall be given to operational and applied research in the following areas in particulars.
Exploitation of local resources for basic manufacture of drugs.
Development of new drugs from local resources. Studies in rational drugs use.
Drug utilization studies.
Traditional Medicines.
Incentives e.g. Prizes shall be provided for encouraging researches.

DRUG CONTROL ORGANIZATION

The Drug and Quality Control Organization at the Federal Level shall be strengthened as per recommendations of the Management Services Division of the Cabinet Secretariat and the E.C.C. Committee on 'Pharmaceutical Regulation' in addition to the organizational requirements for implementing the policy.

Similarly the Provincial Drug Control Organization shall be organized in line with the recommendation of the Senate Committee on health to set up Provincial Directorates of Pharmacy. By doing so the system of drug licensing, registration and pricing and quality control shall be made more objective and efficient. The existing facilities of manpower in the drugs control administration and for drug registration are presently inadequate even for day to day work Additional expert technical staff shall be provided to attend to each of the activities identified above.

PHARMACY COUNCIL

PHARMACY ACT 1967
(As Amended Upto 8th February 1973).

An act to establish Pharmacy Councils to regulate the practice of Pharmacy.
WHEREAS it is expedient to establish Pharmacy Councils to regulate the practice of pharmacy and to provide to matters connected therewith and incidental thereto;
AND WHEREAS the national interest of Pakistan in relation to the achievement of uniformity within the meaning of clause (2) of Article 131 of the Constitution requires Central legislation in the matter; It is hereby enacted as follows:

Central Council: The Pharmacy Council of Pakistan established under section 3;

Pakistan Pharmacists Association: The association registered under the Societies Registration Act.

Pharmacist: A person who is registered under section 24 in register A and Register B.

Pharmacy Institution: means an institution whose qualifications of Pharmacy are recognized under Drug Act.

Provincial Council: The Pharmacy Council of a Province established under section 3.

Composition of Central Council:

The Director General of Health, Government of Pakistan, ex-officio, who shall, unless the Central Government appoints any other officer to be the President, also be the President of the Council;

The officer, if any, appointed under clause (a) to be the President of the Council;

Eight persons to be nominated by the Federal Government out of whom one from each province shall be nominated in consultation with the provincial Government concerned, one shall be a teacher of Pharmaceutics and one a teacher of Pharmaceutical Chemistry;

One person from each province, to be nominated by the Federal Government so far as may be in consultation with the provincial Council concerned;

One person, to be nominated by the Federal Government in consultation with the Pakistan Pharmacists Association; and The Drugs Controller, Government of Pakistan; and The Central Government may by notification in the official Gazette, increase or decrease the number of persons to be nominated by it under clause (c) of sub section (1). Provided that the decrease in the number of members shall not affect the continuance in office of, and the performance of functions by, any member until the expiry of his term.

Composition of the Provincial Council.

A Provincial Council shall, subject to the provisions of sub section (2), consist of the following members namely:

The Secretaries to the Provincial Governments in the Health Department, ex-officio, who shall, unless the Provincial Government appoints any other officer to be the President,

also be the President of the respective Council; and the officers, if any, appointed under clause (a) to be the President of the Council;

Five persons to be nominated by the Provincial Government, of whom one shall be an officer of that Government; and

One person to be nominated by the provincial Branch of the Pakistan Pharmacists Association.

PROVINCIAL HEALTH DEPARTMENT

Provincial Health Department endeavors to ensure affordable, accessible and equitable preventive, curative, promotive and rehabilitative quality health care services to general public. To achieve its objectives, the Health Department:

- Provides emergency health care services throughout the province
- Ensures the availability of essential drugs as per allocation for each type of health facility.
- Ensures the availability of trained staff at every health facility.
- Controls vaccine preventable, endemic and epidemic diseases.
- Strives to improve the health care delivery system at all level in the department.

MISSION STATEMENT

To improve the quality and coverage of Health Services with special focus on Primary Health Care to achieve Millennium Development Goals.

ORGANIZATION

The provincial tier for the control and administration in health system has three levels ministry, secretariat and directorate. Minister for Health in charge of business of department in the provincial legislature; submitting important cases to the Chief Minister/Governor and keeping them informed of the significant developments in health sector.

Secretary Health

Secretary Health is the overall in charge of the Department. He is responsible for the implementation of national policies at provincial level. He gives strategic direction to the department besides being responsible for all operational functions. He is also the principal drawing & disbursing officer of the department. The Secretary Health reports to the Chief Secretary, while the Director General Health Service, Director General Nursing, all the Additional Secretaries (Admin, Development, Technical and General), Executive Director Special Projects, Chief Executives of teaching hospitals, Principals of Medical Colleges and Deans of Post Graduate Institutes and in charges of autonomous bodies are supervised by him.

Director General Health Services

Directorate General of Health Services is at the apex of the line Health Department to supervise health services in the periphery. The Director General Health Services, Punjab, heads this. S/he is supported by the Directors: Communicable Disease Control; Expanded Program of Immunization; Basic Health Services/Headquarters; Reproductive Health / Maternity and Child Health and Planning & Evaluation; and several Additional and Assistant Directors Health Services at the provincial Directorate and by Directors Health Services at Divisional headquarters.

Director Health Services

At division, a Director Health Services assisted by an Additional Director Health Services heads the divisional health management. This level is responsible for the supervision of secondary care DHQ and THQ Hospitals, through respective Medical Superintendents, and Primary Health Care through the District Health Officers.

District Health Officer

District Health Officer (DHO) heads the district health management. S/he is assisted by a number of officers including a District Superintendent Vaccination (DSV); District Sanitary Inspector (DSI); Communicable Disease Control Officer (CDCO); District Inspectors Health Centers (DIHC); District Drug Inspector; Assistant Entomologist (AE); and a Deputy District Health Officer (DDHO) at each constituent Tehsil Headquarters. This level is responsible for supervising Primary Health Care including out-reach services and National Program for Family Planning and Primary Health Care.

Deputy District Health Officer

At tehsil level, there is a Deputy District Health Officer (DDHO), who is supported by a Tehsil Sanitary Inspector (TSI), Assistant Superintendent Vaccination (TSV) and a CDC Inspector (CDCI). They support the DHO in supervising the outreach Primary Health Care in tehsils.

Medical Superintendent

Medical Superintendent is responsible for overall management of the hospital under his/her command. S/he exercises administrative and financial powers as allocated under delegation of rules. The Medical Superintendent supervises all the functions of the hospital, like patient care, and management of financial and human resources, maintenance of building and equipment and ensuring supply of medicines and

consumables. The Medical Superintendent of DHQ and THQ hospital reports to Divisional Director Health Services, while MS of teaching/ autonomous hospital reports to Chief Executive of the institution.

THE RULES ENFORCES BY THE HEALTH DEPARTMENT OF GOVERNMENT OF THE PUNJAB

RULES OF BUSINESS 1973 AMENDED IN 1993

- Public Health and Sanitation
- Medical Profession
- Medical and Nursing Council
- Medical Education including Medical Schools and Colleges and institution for dentistry.
- Control of medicinal drugs, poisons and dangerous drugs (Drug Act and Rules).
- Medical Institutions, Chemical Examination Laboratories and Blood Transfusion Services.
- Collection, compilation, registration and analysis of vital statistics and estimation of population for future projections.
- Service matters except those entrusted to Services, General Administration and Information Department.
- Purchase of stores and capital goods for the department.
- Matters relating to Nursing.

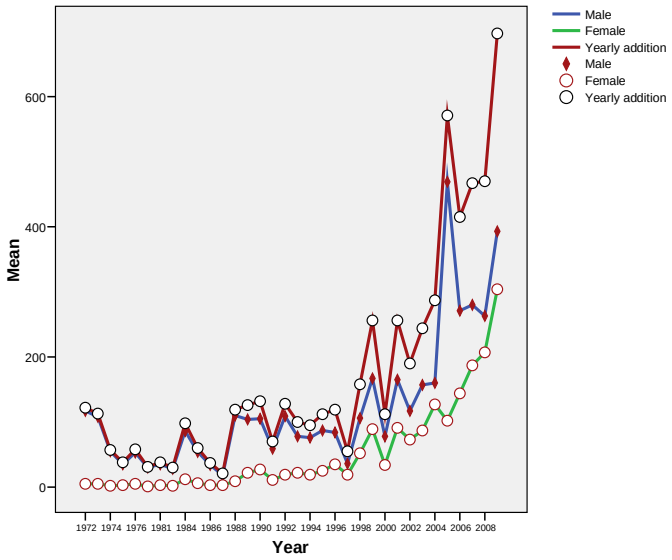


Figure 2. Comparison of pharmacist/ 1000,000 population, % addition and yearly population growth (x1000,000) with time (last thirty four years) 1972-2009; in Punjab province of Pakistan.

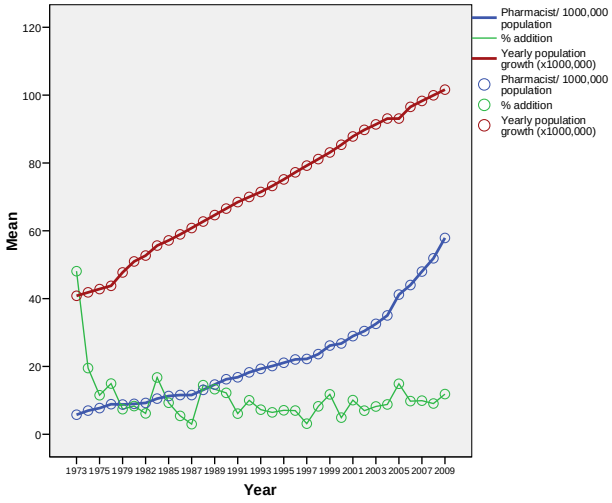


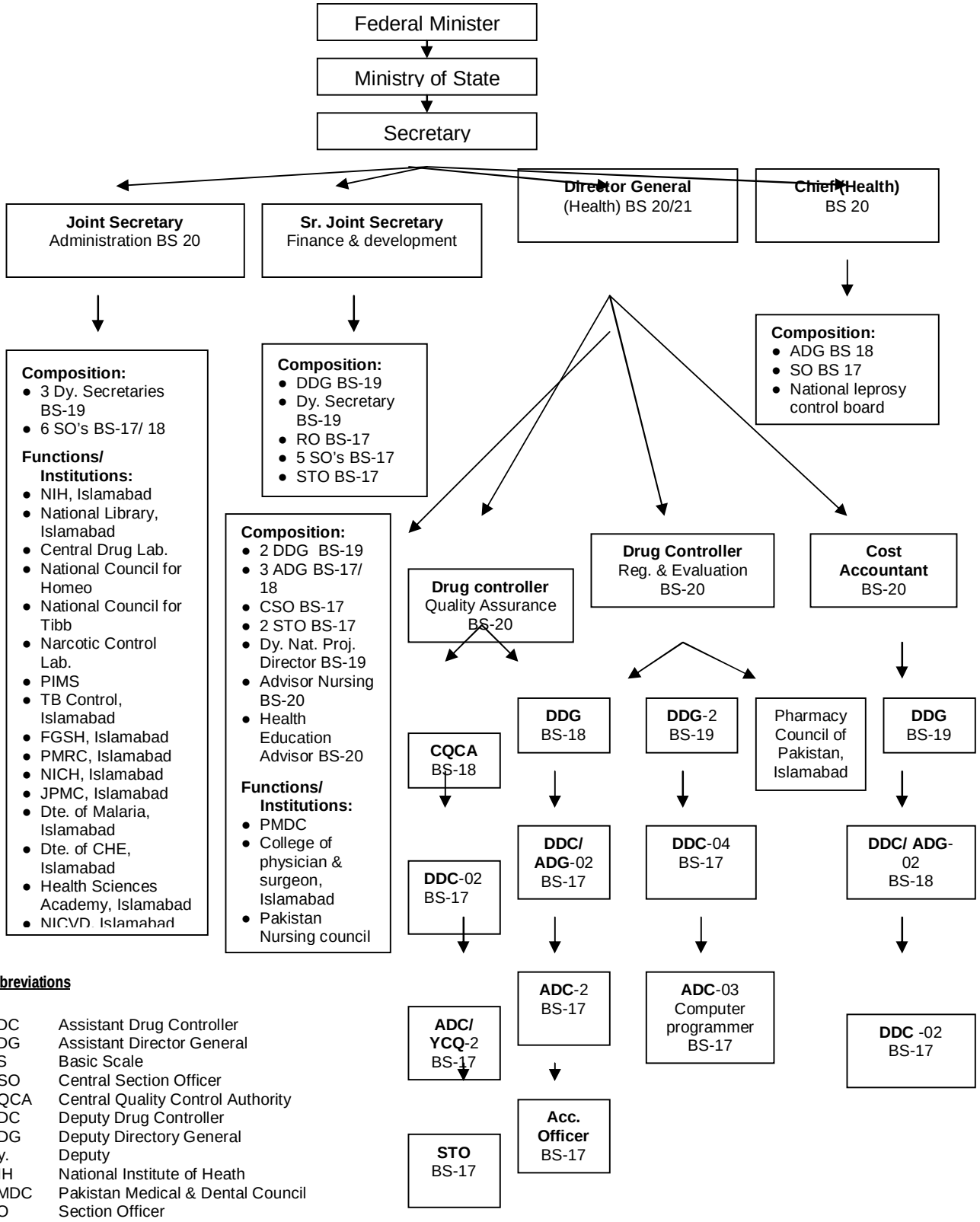
Figure 3. Comparison of male (%), female (%), pharmacist/1000,000 population and % addition of pharmacists with time (last thirty four years) 1972-2009; in Punjab province of Pakistan.

Table 1. Comparison of yearly addition, yearly total, gender (%) of pharmacists, population Vs pharmacist, % addition and yearly population growth during last thirty four years in Punjab province of Pakistan.

Year	Yearly addition	Yearly total	Male	Male %	Female	Female %	Pharmacist per 1000000 population	% Addition	Yearly population growth (X1000000)
1972	122	122	117.00	95.90	5.00	4.09	3.06	.	39.83
1973	113	235	108.00	95.58	5.00	4.43	5.76	48.09	40.83
1974	57	292	55.00	96.49	2.00	3.51	6.98	19.52	41.84
1975	38	330	35.00	92.11	3.00	7.99	7.71	11.52	42.82
1976	58	388	53.00	91.38	5.00	8.62	8.87	14.95	43.77
1979	31	419	30.00	96.77	1.00	3.23	8.78	7.40	47.72
1981	38	457	35.00	92.11	3.00	7.99	8.97	8.32	50.95
1982	30	487	28.00	93.33	2.00	6.67	9.24	6.16	52.69
1984	98	585	86.00	87.76	12.00	12.24	10.51	16.75	55.64
1985	60	645	54.00	90.00	6.00	10.00	11.28	9.30	57.16
1986	37	682	34.00	91.89	3.00	8.11	11.57	5.43	58.93
1987	21	703	18.00	85.71	3.00	14.29	11.56	2.99	60.81
1988	119	822	110.00	92.44	9.00	7.56	13.10	14.48	62.73
1989	126	948	104.00	82.54	22.00	17.46	14.67	13.29	64.63
1990	132	1080	105.00	79.55	27.00	20.45	16.23	12.22	66.54
1991	70	1150	59.00	84.29	11.00	15.71	16.80	6.09	68.46
1992	128	1278	109.00	85.16	19.00	14.84	18.26	10.02	69.98
1993	100	1378	78.00	78.00	22.00	22.00	19.29	7.26	71.44
1994	95	1473	76.00	80.00	19.00	20.00	20.12	6.45	73.22
1995	112	1585	87.00	77.68	25.00	22.32	21.09	7.07	75.14
1996	119	1704	84.00	70.59	35.00	29.41	22.06	6.99	77.23
1997	55	1759	36.00	65.46	19.00	34.55	22.21	3.13	79.21
1998	158	1917	106.00	67.09	52.00	32.91	23.63	8.24	81.14
1999	256	2173	167.00	65.23	89.00	34.77	26.15	11.78	83.09
2000	112	2285	78.00	69.64	34.00	30.36	26.77	4.90	85.36
2001	256	2541	165.00	64.45	91.00	35.55	28.94	10.07	87.81
2002	190	2731	117.00	61.58	73.00	38.42	30.43	6.96	89.75
2003	244	2975	157.00	64.34	87.00	35.66	32.56	8.20	91.37
2004	287	3262	160.00	55.75	127.00	44.25	35.04	8.80	93.09

2005	571	3833	469.00	82.14	102.00	17.86	41.18	14.90	93.09
2006	415	4248	271.00	65.30	144.00	34.70	44.01	9.77	96.53
2007	467	4715	280.00	59.96	187.00	40.04	47.98	9.91	98.28
2008	470	5185	263.00	55.96	207.00	44.04	51.88	9.07	99.95
2009	697	5882	393.00	56.39	304.00	43.62	57.89	11.85	101.62
Total	34	34	34	34	34	34	34	33	34
Mean	173.00	1772.6	121.38	78.6050	51.62	21.4015	21.61	10.6630	70.67
Median	116.00	1328.0	95.50	81.0700	20.50	18.9300	18.78	9.0700	70.71
Grouped Median	115.00	1328.0	95.50	81.0700	20.80	18.9300	18.78	9.0700	70.71
Std. Error of Mean	28.691	263.10	17.789	2.33114	12.127	2.33025	2.418	1.34306	3.289
Sum	5882	60269	4127	2672.57	1755	727.65	735	351.88	2403
Minimum	21	122	18	55.75	1	3.23	3	2.99	40
Maximum	697	5882	469	96.77	304	44.25	58	48.09	102
Range	676	5760	451	41.02	303	41.02	55	45.10	62
First	122	122	117	95.90	5	4.09	3	48.09	40
Last	697	5882	393	56.39	304	43.62	58	11.85	102
Std. Deviation	167.295	1534.2	103.725	13.5928	70.712	13.58755	14.101	7.71527	19.178
Variance	27987.636	2353645.880	10758.910	184.763	5000.183	184.621	198.850	59.525	367.782
Kurtosis	2.406	.661	3.669	-1.368	4.220	-1.367	.325	17.778	-1.185
Std. Error of Kurtosis	.788	.788	.788	.788	.788	.788	.788	.798	.788
Skewness	1.712	1.189	1.895	-.273	2.020	.273	1.007	3.754	-.054
Std. Error of Skewness	.403	.403	.403	.403	.403	.403	.403	.409	.403
Harmonic Mean	81.07	736.02	68.15	76.1716	6.98	11.8017	13.68	8.1080	65.20
Geometric Mean	116.74	1185.3	90.37	77.4089	19.23	16.4835	17.44	9.1833	67.98

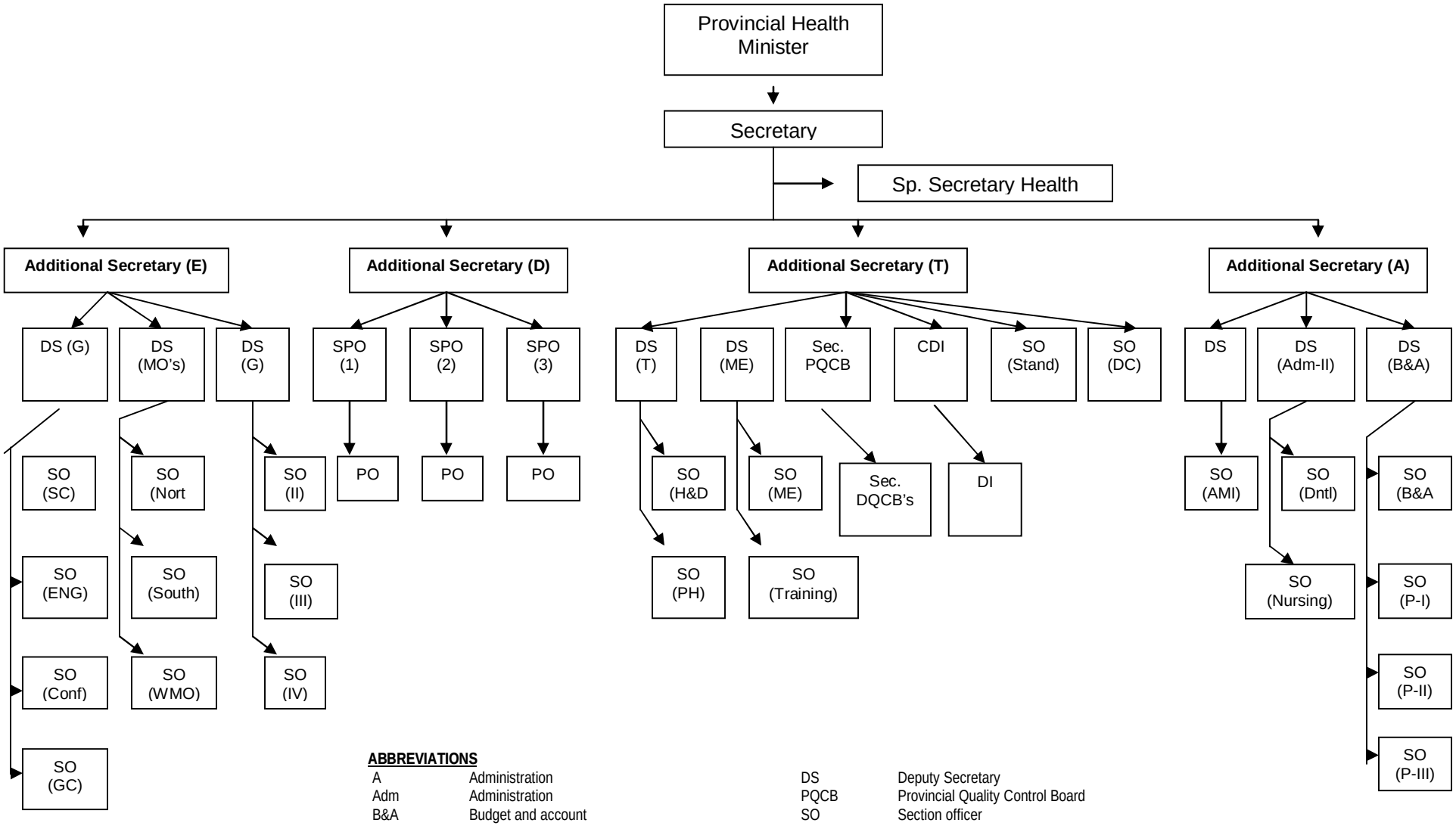
Old Organization Chart of Ministry of Health, Islamabad, Pakistan



Abbreviations

ADC	Assistant Drug Controller
ADG	Assistant Director General
BS	Basic Scale
CSO	Central Section Officer
CQCA	Central Quality Control Authority
DDC	Deputy Drug Controller
DDG	Deputy Directory General
Dy.	Deputy
NIH	National Institute of Heath
PMDC	Pakistan Medical & Dental Council
SO	Section Officer
STO	Senior Technical Officer
STO	Senior Technical Officer

Old Organization of Provincial Health Department, Pakistan



ABBREVIATIONS

A	Administration
Adm	Administration
B&A	Budget and account
CDI	Chief Drug Inspector
DC	drug controller
E	Establishmen
D	Development
DS	Deputy Secretary
PQCB	Provincial Quality Control Board
SO	Section officer
SPO	Senior Purchase Officer
T	Technical
Sec.	Secretary

Chapter 3.

CLINICAL PHARMACY
(Concept and Principles)

Clinical pharmacy deals with various aspects of patient's care and dispensing/ advising the safe and rational use of drugs. It is the branch of pharmacy which deals with the recent and variably implemented form of pharmacy practice. It actually promote the safe, effective and economic use of medicine with application of knowledge of pharmacology, pharmacokinetic, pharmaceutics and therapeutic. Clinical meaning the examination or treatment of admitted patient and pharmacy is the branch of health science dealing with proper dispensing and utilization of drugs. This chapter comprised of basic components, scope, apothecary, pharmaceutical care, medicine management, patient counseling, drug utilization review/ evaluation, therapeutic intervention, drug/ disease monitoring/ management protocol, practical clinical pharmacokinetic, drug donations and evidence based pharmacy practice.

Chapter 3.

CLINICAL PHARMACY
(CONCEPT AND PRINCIPLES)

- BASIC COMPONENTS
- SCOPE OF CLINICAL PHARMACY
- APOTHECARY
- ETT APOTEK
- BASIC CONCEPTS OF CLINICAL PHARMACY
  - Pharmaceutical care
  - Medicine
  - Medicine management
  - Patient counseling/ communication/ consultation
  - Drug utilization review
  - Drug utilization evaluation
  - Therapeutic intervention
  - Drug monitoring
  - Disease monitoring
  - Drug disease management protocol
  - Therapeutical drug monitoring
  - Medication/ pharmacotherapy
  - Practical clinical pharmacokinetic
    - Digoxin
    - Theophyline
    - Gentamicine
    - Lithium
    - Carbamazepine
    - Phenobarbital
    - Primidone
    - Sodium valproate
    - Ciclosprin
- CLINICAL PHARMACY IN DEVELOPING COUNTRIES
  - Ensuring medicines are available
  - Encouraging rational prescribing
  - Rational dispensing
  - The essential drugs concept
  - Communicating clear messages
  - Drug donations
    - WHO guidelines for drug donations 2005
    - Selection of drugs
    - Quality assurance (QA) and shelf life
    - Presentation, packing and labeling
    - Information and management
- EVIDENCE-BASED PHARMACY PRACTICE

The recent and variably implemented form of pharmacy practice called as clinical pharmacy.

The Set of function that promote the safe, effective and economic use of medicine with application of knowledge of pharmacology, pharmacokinetic, pharmaceutics and therapeutic called as clinical pharmacy.
It is the combination of two words; Clinical meaning the examination and treatment of admitted patient and pharmacy is the branch of health science dealing with proper dispensing and utilization of drugs.

A more appropriate definition for clinical pharmacy is, "Clinical pharmacy is the branch of pharmacy which deals with various aspect of patient care, dispensing of drugs and advising patient on the safe and rational use of drug."

The title Clinical Pharmacist is widely regarded to define a pharmacist who works principally to alleviate existing and potential problems that might be caused by medicines use. These pharmacists need postgraduate qualifications and work closely with other health care professionals. The may be found in hospitals and within the primary care environment, though rarely in a community pharmacy.

Clinical pharmacy is the branch of Pharmacy where pharmacists provide patient care that optimizes the use of medication and promotes health, wellness and disease prevention. Clinical pharmacists provide pahrmaceutical care for patients in all health care settings but the clinical pharmacy movement initially began inside hospitals and clinics. Clinical pharmacists often collaborate with physicians and other healthcare professionals. They have extensive education in the biomedical, pharmaceutical, sociobehavioral and clinical sciences. Mostly they possess a Doctor of Pharmacy (Pharm.D) degree and many have completed one or more years of postgraduate training (e.g. a general and/or specialty pharmacy residency). There are also subspecialties within the Pharmacotherapy specialty i.e. cardiology and infectious disease. It is denoted as an additional qualification. In order to obtain one of these specialties they must first be a qualiified/ certified/ registered Pharmacist and then submit a portfolio to the relevent professional bodies to review and determine if they will grant the additional certifications.

Within the system of health care, clinical pharmacists are experts in the therapeutic use of medications. They routinely provide medication therapy evaluations

and recommendations to patients and other health care professionals. They are also supposed a primary source of scientifically valid information and advice regarding the safe, appropriate, and cost-effective use of medications.

BASIC COMPONENTS OF CLINICAL PHARMACY PRACTICE

In some states, clinical pharmacists are given prescriptive authority. Basic components of clinical pharmacy practice are as given below,

1. Prescribing drugs
2. Dispensing and administering drugs
3. Documenting professional services
4. Reviewing drug use
5. Communication
6. Counseling
7. Consulting

SCOPE OF CLINICAL PHARMACY

The scope of clincial pharmacy comprised of following main segments,

1 considered into Drug Distribution Systems
2 Drug Information
3 Drug Utilization
4 Drug Evaluation and Selection
5 Medication Therapy Management
6 Formal Education and Training Program
7 Electronic Data Processing (EDP) Application

APOTHECARY

Apothecary is a historical name for a medical professional who formulates and dispenses materia medica to physicians, surgeons and patients — a role now served by a pharmacist (or, especially in British English, a chemist or dispensing chemist).

In addition to pharmacy responsibilities, the apothecary offered general medical advice and a range of services that are now performed solely by other specialist practitioners, such as surgery and midwifery. Apothecaries often operated through a retail shop which, in addition to ingredients for medicines, sold tobacco and patent medicines. The apothecaries also used many other herbs not listed.

In its investigation of herbal and chemical ingredients, the work of the apothecary may be regarded as a precursor of the modern sciences of chemistry and pharmacology, prior to the formulation of the scientific method.

According to Sharif Kaf al-Ghazal, the first apothecary shops were founded during the Middle Ages in Baghdad. By the end of the 14th century, Geoffrey Chaucer (1342-1400) was mentioning an English apothecary in the *Canterbury Tales*, specifically "The Nun's Priest's Tale".

By the 15th century, the apothecary gained the status of a skilled practitioner, but by the end of the 19th century, the medical professions had taken on their current institutional form, with defined roles for physicians and surgeons, and the role of the apothecary was more narrowly conceived as that of pharmacist (dispensing chemist in British English).

In England, the apothecaries merited their own livery company, the Worshipful Society of Apothecaries, founded in 1617. Elizabeth Garrett Anderson became the first woman to gain a medical qualification in Britain when she passed the Society's examination in 1865.

Apothecaries used their own measurement system, the apothecaries' system, to provide precise weighing of small quantities. Apothecaries also were known to accept special requests for viles *and poisons*. This meaning of the term "apothecary" has not passed into archaic oblivion, as in William Faulkner's still widely read 1930 story "A Rose for Emily" the main character, Miss Emily Grierson, goes to an "apothecary" and buys arsenic, ostensibly to kill a rat (which turns out later to have been her Yankee boyfriend who had apparently become bent on jilting her).

ETT APOTEK

Words which are cognate to *apothecary* have the meaning of "pharmacist" or "dispensing chemist" in certain modern languages. In Swedish, for example, a pharmacy is *ett apotek*. The pharmacist (dispensing chemist) is called *en apotekar.*

BASIC CONCEPTS OF CLINICAL PHARMACY

PHARMACEUTICAL CARE

Cooperative patient centered system for achieving specific and positive patient outcome from responsible medicine. Clinical pharmacy is as essential component of pharmaceutical care.

It is the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life . These outcomes are (i) cure of a disease; (ii) elimination or reduction of a patient's symptomatology;(iii) arresting or slowing of a disease process; or (iv) preventing a disease or symptomatology.

This process requires a clinical pharmacist to review a patient's medication with reference to the doctor's diagnoses, laboratory tests and patient's information.

The clinical pharmacist must therefore work very closely with the doctor and patient in order to gain a correct understanding of the relevance and impact of the various medications on the patient's pathology.

The pharmaceutical care process was originally conceived to be undertaken in a community pharmacy by community pharmacists. In 1996 the Pharmaceutical Society of NZ began a programme to implement the process throughout New Zealand. While some 500 pharmacists undertook an expensive training, it was found that the basic skill level of most pharmacists was not sufficient to enable them to undertake an in-depth review of the patients' medication. Pharmacists are now required to complete a postgraduate diploma in clinical pharmacy to enable them to practice as a Clinical Pharmacist before being considered competent to work at this level.

MEDICINE

The ancient Greek symbol today associated with medicine the world over: the rod of Asclepius with its encoiled serpent. The World Health Organization, the Royal Society of Medicine, the American Medical and Osteopathic Associations, the British and the Australian Medical Associations are some of the bodies that incorporate it in their insignia

Medicine is the art and science of healing. It encompasses a range of health care practices evolved to maintain and restore health by the prevention and treatment of illness.

Contemporary medicine applies health science, biomedical research, and medical technology to diagnose and treat injury and disease, typically through medication, surgery, or some other form of therapy. The word *medicine* is derived from the Latin *ars medicina*, meaning *the art of healing*.

Though medical technology and clinical expertise are pivotal to contemporary medicine, successful face-to-face relief of actual suffering continues to require the application of ordinary human feeling and compassion, known in English as *bedside manner*.

MEDICINE MANAGEMENT

The way of selection, procurement, delivery, prescription, administration and review to optimize the desired outcomes of patient called medicine management.

PATIENT COUNSELING/ COMMUNICATION/ CONSULTATION

The process of developing the therapeutical relationship with patient that provide platform to understand medication related needs called patient counseling/ communication/ consultation.

DRUG UTILIZATION REVIEW

Reviewing medication profiles to ensure the appropriateness of prescript-n or medication order called as drug utilization review.

DRUG UTILIZATION EVALUATION

Evaluation of the medication profiles to ensure the appropriateness of prescript-n or medication order called as drug utilization evaluation.

THERAPEUTIC INTERVENTION

The process of to contact prescriber to discuss concerns identified during drug utilization review called as therapeutic intervention.

DRUG MONITORING

The specialized monitoring for a specific drug or drug therapy for a specific disease state called as drug monitoring.

DISEASE MONITORING

The specialized monitoring for a specific disease state called as disease monitoring.

DRUG DISEASE MANAGEMENT PROTOCOL

It is the collaborative working relationship developed between patient, physician and pharmacist to assure medical treatment, testing procedure and therapeutical appropriateness for the remedy of health problem.

THERAPEUTICAL DRUG MONITORING

It is the clinical evaluation of drug response at the recommended dosage regimen. The improvement of clinical effectiveness by therapeutical drug monitoring may decrease the cost of medical care by preventing adverse drug effects..

MEDICATION/ PHARMACOTHERAPY

Medication, also referred to as medicine or medicament, can be loosely defined as any substance intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease. Other synonyms include pharmacotherapy, pharmacotherapeutics, and drug treatment.

PRACTICAL CLINICAL PHARMACOKINETIC

Clinical pharmacokinetic having five major components,

1 Action and uses
2 Dosage protocol
3 TDM/ dose vs. serum concentration vs. response
4 Pharmacokinetic parameters
5 Potential problems

Certain important therapeutical agents possess critical clinical profiles which are needed to be reviewed before administration to patient. Some of the important such drugs are given below,

DIGOXIN

Action and uses

Digoxin also known as Digitalis, is a purified cardiac glycoside *Digitalis lanata*. Its corresponding aglycone is digoxigenin. It is used in the treatment of various heart conditions, atrial fibrillation/ Flutter, heart failure and supraventricualr parasysmal arrhythmia. Marketed under the trade names Lanoxin, Digoxin, Digitek, and Lanoxicaps. It increase the the force of contraction and reduce the conductivity of AV node.

Dosage Protocol:

Digoxin administered orally for rapid digitalization 1500ug/ in divided over 24 hours, less urgent digitization: 250-500 ug/Day, maintenance digitalization 62.5 – 500ug/day or 125- 500ug/day and emergency digitalization: 750- 1000 ug/ 2hours followed by oral maintenance dose.

Dosage Protocol

Digoxin given orally for rapid digitalization as 1500ug/ in divided over 24 hours, less urgent digitization 250-500 ug/Day, maintenance digitalization 62.5 – 500ug/day or 125- 500ug/day and emergency digitalization 750- 1000 ug/ 2hours followed by oral maintenance dose.

TDM/ Dose vs. Serum Concentration vs. Response:

<0.5 ug/L	No clinical response
0.7ug/L	+ive inotropic and conduction blocking effect
0.8-2ug/L	Optimum therapeutic range
2-2.5ug/L	increase risk of toxicity

>2.5ug/L GIT, CVS and CNS toxicity

Pharmacokinetic Parameters:

Bioavailability	60 to 80% (Oral)
Protein binding	25%
Half life	36 to 48 hours (patients with normal renal function), 3.5 to 5 days (patients with impaired renal function)
Excretion	Renal (60-80% unchanged) Hepatic (20-40%)

Equations: Vd
=3.8x Lean BWt.+3.1xCreatinine Clearance)
Population average value
= 0.8 x BWt. + Creatinine Clearance
In CHF = 0.33 x BWt. + (0.9 x Clearance)

Digitalis lutea

Digitalis purpurea (Foxglove)

Potential Problems:

CHF and renal and hepatic impairment decrease elimination.
Hypothyroidism increase serum concentration

Hypokalaemia, hypomagnesaemia, hypoxia and hyperclacaemia increase sensitivity.

Digitalis purpurea

THEOPHYLINE

Action and uses

It is one the xanthenes alkaloids with diuretic, CVS, cereberovascular vasodilatation and bronchodilatory effects.

Dosage Protocol:

Adults: 200-300 mg Tab. per 12 hourly
Children <35 100mg per day 12 hourly
>35 200mg per day 12 hourly

TDM/ Dose vs. Serum Concentration vs. Response:

<5mg/L No clinical response
5-10mg/L +ive inotropic and conduction blocking effect
10-20mg/L Optimum therapeutic range with minimum side effects
20-30mg/L Mild toxicity; nausea, vomiting, arrhythmia
>30mg/L Cardiac Seizure

Pharmacokinetic Parameters:

Volume of distribution (Vd) 0.48L/Kg
Bioavailability 100%
Protein binding 40%
Half life 5-8 Hours
Excretion 0.04L/H/Kg
X 0.5 in cirrhosis or with cimitidine, ciprofloxacine, erythromycine
X 0.4 in CHF, Hepatomegaly
X 0.9 in sever respiratory obstruction
X 1.6 smokers (10/day)

Potential Problems:

Cimetidine, erythromycin, ciprofloxacin, interferon.

GENTAMICINE

Action and uses: It the antibiotic of aminoglycoside group. Act at 30S subunit of ribosome and inhibit the protein synthesis. It is effective against pseudomonas, proteus, serratia and Gram +ive staphylococcus. It is synthesized from microspore G-ive by fermentation process and majorly produced in south Korea and china. In Europe the major manufacturer is Sandoz Pvt. Ltd.

Dosage Protocol:

Adults: 3mg/kg/D x 7-10Standard dose 6-7mg/kg/D x 7-10 Range of adult dose
Children <2weeks 3mg/kg/12 hourly x14 Days
>2weeks 2mg/kg/8 hourly x 7-10 Days

TDM/ Dose vs. Serum Concentration vs. Response:

<2ug/L Immediate sampling
<12ug/L 1 Hour post IV/ IM
5-12ug/L Therapeutic range

Pharmacokinetic Parameters:

Volume of distribution (Vd) 0.25 L/Kg
Protein binding 0-10%
Half life 2 Hours
Excretion
Cl = Ke x Vd
T1/2 = 0.693/Ke
ΔC= SxFxDose/ Vd

Potential Problems:

Contraindicated in pregnancy, lactation, ototoxicity and nephrotoxicity.

LITHIUM

Action and uses

It is an alkali metal with atomic # 3 and atomic Wt. 6.94amu. lithium word is derived from lithios meaning stone. It was initially discovered in brazile in 1800. It exist as LiOH, LiCO3 and Li3N. lithium is used for gout, mode stablizer, mania, depression, migreian and clustered headach. lithium act by replacing the K, Na, Ca but not Mg and Zn.

Dosage Protocol:

Adults: 400mg SR Tablet OD

TDM/ Dose vs. Serum Concentration vs. Response:

<0.4 m.mol/L	Little clinical response
0.4-1 m.mol/L	Prophylaxis
0.8-1.2 m.mol/L (0.6-1.2)	Optimum therapeutic range
1.2-1.5 m.mol/L	Renal complication
1.5-3.0 m.mol/L	Renal complication, ataxia, diarrhea, dehydration.
0.3-5.0 m.mol/L	Coma, death

Pharmacokinetic Parameters:

Volume of distribution (Vd)	0.5-1
Model	two
Half life	8-38 (18) Hours

Potential Problems:

Clearance decreased by diuretic, ACEI, NSAID's.
Clearance increased by aminophylline and Na loading.
Contraindicated in cardiac insufficiency, pregnancy and lactation.

CARBAMAZEPINE

Action and uses

It is the 1st choice for simple and complex partial seizure tonic clonic. The major side effects are aplastic anemia, dermatological effects, Steven Johnson syndrome.

Dosage Protocol:

Manic Depressive Psychosis:
Adults: 400mg gradually increasing divided dose with Dmax 1600mg.
Children: 400-600mg divided dose
Epilepsy:
Adults: 100-200mg OD/ BD with Dmax 1600mg. The range of 800-1200mg divided.

Paeds:	<1 Y	100-200mg
	1-5	200-400mg
	5-10	400-600mg
	10-15	600-1000mg
	All in divided dose	

TDM/ Dose vs. Serum Concentration vs. Response:

<4mg/L	Little clinical response
4-12mg/L	Optimum therapeutic range
>9mg/L	(combination with other anticonvulsants) Mild toxicity, nystagmus, diplopia etc
>12mg/L	Toxicity

Blood sample drawn after 2-4weeks of starting therapy or 3-4 days after dose adjustment.

Pharmacokinetic Parameters:

Volume of distribution (Vd)	0.8-1.9 L/Kg
Bioavailability	80%
Protein binding	70-80%
Half life	35Hrs beginning 5-7 Hrs regular dosing
Excretion	2% Uchanged renal clearance 0.01-0.03 L/H/Kg at beginning therapy 0.05-0.1 L/H/Kg at chronic therapy

Potential Problems:

Contraindicated in AV conduction abnormalities. Interactions observed with oral anticoagulants, MAOI's, oral contraceptives, erythromycin, isoniazid, cimitidin, dextromethorphene, steroids and diltiazem.

PHENOBARBITAL

Action and uses

Used for tonic clonic, partial siezure and febril siezure.

Dosage Protocol:

Adults: 90-300mg/D
Paeds:

TDM/ Dose vs. Serum Concentration vs. Response:

<15mg/L	Little clinical response
15-40mg/L	Optimum therapeutic range
40-50mg/L	Toxicity; sadness, confusion
>60mg/L	Toxicity; ataxia, lethargy, stupor, coma.

Pharmacokinetic Parameters:

Volume of distribution (Vd)	0.7L/Kg
Protein binding	50%
Half life	100hours
Excretion	80% liver and 20%unchanged renal @0.004L/H/Kg

Cl = Ke x Vd
T1/2 = 0.693/Ke

Potential Problems:

Contraindicated in hepatic failure and sever complication of CNS.

PRIMIDONE

Action and uses

Primidone is the active metabolite of phenobarbitla and used for tonic clonic and partial siezure. The side

effects included sedation, nausea, ataxia etc. It is uasualy not recommended as antiepileptic over phenobarbitoal.

Dosage Protocol:

Adults: 750-3000 mg/D

TDM/ Dose vs. Serum Concentration vs. Response:

5-12ug/L Optimum therapeutic range
>15ug/L Toxicity started

Pharmacokinetic Parameters:

Volume of distribution (Vd) 0.4-1.1L/Kg

Bioavailability	90-100%
Protein binding	20-30% (80% Shargel et al., 2004)
Half life	3-19 (15) Hours autometabolism at chronic use.
Tmax	1-3 Hours
Excretion	40% renal

SODIUM VALPROATE

Action and uses

Sodium valproate converted into valproic acid in blood stream. It is used for generalized absence seizure, myoclonic seizure and tonic clonic seizure.

Mild side effects include anorexia, nausea, diarrhea, Wt. gain, alopecia, skin rash, and thrombocytopenia.

Moderate side effects include confusion, stupor, tremor and hyperammonaemia.

Sever side effects are the pancreatic/ hepatic failure.

Dosage Protocol:

Adults: 1000-3000 mg/D

TDM/ Dose vs. Serum Concentration vs. Response:

50-100ug/ml Optimum therapeutic range
>150ug/ml Toxicity
No clear evidence of therapeutic benefits above 100ug/ml. No clear serum concentration and toxic effects relationship. It also has nonlinear plasma concentration Vs dose relationship.

Pharmacokinetic Parameters:

Volume of distribution (Vd)	0.1-0.5 L/Kg
Protein binding	90-95% (50mg/L)
Half life	15-20 hours
Excretion	<5% renal

Potential Problems:

Phenobarbital level increased if administered with valproate. Na valproate decrease metabolism of lamotrigine, phenytoin and carbamazepine. The enzyme inducing drugs increase the metabolism of valproate.

Contraindicated in pregnancy.

CICLOSPRIN

Action and uses

It is an immunosupressant and extracted from fungus tolypocladium inflatum genus. Majorly used for transpaltaiton or grafting rejection of kidney, heart, lungs, liver, pancrease, boine marrow, arthritis and ulcerative colitis.

The adverse effects include the nephrotoxicity, hepatotoxicity, GI intolerance, hypertrichosis, hirsutism, gingival hyperplasia.

The calcineurin inhibitor acts at early stage of helper T-cell by interefring interleukin-2. that decrease cytotoxic lymphocytes that cause tissue damage.

Dosage Protocol:

Adults: 2-5 mg/Kg/D

I/V 2mg/Kg/D

2.5 mg/Kg/D for arthritis.

TDM/ Dose vs. Serum Concentration vs. Response:

200-400 ug/L Therapeutic range for post operative targeted concentration
300 ug/L Upper limit
100-200 ug/L 3-6 months post transplant

Pharmacokinetic Parameters:

Volume of distribution (Vd) 4-8 L/Kg

Bioavailability	0.2-0.5 %
Protein binding	98%
Half life	9 Hours
Excretion	0.1-2 L/H/Kg 40% higher in children require higher dose

Potential Problems:

Grape fruit, macrolide, ketoconazole, diltiazeme, verapamil, oral contraceptives, protease inhibitor increase serum level and increase toxicity.

Monitoring: U&C (urine and electrolyte), FBC (full blood count) fornightly until disease stabilized than monthly for 4 months, then 3 monthly.

Check: lipid and urate at 3monthly interval use base line Creatinine to alter dose.

CLINICAL PHARMACY IN DEVELOPING COUNTRIES

Pharmaceutical services in developing countries face particular challenges that are significantly different from those faced by pharmacists in the so-called developed world.

Medicines that are normally restricted to prescription in the developed world may be readily available on general sale in developing countries, while other extremely useful medicines such as morphine for severe pain may not be available at all or in such small quantities as to be effectively unobtainable. Many patients will not be able to afford all their prescribed medicines and so must choose which ones to buy. Doctors are supposed to make patients better, so often use irrational choices to achieve a cure.

ENSURING MEDICINES ARE AVAILABLE

Many developing nations have developed national drug policies, a concept that has been actively promoted by the WHO. For example, the national drug policy for Indonesia drawn up in 1983 had the following objectives:

1 To ensure the availability of drugs according to the needs of the population.
2 To improve the distribution of drugs in order to make them accessible to the whole population.
3 To ensure efficacy, safety quality and validity of marketed drugs and to promote proper, rational and efficient use.
4 To protect the public from misuse and abuse.
5 To develop the national pharmaceutical potential towards the achievements of self-reliance in drugs and in support of national economic growth.
6 To achieve these objectives following changes can be implemented,
7 To established and implemented a national list of essential drugs in all public sector institutions. Which should be revised periodically.
8 To issue a ministerial decree in public sector institutions to prescribed generically and established pharmacy and therapeutics committees in all hospitals.
9 To have procure based on the essential drugs list and enforced in district hospitals and health centers.
10 To supply most drugs by three governments owned companies.
11 To developed Training modules for drug management and rational drug use and rolled out to relevant personnel.
12 To strengthened the central drug laboratory and provincial quality control laboratories.
13 To developed a program on rational drug use in major teaching hospitals, hospital formulary, guidelines for rational diagnosis and treatment guidelines for the rational use of antibiotics.
14 To make available generic drugs at affordable costs to low-income groups.

ENCOURAGING RATIONAL PRESCRIBING

One of the first challenges is to promote and develop rational prescribing, and a number of international initiatives exist in this area. WHO has actively promoted rational drug use as one of the major elements in its Drug Action Programme. In its publication *A Guide to Good Prescribing* the process is outlined as:

1 Define the patient's problem
2 Specify the therapeutic objectives
3 Verify whether your personal treatment choice is suitable for this patient
4 Start the treatment
5 Give information, instructions and warnings
6 Monitor (stop) the treatment.

The emphasis is on developing a logical approach, and it allows for clinicians to develop personal choices in medicines (a personal formulary) which they may use regularly. The program seeks to promote appraisal of evidence in terms of proven efficacy and safety from controlled clinical trial data, and adequate consideration of quality, cost and choice of competitor drugs by choosing the item that has been most thoroughly investigated, has favorable pharmacokinetic properties and is reliably produced locally. The avoidance of combination drugs is also encouraged.

The routine and irrational use of injections should also be challenged. One study undertaken in Indonesia found that nearly 50% of infants and children and 75% of the patients aged five years or over visiting government health centers received one or more injections. The highest use of injections was for skin disorders, musculoskeletal problems and nutritional deficiencies. Injections, as well as being used inappropriately, are often administered by untrained personnel; these include drug sellers who have no understanding of clean or aseptic techniques.

Another group active in this area is the International Network for the Rational Use of Drugs (INRUD). This organization, established in 1989, exists to promote rational drug use in developing countries. As well as producing training programs and publications, the group is undertaking research in a number of member countries, focused primarily on changing behavior to improve drug use. One of the most useful publications from this group is entitled *Managing Drug Supply*. It

covers most of the drug supply processes and is built up from research and experience in many developing countries. There a number of case studies described, many of which have general application for pharmacists working in developing countries.

In all the talk of rational drug use, the impact of the pharmaceutical industry cannot be ignored, with its many incentive schemes for doctors and pharmacy staff who dispense advice or encourage use of particular products. These issues have been highlighted in a study of pharmaceutical sales representatives (medreps) in Mumbai. This was an observational study of medreps' interactions with pharmacies, covering a range of neighborhoods containing a wide mix of social classes. It is estimated that there are approximately 5000 medreps in Mumbai, roughly one for every four doctors in the city. Their salaries vary according to the employing organization, with the multinationals paying the highest salaries. The majority work to performanace-related incentives. One medrep stated "There are a lot of companies, a lot of competition, a lot of pressure to sell, sell! Medicine in India is all about incentives to doctors to buy your medicines, incentives for us to sell more medicines. Even the patient wants an incentive to buy from this shop or that shop. Everywhere there is a scheme, that's business, that's medicine in India.'

The whole system is geared to winning over confidence and getting results in terms of sales; this is often achieved by means of gifts or invitations to symposia to persuade doctors to prescribe. With the launch of new and expensive antibiotics worldwide, the pressure to sell with little regard to the national essential drug lists or rational prescribing. One medrep noted that this was not a business for those overly concerned with morality. Such a statement is a sad reflection on parts of the pharmaceutical industry, which has an important role to play in the development of the health of a nation. It seems likely that short-term gains are made at the expense of increasing problems such as antibiotic resistance. The only alternatives are to ensure practitioners have the skills to appraise medicine promotion activities or to more stringently control pharmaceutical promotional activities.

RATIONAL DISPENSING

In situations where medicines are dispensed in small, screwed-up pieces of brown paper, the need for instructions to the patient takes on a whole new dimension. Medicines should always be issued in appropriate containers and labelled. While the patient may be unable to read, the next healthcare worker who seeks to help the patient is is probably literate. There are many tried-and-tested methods in the literature for using pictures and diagrams to aid patient compliance. Symbols such as a rising or setting sun to depict time of day have also been used, particularly for treatments where regular medication is important, such as cases of tuberculosis or leprosy.

Poverty may force patients to purchase one day's supply of medicines at a time, so it is important to ensure that antibiotics are used rationally and not just for one or two day's treatment. Often, poor patients need help from pharmacists to understand which the most important medicines are and to identify the prescribed items, typically vitamins, that can be missed in order to reduce the overall cost of the prescription to a more manageable level.

THE ESSENTIAL DRUGS CONCEPT

The essential drugs list concept was developed from a report to the 28th World Health Assembly in 1975 as a scheme to extend the range of necessary drugs to populations who had poor access because of the existing supply structure. The plan was to develop essential drugs lists based on the local health needs of each country and to periodically update these with the advice of experts in public health, medicine, pharmacology, pharmacy and drug management. Resolution number 28.66 at the Assembly requested the WHO Director-General to implement the proposal, which led subsequently to an initial model list of essential drugs (WHO Technical Series no 615, 1977). This model list has undergone regular review at approximately two-yearly intervals and the current 14th list was published in March 2005. The model list is perceived by the WHO to be an indication of a common core of medicines to cover most common needs. There is a strong emphasis on the need for national policy decisions and local ownership and implementation. In addition, a number of guiding principles for essential drug programs have emerged.

1 The initial essential drugs list should be seen as a starting point.
2 Generic names should be used where possible, with a cross-index to proprietary names.
3 Concise and accurate drug information should accompany the list.
4 Quality, including drug content stability and bioavailability, should be regularly assessed for essential drug supplies.
5 Decisions should be made about the level of expertise required for drugs. Some countries make all the drugs on the list available to teaching hospitals and have smaller lists for district hospitals and a very short list for health centers.
6 Success depends on the efficient supply, storage and distribution at every point.

7 Research is sometimes required to settle the choice of a particular product in the local situation.

The Model List of Essential Drugs

The model list of essential drugs is divided into 27 main sections, which are listed in English in alphabetical order. Recommendations are for drugs and presentations. For example, paracetamol appears as tablets in strengths of 100 mg to 500 mg, suppositories 100 mg and syrup 125 mg/5ml. Certain drugs are marked, which denotes an example of a therapeutic group, and other drugs in the same group could serve as alternatives.

The lists are drawn up by consensus and generally are sensible choices. There are ongoing initiatives to define the evidence that supports the list. This demonstrates the areas where RCTs (randomized controlled trials) or systematic reviews exist and serves to highlight areas either where further research is needed or where similar drugs may exist which have better supporting evidence.

In addition to work to strengthen the evidence base, there is a proposal to encourage the development of Cochrane reviews for drugs that do not have systematic review evidence.

Application of NNTs (numbers needed to treat) to the underpinning evidence should further strengthen the lists. At present, there is an assumption among doctors in some parts of the world that the essential drugs list is really for the poor of society and is somehow inferior. The use of NNTs around analgesics in the list goes some way to disprove this and these developments may increase the importance of essential drugs lists.

COMMUNICATING CLEAR MESSAGES

The impact of pharmaceutical representatives and the power of this approach has led to the concept of academic detailing to provide clear messages. A study by Thaver and Harpham described the work of 25 private practitioners in area around Karachi. The work was based on assessment of prescribing practices, and for each practitioner included 30 prescriptions for acute respiratory infections (ARIs) or diarrhea in children under 12 years of age. A total of 736 prescriptions were analysed and it was found that an average of four drugs were either prescribed or dispensed for each consultation. An antibiotic was prescribed in 66% of prescriptions, and 14% of prescriptions were for an injection. Antibiotics were requested for 81% of diarrhea cases and 62% of ARI cases. Of the 177 prescriptions for diarrhea, only 29% were for oral rehydration solution. The researchers went on to convert this information into clear messages for academic dealing back to the doctors. The researchers went on to implement the program and assessed the benefits. This was a good piece of work based on developing messages that are supported by evidence.

DRUG DONATIONS

It is a natural human reaction to want to help in whatever way possible when face with human disaster, either as a result of some catastrophe or because of extreme poverty. Sympathetic individuals want to take action to help in a situation in which they would otherwise be helpless, and workers in difficult circumstances, only too aware of waste and excess at home, want to make use of otherwise worthless materials. The problem is that these situations do not lend themselves to objectivity. There are numerous accounts of tons of useless drugs being air-freighted into disaster areas. It the requires huge resources to sort out these charitable acts and often the drugs cannot be identified because the labels are not in a familiar language. In many cases, huge quantities have to be destroyed simply because the drugs are out of date, spoiled, unidentifiable, or totally irrelevant to local needs. Generally, had the cost of shipping been donated instead, then many more people would have benefited.

In response to this, the WHO has generated guidelines for drug donations from a consensus of major international agencies involved in emergency relief. If these are followed, a significant improvement in terms of patient benefit and use of human resources will result.

WHO guidelines for drug donations 2005

Selection of drugs

1 drugs should be based on expressed need, be relevant to disease pattern and be agreed with the recipient.
2 Medicines should be listed on the country's essential drugs list or WHO model list.
3 Formulations and presentations should be simiar to those used in the recipient country.

Quality assurance (QA) and shelf life

1 Drugs should be from a reliable source and WHO certification for quality of pharmaceuticals should be used.
2 No returned drugs from patients should be used.
3 All drugs should have a shelf life of at least 12 months after arrival in the recipient country.

Presentation, packing and labelling

1 All drugs must be labelled in a language that is easily understood in the recipient country and contain details of generic name, batch number, dosage form, strength, quantity, name of manufacturer, storage conditions and expiry date.
2 Drugs should be presented in reasonable pack sizes (e.g. no sample or patient starter packs).
3 Material should be sent according to international shipping regulations with detailed packing lists. Any storage conditions must be clearly stated on the containers, which should not weigh more than 50 kg. Drugs should not be mixed with other supplies.

Information and management

1 Recipients should be informed of all drug donations that are being considered or under way.

2 Declared value should be based on the wholesale price in the recipient country or on the wholesale world market price.

3 Cost of international and local transport, warehousing, etc, should be paid by the donor agency unless otherwise agreed with the recipient in advance.

EVIDENCE-BASED PHARMACY PRACTICE

While modern practices, including the development of clinical pharmacy, are important, many basic issues await significant change in developing countries.

1 Medicines can often be found stored together in pharmacological groups rather than in alphabetical order by type.

2 Fridge space is often inadequate and refrigerators unreliable.

3 There are different challenges, such as ensuring that termites do not consume the outer packages and labels or that storage is free of other vermin such as rats.

4 Dispensary packaging and labelling can be woefully inadequate and patients leave with little or no understanding of how to take medicines which may have cost them at least one week's earnings.

5 Medicines are often out of stock, not just for a few hours but for days or even weeks, particularly at the end of the financial year.

6 Protocols and standard operating procedures are rarely found.

7 Even when graduate pharmacists are employed, they often have little opportunity to perform above the level of salesperson, simply issuing medicines and collecting payment. For example, several hospital pharmacies in Mumbai, India, are open 24 hours per day for 365 days per year but only to function as retail outlets selling medicines to outpatients or to relatives of inpatients who then hand over the medicines to the nursing staff for administration.

It is therefore concluded, the Evidence is just as important in the developing world as it is in the developed world. Poverty comes in many forms and while the form most noticed is famine and poor housing, both of which are potent killers, medical and knowledge poverty are also significant. Evidence-based practice is one of the ways in which these problems can be minimized. Potentially, one of the greatest benefits of the internet is the possibility of ending knowledge poverty and in turn influencing all the factors that undermine wellbeing. Essential drugs programs have been a major step forward in ensuring that the maximum number benefits from effective drug therapy for disease.

ESSENTIAL MEDICINES

Essential medicines
Essential medicines: theory and practice
Cost-to-benefit ratio
Number of drugs

Essential medicines, as defined by the World Health Organization are "those drugs that satisfy the health care needs of the majority of the population; they should therefore be available at all times in adequate amounts and in appropriate dosage forms, at a price the community can afford."

The WHO has published a model list of essential medicines. Each country is encouraged to prepare their own lists taking into consideration local priorities. At present over 150 countries have published an official essential medicines list. The WHO List contains a core list and a complementary list.

The core list presents a list of minimum medicine needs for a basic health care system, listing the most efficacious, safe and cost-effective medicines for priority conditions. Priority conditions are selected on the basis of current and estimated future public health

relevance, and potential for safe and cost-effective treatment.

The complementary list presents essential medicines for priority diseases, for which specialized diagnostic or monitoring facilities are needed. In case of doubt medicines may also be listed as complementary on the basis of consistent higher costs or less attractive cost-effectiveness in a variety of settings.

The compilation of an essential medicines list enables health authorities, especially in developing countries, to optimize pharmaceutical resources.

The list is important because:

It forms the basis of national drugs policy in many countries, both developed and developing (e.g. South Africa, Eritrea).

Governments refer to WHO recommendations when making decisions on health spending.

ESSENTIAL MEDICINES: THEORY AND PRACTICE

The original 1977 WHO definition of "**essential medicines**" was that they were 'of utmost importance, basic, indispensable, and necessary for the healthcare needs of the population'. The concept was mentioned in one of the ten points of the 1978 Alma Ata Declaration on primary health care.

The difficulty of putting this into practice is reflected in the rather longer and more categorical 2002 definition:

'Essential medicines are those that satisfy the priority health care needs of the population. They are selected with due regard to public health relevance, evidence on efficacy and safety, and comparative cost-effectiveness. Essential medicines are intended to be available within the context of functioning health systems at all times in adequate amounts, in the appropriate dosage forms, with assured quality and adequate information, and at a price the individual and the community can afford. The implementation of the concept of essential medicines is intended to be flexible and adaptable to many different situations; exactly which medicines are regarded as essential remains a national responsibility.

The *WHO Model List of Essential Medicines* has been updated every two years since 1977. The current version, the 15th list, dates from March 2007.

COST-TO-BENEFIT RATIO

Cost effectiveness is the subject of fierce debate between producers (pharmaceutical companies) and purchasers of drugs (national health services).

NUMBER OF DRUGS

The number of drugs has nearly doubled, from 186 in 1977 to 320 in 2002. The range has increased substantially over the years and now includes antimigraine drugs, antidotes, and antineoplastic drugs.

DRUG ABUSE

- Drug abuse
- Public health definitions
- Medical definitions
- Historical medical use of the term
- Potential for harm
- Legal approaches

A state of kind of compulsion to take drug continuously or periodically to experienced its psychic effects and obtained relief from tension, emotional discomfort or physical dependence called as drug abuse. It is three main types,

- Habitual drug abuse
- Emotional drug abuse
- Psychological drug abuse

It has a wide range of definitions related to taking a psychoactive drug or performance enhancing drug for a non-therapeutic or non-medical effect. All of these definitions imply a negative judgement of the drug use in question (compare with the term responsible drug use for alternative views). Some of the drugs most often associated with this term include alcohol, amphetamines, barbiturates, benzodiazepines, cocaine, methaqualone, and opium alkaloids. Use of these drugs may lead to criminal penalty in addition to possible physical, social, and psychological harm, both strongly depending on local jurisdiction. Other definitions of drug abuse fall into four main categories: public health definitions, mass communication and vernacular usage, medical definitions, and political and criminal justice definitions.

An estimated 5.6 of the global population aged 15 to 64, or 185 million people, consume illicit drugs annually.

PUBLIC HEALTH DEFINITIONS

Public health practitioners have attempted to look at drug abuse from a broader perspective than the individual, emphasising the role of society, culture and availability. Rather than accepting the loaded terms alcohol or drug "abuse," many public health professionals have adopted phrases such as "alcohol and drug problems" or "harmful/problematic use" of drugs.

The Health The mental health insttitional of hold deez of British Columbia — in their 2005 policy discussion paper, *A Public Health Approach to Drug Control in Canada* — has adopted a public health model of psychoactive substance use that challenges the simplistic black-and-white construction of the binary (or complementary) antonyms "use" vs. "abuse". This model explicitly recognizes a spectrum of use, ranging from beneficial use to chronic dependence (see diagram to the right).

MEDICAL DEFINITIONS

In the modern medical profession, the two most used diagnostic tools in the world, the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM) and the World Health Organization's International Statistical Classification of Diseases and Related Health Problems (ICD), no longer recognise 'drug abuse' as a current medical diagnosis. Instead, they have adopted *substance abuse* as a blanket term to include drug abuse and other things. Physical dependence, abuse of, and withdrawal from drugs and other miscellaneous substances is outlined in the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR)). It's section Substance dependence begin with:

*"**Substance dependence** When an individual persists in use of alcohol or other drugs despite problems related to use of the substance, substance dependence may be diagnosed. Compulsive and repetitive use may result in tolerance to the effect of the drug and withdrawal symptoms when use is reduced or stopped. This, along with Substance Abuse are considered Substance Use Disorders...."*

However, other definitions differ; they may entail psychological or physical *dependence* , and may focus on treatment and prevention in terms of the social consequences of substance uses.

POTENTIAL FOR HARM

Depending on the actual compound, drug use may lead to health problems, social problems, physical dependence, or psychological addiction.

Drug abuse makes central nervous system (CNS) effects, which produce changes in mood, levels of awareness or perceptions and sensations. Most of these drugs also alter systems other than the CNS. Some of these are often thought of as being abused. Some drugs appear to be more likely to lead to uncontrolled use than others.

Traditionally, new pharmacotherapies are quickly adopted in primary care settings, however, drugs for substance abuse treatment have faced many barriers. Naltrexone, a drug originally marketed under the name "ReVia," and now marketed in intramuscular formulation as "Vivitrol" or in oral formulation as a generic, is a medication approved for the treatment of alcohol dependence. This drug has reached very few patients. This may be due to a number of factors, including resistance by Addiction Medicine specialists and lack of resources.

LEGAL APPROACHES

Related articles: Prohibition (drugs), Arguments for and against drug prohibition

Most governments have designed legislation to criminalise certain types of drug use. These drugs are often called "illegal drugs" but generally what is illegal is their unlicensed production, distribution, and possession. These drugs are also called "controlled substances". Even for simple possession, legal punishment can be quite severe (including the death penalty in some countries). Laws vary across countries, and even within them, and have fluctuated widely throughout history.

Attempts by government-sponsored drug control policy to interdict drug supply and eliminate drug abuse have been largely unsuccessful. In spite of the huge efforts by the U.S., drug supply and purity has reached an all time high, with the vast majority of resources spent on interdiction and law enforcement instead of public health. In the United States, the number of nonviolent drug offenders in prison exceeds by 100,000 the total incarcerated population in the EU, despite the fact that the EU has 100 million more citizens.

Despite drug legislation (and some might argue because of it), large, organized criminal drug cartels operate world-wide. Advocates of decriminalization argue that drug prohibition makes drug dealing a lucrative business, leading to much of the associated criminal activity.

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Chapter 4.

MEDICAL PRESCRIPTION

Prescription is the complex mix of rational and emotion process with the intention of the patient recovery. It is a scientific way to forward/ communicate the medication or procedure to treat any medical complication. This chapter comprised of all the aspects of prescription i.e. format, definition, contents, handling, forgeries, prevention, legibility, abbreviations, non-prescribing drug prescriptions and related usage of this term. There also certain samples of definitions, storage, security, format and information added by the pharmacist are given for help and guidance.

Chapter 4.

MEDICAL PRESCRIPTION

- Prescription
- Prescription drugs
- Format and definition
- Format and definition
  - Contents
  - Handling
  - Forgeries and prevention
- Writing prescriptions
  - Who can write prescriptions
  - Legibility
  - Conventions for avoiding ambiguity
  - Abbreviations
- Non-prescription drug prescriptions
- Related usage of the term prescription
- History
- Use of Technology
- Exhibit A: sample legal definition of a prescription
- Exhibit B: sample legal requirement for storage of prescriptions
- Exhibit C: sample legal requirements for security and format
- Exhibit D: sample requirements on information added by the pharmacist
- Exhibit E: New Jersey requirements for prescription blanks

A written direction for the preparation and administration of a remedy called prescription and denoted as (℞).

The complex mix of rational and emotion process with the intention of the patient recovery called prescription.

A prescription is a health-care program implemented by a physician or other medical practitioner in the form of instructions that govern the plan of care for an individual patient. Prescriptions may include orders to be performed by a patient, caretaker, nurse, pharmacist or other therapist. Commonly, the term *prescription* is used to mean an order to take certain medications. Prescriptions are often written, though they may be entered electronically via a computerized physician order entry (also called a computerized prescriber order entry system), or electronic prescribing. Alternatively, they may be issued verbally to the patient, a nurse, a pharmacist or other therapist. Prescriptions have legal implications, as they may indicate that the prescriber takes responsibility for the clinical care of the patient and in particular for monitoring efficacy and safety.

PRESCRIPTION DRUG

A prescription drug is a licensed medicine that is regulated by legislation to require a prescription before it can be obtained. The term is used to distinguish it from over-the-counter drugs which can be obtained without a prescription. Different jurisdictions have different definitions of what constitutes a prescription drug.

Dispensation of prescription drugs often includes a package insert (in Europe, a Patient Information Leaflet or PIL) that gives detailed information about the drug.

The two symbols most commonly associated with pharmacy are the mortar and pestle and the ℞ (*recipere*) character, which is often written as "rx" in typed text. The show globe was also used in English speaking countries until the early 20th century. Pharmacy organizations often use other symbols, such as the Bowl of Hygieia, conical measures, and caduceuses in their logos.

Other symbols are common in different countries: the green Greek cross in France, Argentina, the United Kingdom, Belgium, and Spain, the increasingly-rare Gaper in The Netherlands, and a red stylized letter A in Germany and Austria (from *Apotheke*, the German word for pharmacy, from the same Greek root as the English word 'apothecary').

FORMAT AND DEFINITION

Prescriptions are either entered into a Computer physician order entry system, handwritten on preprinted prescription forms that are assembled into pads, or alternatively printed onto similar forms using a computer printer. Preprinted on the form is text that identifies the document as a prescription, the name and address of the prescribing provider and any other legal requirement such as a registration number (e.g. DEA Number in the United States). Unique for each prescription is the name of the patient. In the United Kingdom the patient's name and address must also be recorded. Each prescription is dated and some jurisdictions

may place a time limit on the prescription. There is the specific "recipe" of the medication and the directions for taking it. Finally there is the medical practitioner's signature.

The symbol "R_x" meaning "prescription" is a transliteration of a symbol resembling a capital *R* with a cross on the diagonal (℞).

There are various theories about the origin of this symbol - some note its similarity to the Eye of Horus, others to the ancient symbol for Jupiter, both gods whose protection may have been sought in medical contexts. Alternatively, it may be intended as an abbreviation of the Latin "recipe", the imperative form of "recipere", "to take or take thus", and it is quite possible that more than one of these factors influenced its form. Literally, "Recipe" means simply "Take...." and when a medical practitioner writes a prescription beginning with "Rx", he or she is completing the command. This was probably originally directed at the pharmacist who needed to *take* a certain amount of each ingredient to compound the medicine, rather than at the patient who must "take" the medicine, in the sense of consuming it.

The word "prescription" can be decomposed into "pre" and "script" and literally means, "to write before" a drug can be prepared. Those within the industry will often call prescriptions simply "scripts".

Contents

Both pharmacists and prescribers are regulated professions in most jurisdictions. A prescription as a communications mechanism between them is also regulated and is a legal document. Regulations may define what constitutes a prescription, the contents and format of the prescription (including the size of the piece of paper - see Exhibit C paragraph 10) and how prescriptions are handled and stored by the pharmacist. Many jurisdictions will now allow faxed or phone prescriptions containing the same information. Exhibit A below illustrates the legal definition of a prescription.

Drug companies use direct-to-prescriber advertising in an effort to convince prescribers to dispense as written with brand-name products rather than generic drugs.

Many brand name drugs have less expensive generic drug substitutes that are therapeutically equivalent. Prescriptions will also contain instructions on whether the prescriber will allow the pharmacist to substitute a generic version of the drug. This instruction is communicated in a number of ways.

In some jurisdictions, the preprinted prescription contains two signature lines: one line has "dispense as written" printed underneath; the other line has "substitution permitted" underneath. Some have a preprinted box "dispense as written" for the prescriber to check off (but this is easily checked off by anyone with access to the prescription). Other jurisdictions the protocol is for the prescriber to handwrite one of the following phrases: "dispense as written", "DAW", "brand necessary", "do not substitute", "no substitution", "medically necessary", "do not interchange".

As a guideline, pediatric prescriptions should include the age of the child if the patient is less than twelve and the age and months if less than five. (In general, including the age on the prescription is helpful.) In some jurisdictions, it may be a legal requirement to include the age of child on the prescription. Adding the weight of the child is also helpful.

Prescriptions often have a "label" box. When checked, pharmacist is instructed to label the medication. When not checked, the patient only receives instructions for taking the medication and no information about the prescription itself.

Some prescribers further inform the patient and pharmacist by providing the indicator for the medication; i.e. what is being treated. This assists the pharmacist in checking for errors as many common medications can be used for multiple medical conditions.

Some prescriptions will specify whether and how many "repeats" or "refills" are allowed; that is whether the patient may obtain more of the same medication without getting a new prescription from the medical practitioner. Regulations may restrict some types of drugs from being refilled.

In group practices, the preprinted portion of the prescription may contain multiple prescribers' names. Prescribers typically circle themselves to indicate who is prescribing or there may be a checkbox next to their name.

Handling

When filled by a pharmacist, as a matter of business practice, the pharmacist may write certain information right on the prescription. This may also be mandated by legislation (see Exhibit D). Information such as the actual manufacturer of the drug and the date the medication was dispensed may be written right onto the prescription. Legislation may require the pharmacist sign the prescription. In computerized pharmacies, all such information is printed and stapled to the prescription. Sometimes such information is printed onto labels and the labels affixed right onto the prescription.

When filled by the pharmacist, prescriptions are typically assigned a "prescription number" (often abbreviated "Rx#" in the US) that is unique to the pharmacy that filled the prescription. The prescription number is written right on the prescription by the pharmacist. The prescription number has the practical purpose of uniquely identifying the prescription later on while filed (both manual and electronic). The prescription number is also put on the label on the dispensed medication. The patient may be required to reference the prescription number for refills and drug insurance claims. There may also be a legal requirement for prescription numbers for subsequent identification purposes.

As a legal document, some jurisdictions will mandate the archiving of the original paper prescription in the pharmacy. Often the patient cannot take the original prescription with them. Some jurisdictions may entitle patients to a copy. The retention period varies but can be as long as six years. See Exhibit B for sample legislation governing the archiving of prescriptions. Once the retention period has passed, privacy legislation may dictate what can be done with the original paper prescription. Legislation may also dictate what happens to the prescriptions if the pharmacy closes or is sold. For example, if the pharmacy goes out of business, the pharmacist may be required to return the prescription to the patient, to the next closest pharmacy or to the governing body for pharmacists.

Prescriptions for non-narcotic drugs may also be "transferred" from one pharmacy to another for subsequent repeats to be dispensed from another pharmacy. The physical piece of paper that is the prescription is not transferred, but all the information on it is transferred from one pharmacy to another. Legislation may dictate the protocol by which the transfer occurs and whether the transfer needs to be noted on the original paper prescription.

It is estimated that 3 billion (3 thousand million) prescriptions were written in the United States in 2002. This number has grown from 1.5 billion in 1989 and is expected to continue to grow.

Forgeries and prevention

Prescriptions are sometimes forged because many narcotics are cheaper and safer as prescription drugs than as street drugs. Forgery takes many forms: Prescription pads are sometimes stolen, amounts may be altered on legitimate prescriptions, call back numbers may be falsified and phoned or faxed prescriptions faked.

Some medical practitioners will use prescription pads that contain similar security measures as checks to make photocopying prescriptions harder. These security measures may be mandated by law—see Exhibit C for sample legal specifications. Legislation may mandate that only certain printers may print prescriptions. New Jersey, for example, requires that only state approved printers may be used to print official "New Jersey Prescription Blanks. (See Exhibit E.) Prescribers can make it harder for amount forgeries by writing out the amounts in words. Again, this may be mandated by law.

Some jurisdictions help control stolen prescriptions by requiring special "triplicate prescriptions" for certain classes of drugs. Blank triplicates are only available from the regulating agency and are individually numbered. The medical practitioner retains a copy, the second and third copies are given to the patient to give to the pharmacist. The pharmacist retains the second copy and the third copy is submitted to the regulating agency. The regulating agency can issue lists of forged prescriptions that pharmacists can check. In this example, the prescription's validity is further limited to 72 hours from issuance. California has recently replaced triplicate forms with new forms that are impossible to photocopy or fax: the background is printed with repetitions of the word *void* in a color that shows up as black on a photocopy.

States have various laws making theft of prescription blanks or forgery of prescriptions criminal offenses and/or providing special treatment for these offenses (for Example N.J. Stat. 2C:21-1. making forgery of a prescription blank a third degree rather than fourth degree offense).

When forgery is suspected, pharmacists will call the medical practitioner to verify the prescription. Forged prescriptions are no longer considered medical documents and doctor-patient confidentiality rules no longer apply.

WRITING PRESCRIPTIONS

Who can write prescriptions

Who can issue prescriptions is governed by local legislation. In the United States medical practitioners, veterinarians, dentists, and podiatrists have prescribing power. In addition, pharmacists are allowed to prescribe in most states through the use of a drug formulary, and in some states as independent prescribers. In all states, optometrists prescribe medications to treat certain eye diseases, and also issue spectacle and contact lens prescriptions for corrective eyewear. States allow registered certified physician assistants (also known as physician associates or PAs) prescription powers in all 50 states. Registered pharmacists prescriptive authority in only 6 states. Several states have passed RxP legislation, allowing clinical psychologists (PhD's or PsyD's) who are registered as medical psychologists and have also undergone specialized training in script-writing to prescribe a limited number of drugs to treat emotional and mental disorders.

Legibility

Prescriptions, when handwritten, are notorious for being often illegible (5% according to an Irish study. In the US, medical practitioners' sloppy handwriting kills more than 7,000 people annually", "according to a July 2006 report from the National Academies of Science's Institute of Medicine (IOM)". Contrary to popular belief, pharmacists do not have special deciphering skills. Historically, physicians used Latin words and abbreviations to convey the entire prescription to the pharmacist. Today, many of the abbreviations are still widely used and must be understood to interpret prescriptions. At other times, even though some of the individual letters are illegible, the position of the legible letters and length of the word is sufficient to distinguish the medication based on the knowledge of the pharmacist. For prescribers that the pharmacist deals with regularly, they learn to read the prescriber's handwriting. When in doubt, pharmacists call the medical practitioner. Some jurisdictions have made legible prescriptions a law (e.g. Florida). Some have advocated the elimination of handwritten prescriptions

altogether and computer printed prescriptions are becoming increasingly common in some places.

Conventions for avoiding ambiguity

Over the years, prescribers have developed many conventions for prescription-writing, with the goal of avoiding ambiguities or misinterpretation. These include:

1 Careful use of decimal points to avoid ambiguity:

- Avoiding unnecessary decimal points: a prescription will be written as 5 mL instead of 5.0 mL to avoid possible misinterpretation of 5.0 as 50.
- Always using zero prefix decimals: e.g. 0.5 instead of .5 to avoid misinterpretation of .5 as 5.
- Avoiding trailing zeros on decimals: e.g. 0.5 instead of .50 to avoid misinterpretation of .50 as 50.
- Avoiding decimals altogether by changing the units: 0.5 g is less easily confused when written as 500 mg.

2 "mL" is used instead of "cc" or "cm³" even though they are technically equivalent to avoid misinterpretation of 'c' as '0' or the common medical abbreviation for "with" (the Latin "*cum*"), which is written as a 'c' with a bar above the letter. Further, cc could be misinterpreted as "c.c.", which is an uncommonly used abbreviation for "take with meals" (the Latin "*cum cibum*").

3 Directions written out in full in English (although some common Latin abbreviations are listed below).

4 Quantities given directly or implied by the frequency and duration of the directions.

5 Where the directions are "as needed", the quantity should always be specified.

6 Where possible, usage directions should specify times (7 am, 3 pm, 11 pm) rather than simply frequency (3 times a day) and especially relationship to meals for orally consumed medication.

7 The use of permanent ink.

8 Avoiding unspecified *prn* or "as needed" instructions—instead, specific limits and indicators are provided e.g. "every 3 hours prn pain."

9 For refills, the minimum duration between repeats and number of repeats should be specified.

10 Providing the indication for all prescriptions even when obvious to the prescriber, so that the pharmacist may identify possible errors.

11 Avoiding units such as "teaspoons" or "tablespoons."

12 Writing out numbers as words *and* numerals ("dispense #30 (thirty)") as in a bank draft or cheque.

13 The use of apothecary/avoirdupois units and symbols of measure -- pints (O), ounces (℥), drams (ʒ), scruples (℈), grains (gr), and minims is discouraged given the potential for confusion. For example, the abbreviation for a grain ("gr") can be confused with the gram, abbreviated g, and the symbol for minims, which looks almost identical to an 'm', can be confused with micrograms or meters. Also, the symbols for ounce (℥) and dram (ʒ) can easily be confused with the numeral '3', and the symbol for pint (O) can be easily read as a '0'. Given the potential for errors, metric equivalents should always be used.

14 The use of the degree symbol (°), which is commonly used as an abbreviation for hours (e.g., "q 2-4°" for every 2 - 4 hours), should not be used, since it can be confused with a '0'. Further, the use of the degree symbol for primary, secondary, and tertiary (1°, 2°, and 3°) is discouraged, since the former could be confused with quantities (i.e. 10, 20 and 30, respectively).

Abbreviations

See list of abbreviations used in medical prescriptions. Many abbreviations are derived from Latin phrases. Hospital pharmacies have more abbreviations, some specific to the hospital. Different jurisdictions follow different conventions on what is abbreviated or not. Prescriptions that don't follow area conventions may be flagged as possible forgeries.

Some abbreviations which are ambiguous, or which in their written form might be confused with something else, are not recommended and should be avoided. These are included in a separate list in Appendix 1. However, all abbreviations carry an increased risk for confusion and misinterpretation and should be used cautiously.

NON-PRESCRIPTION DRUG PRESCRIPTIONS

Prescriptions are also used for things that are not strictly regulated as a prescription drug. Prescribers will often give non-prescription drugs out as prescriptions because drug benefits plans may reimburse the patient only if the over-the-counter medication is taken under the direction of a medical practitioner. Conversely, if a medication is available over-the-counter, prescribers may ask patients if they want it as a prescription or purchase it themselves. Pharmacists may or may not be able to price the medication competively with over-the-counter equivalents. If the patient wants the medication not under prescription, the prescriber is usually careful to give the medication name to the patient on a blank piece of paper to avoid any confusion with a prescription. This is applied to non-medications as well. For example, crutches, and registered massage therapy may be reimbursed under some health plans, but only if given out by a prescriber as a prescription.

Prescribers will often use blank prescriptions as general letterhead. Legislation may define certain equipment as "prescription devices". Such prescription devices can only be used under the supervision of authorized personnel and such authorization is typically documented using a prescription. Examples of prescription devices include dental cement (for affixing braces to tooth surfaces), various prostheses, gut sutures, sickle cell tests, cervical cap and ultrasound monitor.

In some jurisdictions, hypodermic syringes are in a special class of their own, regulated as illicit drug use accessories separate from regular medical legislation. Such legislation will often specify a prescription as the means by which one may legally possess syringes.

RELATED USAGE OF THE TERM PRESCRIPTION

Prescription may also be used as a short form for prescription drugs to distinguish from over-the-counter drugs. In reference to the entire system of controlling drug distribution (as opposed to illicit drugs), "prescription" is often used as a metaphor for healthy directions from a prescribing medical practitioner. A "green prescription" is direction from a medical practitioner to a patient for exercise and healthy diet.

HISTORY

The concept of prescriptions dates back to the beginning of history. So long as there were medications and a writing system to capture directions for preparation and usage, there were prescriptions.

Modern prescriptions are actually "extemporaneous prescriptions" from the Latin (*ex tempore*) for "at/from time". "Extemporaneous" means the prescription is written on the spot for a specific patient with a specific ailment. This is distinguished from a non-extemporaneous prescription which is a generic recipe for a general ailment. Modern prescriptions evolved with the separation of the role of the pharmacists from that of the physician. Today the term "extemporaneous prescriptions" is reserved for "compound prescriptions" which requires the pharmacist to mix or "compound" the medication in the pharmacy for the specific needs of the patient.

Predating modern legal definitions of a prescription, a prescription traditionally is composed of four parts: a "superscription", "inscription", "subscription" and "signature".

The superscription section contains the date of the prescription and patient information (name, address, age, etc). The symbol "Rx" separates the superscription from the inscriptions sections. In this arrangement of the prescription, the "Rx" is a symbol for *recipe* or literally the imperative "take." This is an exhortation to the pharmacist by the medical practitioner, "I want the patient to have the following medication" - in other words, "take the following components and compound this medication for the patient."

The inscription section defines what the medication is. The inscription section is further composed of one or more of:

1. a "basis" or chief ingredient indended to cure (*curare*)
2. an "adjuvant" to assist its action and make it cure quickly (*cito*)
3. a "corrective" to prevent or lessen any undesirable effect (*tuto*)
4. a "vehicle" or "excipient" to make it suitable for administration and pleasant to the patient (*jucunde*)

The "subscription" section contains dispensing directions to the pharmacist. This may be compounding instructions or quantities.

The "signature" section contains directions to the patient and is often abbreviated "Sig." or "Signa." It also obviously contains the signature of the prescribing medical practitioner though the word "signature" has two distinct meanings here and the abbreviations are sometimes used to avoid confusion.

Thus sample prescriptions in modern textbooks are often presented as:

Rx: Medication

Disp.: Dispensing instructions

Sig.: Patient instructions

USE OF TECHNOLOGY

As a prescription is nothing more than information among a prescriber, pharmacist and patient, information technology can be applied to it. Existing information technology is adequate to print out prescriptions. Medical information systems in some hospitals do away with prescriptions within the hospital. There are proposals to securely transmit the prescription from the prescriber to the pharmacist using smartcard or the internet. In the United Kingdom a project called the Electronic Transfer of Prescriptions (ETP) within the National Programme for IT (NPfIT) is currently piloting such a scheme between prescribers and pharmacies.

Within computerized pharmacies, the information on paper prescriptions is recorded into a database. Afterward, the paper prescription is archived for storage and legal reasons.

A pharmacy chain is often linked together through corporate headquarters with computer networking. Walgreens, for example, uses satellite technology to share patient information. A person who has a prescription filled at one Walgreens can get a refill of that prescription at any other store in the chain, as well as have their information available for new prescriptions at any Walgreens.

Some online pharmacies also offer services to customers over the internet. Walgreens' web site, for example, allows customers to order refills for medicine over the internet, and allows them to specify the store that they will pick up the medicine from. Their web site also allows consumers to lookup their prescription history, and to print it out.

Many pharmacies now offer services to ship prescription refills right to the patient's home. CVS, for example, will ship refills free of charge. They also offer mail service where you can mail in a new, original prescription and a signed document, and they will ship the filled prescription back to you.

Pharmacy information systems are a potential source of valuable information for pharmaceutical companies as it contains information about the prescriber's prescribing habits. Prescription data mining of such data is a developing, specialized field.

Many prescribers lack the digitized information systems that reduce prescribing errors. To reduce these errors, some investigators have developed modified prescription forms that prompt the prescriber to provide all the desired elements of a good prescription. The modified forms also contain pre-defined choices such as common quantities, units and frequencies that the prescriber may circle rather than write out. Such forms are thought to reduce errors, especially omission and handwriting errors and are actively under evaluation. (See: Kennedy AG, Littenberg B. A Modified Outpatient Prescription Form to Reduce Prescription Errors. *Joint Commission Journal of Quality and Safety* 2004; 30:480-487.)

Exhibit A: Sample legal definition of a prescription

(a) "Prescription" means an oral, written, or electronic transmission order that is both of the following:

(1) Given individually for the person or persons for whom ordered that include all of the following:

(A) The name or names and address of the patient or patients.

(B) The name and quantity of the drug or device prescribed and the directions for use.

(C) The date of issue.

(D) Either rubber stamped, typed, or printed by hand or typeset, the name, address, and telephone number of the prescriber, his or her license classification, and his or her federal registry number, if a controlled substance is prescribed.

(E) A legible, clear notice of the condition for which the drug is being prescribed, if requested by the patient or patients.

(F) If in writing, signed by the prescriber issuing the order, or the certified nurse-midwife, nurse practitioner, or physician assistant who issues a drug order pursuant to Section 2746.51,2836.1, or 3502.1.

(2) Issued by a precribing medical practitioner if a drug order is issued pursuant to Section 2746.51, 2836.1, or 3502.1.

(b) Notwithstanding subdivision (a), a written order of the prescriber for a dangerous drug, except for any Schedule II controlled substance, that contains at least the name and signature of the prescriber, the name and address of the patient in a manner consistent with paragraph (3) of subdivision (b) of Section 11164 of the Health and Safety Code, the name and quantity of the drug prescribed, directions for use, and the date of issue may be treated as a prescription by the dispensing pharmacist as long as any additional information required by subdivision (a) is readily retrievable in the pharmacy. In the event of a conflict between this subdivision and Section 11164 of the Health and Safety Code, Section 11164 of the Health and Safety Code shall prevail.

(c) "Electronic transmission prescription" includes both image and data prescriptions. "Electronic image transmission prescription" means any prescription order for which a facsimile of the order is received by a pharmacy from a licensed prescriber. "Electronic data transmission prescription" means any prescription order, other than an electronic image transmission prescription, that is electronically transmitted from a licensed prescriber to a pharmacy.

(d) The use of commonly used abbreviations shall not invalidate an otherwise valid prescription.

(e) Nothing in the amendments made to this section (formerly Section 4036) at the 1969 Regular Session of the Legislature shall be construed as expanding or limiting the right that a chiropractor, while acting within the scope of his or her license, may have to prescribe a device.

Exhibit B: Sample legal requirement for storage of prescriptions

1. All prescriptions shall be filed in one of the following ways:

A. Three separate files may be maintained; a file for Schedule II prescriptions dispensed; a file for Schedule III, IV and V prescriptions dispensed; and a file for all other prescriptions dispensed.

B. Two files may be maintained; a file for all Schedule II prescriptions dispensed and another file for all other prescriptions dispensed, including those in Schedule III, IV and V. If this method is used, the prescriptions for Schedule III, IV and V substances must be stamped with the letter "C" in red ink, not less than one inch high, in the lower right-hand corner. This distinctive marking makes the records readily retrievable for inspection. Pharmacies with automatic data processing systems are exempted from marking Schedule III, IV and V controlled substance prescriptions with the red "C".

2. A hard copy of original prescriptions, whether records are maintained manually or in a data processing system, shall be assigned a serial number and maintained by the pharmacy in numerical and chronological order. All prescriptions shall be maintained for at least five years from the date of original dispensing.

3. If a pharmacy utilizes a data processing system for record keeping, all computer generated labels should be affixed to the prescription document in such a manner as not to obscure information on the face of the document.

Exhibit C: Sample legal requirements for security and format

Sec. 2. (a) All controlled substance prescriptions written by licensed Indiana practitioners, as defined by IC 16-42-19-5, must contain the following security features:

(1) A latent, repetitive "void" pattern screened at five percent (5%) in reflex blue must appear across the entire face of the document when the prescription is photocopied.

(2) There shall be a custom artificial watermark printed on the back side of the base paper so that it may only be seen at a forty-five (45) degree angle. The watermark shall consist of the words "Indiana Security Prescription", appearing horizontally in a step-and-repeated format in five lines on the back of the document using 12-point Helvetica bold type style.

(3) An opaque RX symbol must appear in the upper right-hand corner, one-eighth (1/8) of an inch from the top of the pad and five-sixteenths (5/16) of an inch from the right side of the pad. The symbol must be three-fourths (3/4) inch in size and must disappear if the prescription copy is lightened.

(4) Six (6) quantity check-off boxes must be printed on the form and the following quantities must appear and the appropriate box be checked off for the prescription to be valid:

(A) 1-24

(B) 25-49

(C) 50-74

(D) 75-100

(E) 101-150

(F) 151 and over.

(5) No advertisements may appear on the front or back of the prescription blank.

(6) Logos, defined as a symbol utilized by an individual, professional practice, professional association, or hospital, may appear on the prescription blank. The upper left one (1) inch square of the prescription blank is reserved for the purpose of logos. Only logos, as defined by this subdivision, may appear on the prescription blank.

(7) Only one (1) prescription may be written per prescription blank. The following statement must be printed on the bottom of the pad: "Prescription is void if more than one (1) prescription is written per blank.".

(8) Refill options that can be circled by the prescriber must appear below any logos and above the signature lines on the left side of the prescription blank in the following order: Refill NR 1 2 3 4 5 Void after_____.

(9) Practitioner name and state issued professional license number must be preprinted, stamped, or manually printed on the prescription.

(10) All prescription blanks printed under this rule shall be four and one-fourth (4-1/4) inches high and five and one-half (5-1/2) inches wide.

(b) Nothing in this rule shall prevent licensed Indiana practitioners from utilizing security paper prescriptions for the prescribing of any legend drug. (Indiana Board of Pharmacy; 856 IAC 1-34-2; filed Jul 5, 1995, 9:45 a.m.: 18 IR 2782, eff Jan 1, 1996)

Exhibit D: sample requirements on information added by the pharmacist

Taken from the Ontario's *Drug and Pharmacies Regulation Act*, paragraph 156.

(1) Every person who dispenses a drug pursuant to a prescription shall ensure that the following information is recorded on the prescription,

(a) the name and address of the person for whom the drug is prescribed;

(b) the name, strength (where applicable) and quantity of the prescribed drug;

(c) the directions for use, as prescribed;

(d) the name and address of the prescriber;

(e) the identity of the manufacturer of the drug dispensed;

(f) an identification number or other designation;

(g) the signature of the person dispensing the drug and, where different, also the signature of the person receiving a verbal prescription;

(h) the date on which the drug is dispensed;

(i) the price charged. R.S.O. 1990, c. H.4, s. 156 (1).

Exhibit E: New Jersey requirements for prescription blanks

From New Jersey official statutes:

45:14-55 Use of New Jersey Prescription Blanks.

16. a. A practitioner practicing in this State shall use non-reproducible, non-erasable safety paper New Jersey Prescription Blanks bearing that practitioner's license number whenever the practitioner issues prescriptions for controlled dangerous substances, prescription legend drugs or other prescription items. The prescription blanks shall be secured from a vendor approved by the Division of Consumer Affairs in the Department of Law and Public Safety.

b. A licensed practitioner practicing in this State shall maintain a record of the receipt of New Jersey Prescription Blanks. The practitioner shall notify the Office of Drug Control in the Division of Consumer Affairs as soon as possible but no later than 72 hours of being made aware that any New Jersey Prescription Blank in the practitioner's

possession has been stolen. Upon receipt of notification, the Office of Drug Control shall take appropriate action, including notification to the Department of Human Services and the Attorney General.

45:14-56 Health care facility prescriptions.

17. a. Prescriptions issued by a health care facility licensed pursuant to P.L.1971, c.136 (C.26:2H-1 et seq.) shall be written on non-reproducible, non-erasable safety paper New Jersey Prescription Blanks. The prescription blanks shall be secured from a vendor approved by the Division of Consumer Affairs in the Department of Law and Public Safety. The New Jersey Prescription Blanks shall bear the unique provider number assigned to that health care facility for the issuing of prescriptions for controlled dangerous substances, prescription legend drugs or other prescription items.

b. A health care facility shall maintain a record of the receipt of New Jersey Prescription Blanks. The health care facility shall notify the Office of Drug Control in the Division of Consumer Affairs as

soon as possible but no later than 72 hours of being made aware that any New Jersey Prescription Blank in the facility's possession has been stolen. Upon receipt of notification, the Office of Drug Control shall take appropriate action including notification to the Department of Human Services and the Attorney General.

45:14-57 Requirements for prescription to be filled.

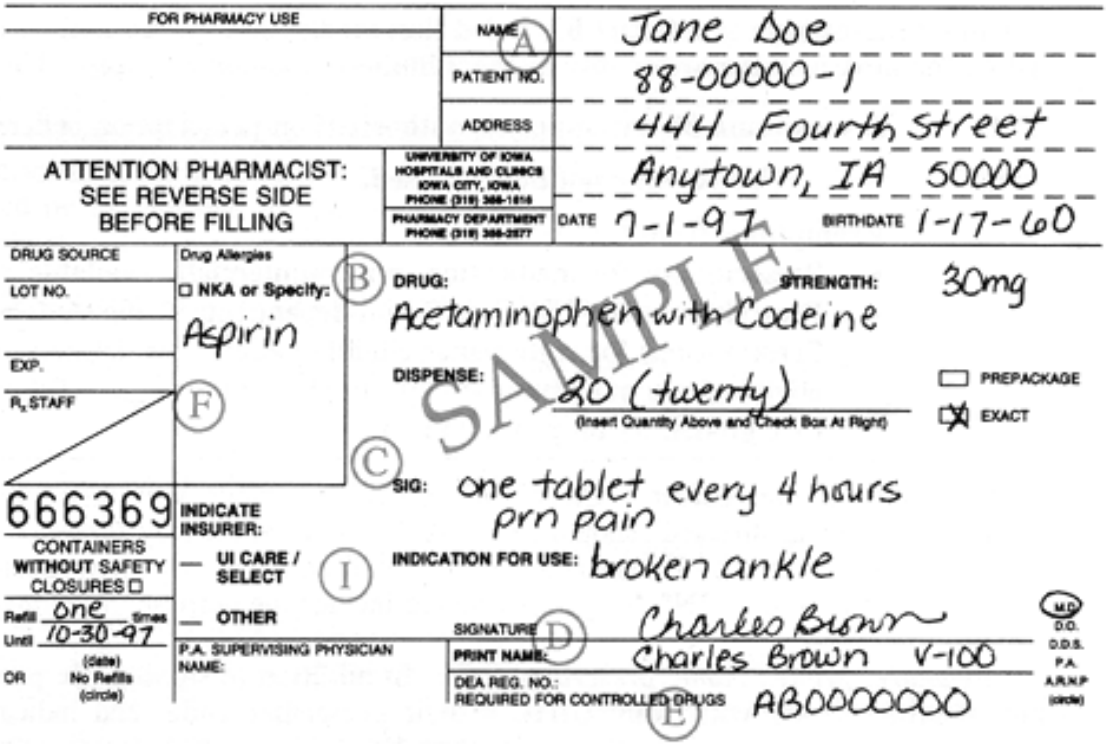
18.A prescription issued by a practitioner or health care facility licensed in New Jersey shall not be filled by a pharmacist unless the prescription is issued on a New Jersey Prescription Blank bearing the practitioner's license number or the unique provider number assigned to a health care facility.

45:14-59 Format for New Jersey Prescription Blanks.

20.The Division of Consumer Affairs in the Department of Law and Public Safety shall establish the format for uniform, non-reproducible, non-erasable safety paper prescription blanks, to be known as New Jersey Prescription Blanks, which format shall include an identifiable logo or symbol that will appear on all prescription blanks. The division shall approve a sufficient number of vendors to ensure production of an adequate supply of New Jersey Prescription Blanks for practitioners and health care facilities statewide.

Guidelines for complete, sage and accurate discharge and outpatient prescription writing

One of the primary communication links between the prescriber, pharmacist, and patient is complete, safe and accurate prescription writing. Completion of all “essential elements” of a prescription will assure that it is accurately interpreted and not subject to alteration. Attention to detail when writing prescriptions will prevent the need for the Department of Pharmaceutical Care to contact the prescriber to clarify prescriptions and reduce patient delays. Properly written prescriptions will help ensure continuity of care in the patient’s local community.



Duplicate Prescription System

The Duplicate Prescription System is structured to produce an original and exact copy of the medication order. Under this system, the Department of Pharmaceutical Care is authorized to dispense the take home supply of medication from the copy of the prescription and return the original prescription to the patient to obtain continuing supplies in the local community. The use of other, nonstandard prescription blanks within the is not authorized.

The "essential elements" of a prescription are depicted in the preceding figure of a prescription and described.

(A) Patient name, address, hospital number, birthdates and date prescription is written. This information may be transmitted to the prescription by using the patient's addressograph plate. The hospital number is essential to assure that the intended patient receives, and is billed for, the correct medication.

(B) The name, strength, and quantity of the drug. Medications should be ordered by the generic name, not by the proprietary or trade names.

Hospital policy and the Joint Commission on Accreditation of Healthcare Organizations standards permit the use of drug name abbreviations in medication orders only if the abbreviation has been specifically approved by the hospital and it appears on a published list. "Coined" abbreviations such as HCTZ, AZT, T3, MSO4, and ddC are not acceptable medical abbreviations, may be misinterpreted, and may cause drug errors. Medication orders that contain nonapproved drug name abbreviations are not valid. Pharmacists are authorized to withhold dispensing of medications ordered via nonapproved abbreviations.

A separate prescription blank must be used for each drug prescribed. Multiple prescriptions on a single blank are unsafe and greatly increase the potential for medication errors.

For Drug Enforcement Administration (DEA) narcotics and controlled substances, including anabolic steroids, the quantity should be written in words as well as numbers to prevent alteration of the prescription.

The quantity of drug to be dispensed should be indicated. Outpatient prescriptions should be written for no more than a 30 day supply with continuing supplies to be prescribed as refills. In order to minimize patient delays, the pharmacist is authorized to round the quantity dispensed to the nearest available prepackage quantity (usually a one month supply) only for prescriptions with refills authorized.

Outpatient Prescription Medication Supply Limits

The United States Supreme Court has ruled that medications purchased by hospitals (at special institutional prices) must be for inpatient use or for dispensing a limited take home supply. The following rules must apply:

1. A maximum 30 day supply is authorized on prescription orders.

2. Refill requests may not be processed.

3. Exemptions from the above rules:

- Prescriptions for medications not commercially available.
- Prescriptions for staff and dependents at the same address.
- Prescriptions for state paper eligible patients (as defined by policy). These patients are eligible for a maximum 90 day supply with a single refill of specific maintenance medications. (See guidelines on pages 9 to 10.)

(C) Directions to the patient. Clear and concise directions will assist your patient in the appropriate use of the medication. "Take as directed" should be avoided. Your patient may forget or confuse verbal directions or lose a separate note. The Department of Pharmaceutical Care will complete a patient medication calendar for tapered or intermittent dosage schedules. The "PRN" designation should include the purpose of the medication (e.g., PRN sleep, PRN pain).

(D) Signature, printed name, prescriber code. In addition to signing the prescription, print your name legibly below your signature along with your " digit prescriber code, and indicate your practitioner status by circling the appropriate initials to the right of the signature line. This will facilitate communications with health care practitioners throughout the state who have a need to accurately identify the prescriber and it will also decrease the possibility of forgery. To prevent illegal drug diversion, supplies of prescription blanks may not be signed by the prescriber in advance of use. Prescriptions must only be signed by the prescriber at the time prescriptions are written for a specific patient. Physician assistants must also indicate the name of their supervising physician in the designated space.

(E) DEA number. Your personal Drug Enforcement Administration (DEA) registration number (or the DEA registration number for eligible practitioners) with your personal 4 digit prescriber code must be included on all prescriptions for drugs classified as controlled substances. This step is a safety mechanism to prevent prescription forgery because each DEA number can be checked to verify

its validity. When your DEA number is omitted, it is illegal for any pharmacy to fill the prescription. Pharmacy does not have a list of every prescriber's DEA number; therefore, this omission causes your patient to be inconvenienced until the deficiency is corrected.

Physician assistants and advanced registered nurse practitioners are authorized to prescribe controlled substances after obtaining a mid level practitioner's registration from the DEA. However, physician assistants are not authorized to prescribe Schedule II substances listed as stimulants or depressants.

Applications forms for personal DEA registration and instructions for completion are available at the Pharmacy Office.

(F) Drug allergies. The patient's medication allergies should be specified in this space on one of the prescriptions for each set of prescriptions. If there are no known allergies, please check the box next to "NKA." The pharmacist will obtain or confirm allergy information with the patient as necessary at the time the prescription is presented to the Ambulatory Care Pharmacy.

(G) Containers without safety closures. "Childproof" containers with safety closures are used for dispensing all prescription medications (with limited exceptions) in accordance with the Federal Poison Prevention Packaging Act of 1970. You may indicate the need for nonsafety closures for a patient for whom childproof containers may cause difficulty by checking the designated box.

(H) Refill designation. Always circle "no refills" or specify the number of times and/or the last date the prescription may be refilled. "PRN" is not a valid refill designation.

Prescriptions may be refilled at the Department of Pharmaceutical Care ONLY for hospital staff and dependents at the same address or for patients whose medications are not commercially available. Prescriptions for these eligible patients groups (excluding controlled substances) may be refilled a maximum of 11 times or for 12 months whichever is less. Prescriptions for DEA controlled substances in Schedules III, IV, and V may be refilled a maximum of five times or for six months whichever is less. Prescriptions for Schedule II controlled substances may not be refilled.

(I) Indication for Use. The indication for use should be specified in this space for each prescription. This information permits the pharmacist to reinforce prescriber instructions with the patient and helps the patient understand what the medications are for. Federal regulations require the pharmacist to obtain information on the patient's disease state(s) so that appropriate utilization review and counseling can occur.

Source: www.healthcare.uiowa.edu

Chapter 5.

RESEARCH STUDIES AND CLINICAL TRIALS

This chapter illustrates the study designs most frequently encountered in the medical literature. In medical research, subjects are observed or experiments are undertaken. Experiments involving humans are called trials. Experimental studies may also use animals and tissue, although we did not discuss them as a separate category; the comments pertaining to clinical trials are relevant to animal and tissue studies as well.
Each type of study discussed has advantages and disadvantages. Randomized, controlled clinical trials are the most powerful designs possible in medical research, but they are often expensive and time-consuming. Well-designed observational studies can provide useful insights on disease causation, even though they do not constitute proof of causes. Cohort studies are best for studying the natural progression of disease or risk factors for disease; case–control studies are much quicker and less expensive. Cross-sectional studies provide a snapshot of a disease or condition at one time, and we must be cautious in inferring disease progression from them. Surveys, if properly done, are useful in obtaining current opinions and practices. Case–series studies should be used only to raise questions for further research.
We have used several presenting problems to illustrate different study designs. We will point out salient features in the design of the presenting problems as we go along, and we will return to the topic of study design again after all the prerequisites for evaluating the quality of journal articles have been presented.

STUDY DESIGN IN PHARMACEUTICAL RESEARCH

BIOASSAY
- Uses of Bioassay
- Standards used in Bioassay
- Designing the Bioassays
- Quantal and graded responses

CLASSIFICATION OF STUDY DESIGNS

I OBSERVATIONAL STUDIES

A Case–Series Studies/ Retrospective study

B Case–Control Studies

C Cross-Sectional Studies
- Diagnosing or Staging a Disease
- Evaluating Different Methods of Doing the Same Thing
- Establishing Norms
- Surveys

D Cohort Studies/ prospective studies
- Outcome Assessment

E Historical Cohort Studies
- Comparison of Case–Control and Cohort Studies

II EXPERIMENTAL STUDIES OR CLINICAL TRIALS

HISTORY OF CLINICAL TRIALS

TYPES OF CLINICAL TRIALS

DESIGNING THE CLINICAL TRIALS

CLINICAL TRIAL PROTOCOL

DESIGN FEATURES
- Informed consent
- Statistical power

PHASES OF CLINICAL TRIALS
- Pre-clinical studies
- Phase 0
- Phase I
- Phase II

Trial design
- Phase III
- Phase IV

A CONTROLLED TRIALS:
- Trials in healthcare
- Trials with parallel or Independent Concurrent Controls
- Aspects of control in research studies
- Types of control groups
- Randomized Controlled Trials
- Randomization in research studies
- Randomization procedures

1 Complete randomization

2 Permuted block randomization

3 Covariate-adaptive randomization

4 Outcome-adaptive randomization
- Allocation concealment
- Nonrandomized Trials
- Trials with Self-Controls
- Crossover study
- Trials with External Controls

B UNCONTROLLED STUDIES

III QUASI-EXPERIMENTAL STUDY
- Design
- Advantages
- Disadvantages

IV META-ANALYSIS & REVIEW PAPERS

ADVANTAGES & DISADVANTAGES OF DIFFERENT STUDY DESIGNS
- Advantages & Disadvantages of Clinical Trials
- Advantages & Disadvantages of Cohort Studies
- Advantages & Disadvantages of Case–Control Studies
- Advantages & Disadvantages of Cross-Sectional Studies
- Advantages & Disadvantages of Case–Series Studies

V DIFFICULTIES
- Outside pressure
- Statistical error
- Blinding problems
- Medical applications
- Forensic application
- Study duration
- Administration of clinical trials
- Ethical conduct
- Safety
- Assuring the sponsorship
- Assuring safety by Local site investigators
- Institutional review board (IRBs)
- Role of regulatory agencies
- Accidents

FINANCIAL ISSUES
- Sponsor
- Investigators
- Patients
- Participating criteria in a clinical trial

This chapter introduces the different kinds of studies commonly used in medical research. Because we believe that knowing how a study is designed is important for understanding the conclusions that can be drawn from it, we have chosen to devote considerable attention to the topic of study designs.

If you are familiar with the medical literature, you will recognize many of the terms used to describe different study designs. If you are just beginning to read the literature, you should not be dismayed by all the new terminology; there will be ample opportunity to review and become familiar with it. Also, the glossary at the end of the book defines the terms we use here. In the final chapter of this book, study designs are reviewed within the context of reading journal articles, and pointers are given on how to look for possible biases that can occur in medical studies. Bias can be due to the manner in which patients are selected, data are collected and analyzed, or conclusions are drawn.

Research is a highly intellectual job, that not only demand the professional relevant expertise but also sufficient personal involvement to get some solution of already described problem. Different disciplines follow their typical protocols and research methodologies with accordance of requirement of their studies and experiments. The research proposals, outlines or synopsis also recommended by certain institutions to frame out the study. When choosing a study design, many factors must be taken into account. Different types of studies are subject to different types of bias. For

example, recall bias is likely to occur in cross-sectional or case-control studies where subjects are asked to recall exposure to risk factors. Subjects with the relevant condition (e.g. breast cancer) may be more likely to recall the relevant exposures that they had undergone (e.g. hormone replacement therapy) than subjects who don't have the condition. The ecological fallacy may occur when conclusions about individuals are drawn from analyses conducted on grouped data. The nature of this type of analysis tends to overestimate the degree of association between variables.

BIOASSAY

Bioassay is the estimation of the concentration or potency of a substance by measurement of the biological response that it produces. It is actually the methods for measuring drug effects needed to compare the properties of different substances, under different circumstances, requirements and techniques. It is an extension to studies in human beings that describe the development of animal models to bridge the predictive gap between animal physiology and human disease. That also used to evaluate therapeutic efficacy in a clinical setting. Experimental design and statistical analysis are central to the interpretation of all types of data.

Uses of Bioassay

The uses of bioassay are as given below,

- to measure the pharmacological activity of new or chemically undefined substances
- to investigate the function of endogenous mediators
- to measure drug toxicity and unwanted effects.
- to develop of new drugs
- to measure the *concentration* of drugs and other active substances in the blood or other body fluids, an application now superseded by analytical chemistry techniques(often used in the past).
- to study the new hormonal or other chemically mediated control systems. Mediators in such systems are often first recognised by the biological effects that they produce. The first clue may be the finding that a tissue extract or some other biological sample produces an effect on an assay system. For example, the ability of extracts of the posterior lobe of the pituitary to produce a rise in blood pressure and a contraction of the uterus was observed at the beginning of the 20th century. These actions were developed as quantitative assay procedures, and a standard preparation of the extract was established by international agreement in 1935. By use of these assays, it was shown that two distinct peptides-*vasopressin* and *oxytocin* -were responsible, and they were eventually identified and synthesized in 1953. Biological assay had already revealed much about the synthesis, storage and release of the hormones, and was essential for their purification and identification. Nowadays, it does not take 50 years of laborious bioassays to identify new hormones before they are chemically characterised,[2] but bioassay still plays a key role.

Standards used in Bioassay

Biological assays are designed to measure the *relative* potency of two preparations, usually a standard and an unknown. The best kind of standard is, of course, the pure substance, but it may be necessary to establish standard preparations of various hormones, natural products and antisera against which laboratory samples can be calibrated, even though the standard preparations are not chemically pure.

Designing the Bioassays

Given the aim of comparing the activity of two preparations, a standard (S) and an unknown (U) on a particular preparation, a bioassay must provide an estimate of the dose or concentration of U that will produce the same biological effect as that of a known dose or concentration of S. The log dose-effect curves for S and U are parallel, the ratio, M, of equiactive doses will not depend on the magnitude of response chosen. Thus M provides an estimate of the potency ratio of the two preparations. A comparison of the

magnitude of the effects produced by equal doses of S and U does not provide an estimate. The main problem with all types of bioassay is that of biological variation, and the design of bioassays is aimed at: minimizing variation and avoiding systematic errors resulting from variation

Quantal and graded responses

An assay may be based on a *graded response* (e.g. change in blood glucose concentration, contraction of a strip of smooth muscle, change in the time taken for a rat to run a maze), or on *all-or-nothing responses* (e.g. death, loss of righting reflex, success in maze running within a stipulated time). With the latter, sometimes known as a *discontinuous* or *quantal response*, the proportion of animals responding will increase with dose. The shape and slope of such a curve is governed by the individual variation between animals-the more uniform the population, the steeper the curve and the more precise the assay. With graded responses, the steepness of the dose-response curve is a property of the test system and has nothing to do with biological variation. Quantal responses can be used in essentially the same way as graded responses for the purposes of bioassay, although the appropriate statistical procedures are slightly different.

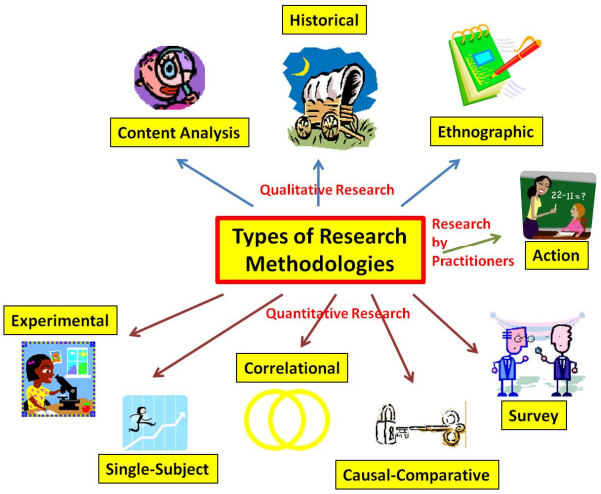


Figure 1. Research types and methodologies.

CLASSIFICATION OF STUDY DESIGNS

There are several different schemes for classifying study designs. We have adopted one that divides studies into those in which the subjects were merely observed, sometimes called observational studies, and those in which some intervention was performed, generally called experiments. This approach is simple and reflects the sequence an investigation sometimes takes. With a little practice, you should be able to read medical articles and classify studies according to the outline in following given table with little difficulty.

CLASSIFICATION OF STUDY DESIGNS

I. Observational studies

A. Descriptive or case–series
B. Case–control studies (retrospective)
   1. Causes and incidence of disease
   2. Identification of risk factors
C. Cross-sectional studies, surveys (prevalence)
   1. Disease description
   2. Diagnosis and staging
   3. Disease processes, mechanisms
D. Cohort studies (prospective)
   1. Causes and incidence of disease
   2. Natural history, prognosis
   3. Identification of risk factors
E. Historical cohort studies

II. Experimental studies/ Clinical trials

F. Controlled trials
   1. Parallel or concurrent controls
      a. Randomized
      b. Not randomized
   2. Sequential controls
      a. Self-controlled
      b. Crossover
   3. External controls (including historical)
G. Studies with no controls

III. Quasi-experimental study

IV. Meta-analyses

Each study design in above given table is illustrated in this chapter, using some of the studies that are presenting problems in upcoming chapters. In observational studies, one or more groups of patients are observed, and characteristics about the patients are recorded for analysis. Experimental studies involve an intervention—an investigator-controlled maneuver, such as a drug, a procedure, or a treatment—and interest lies in the effect the intervention has on study subjects. Of course, both observational and experimental studies may involve animals or objects, but most studies in medicine (and the ones discussed most frequently in this text) involve people.

I. OBSERVATIONAL STUDIES

Observational studies are of four main types: case–series, case–control, cross-sectional (including surveys), and cohort studies. When certain characteristics of a group (or series) of patients (or cases) are described in a published report, the result is called a case–series study; it is the simplest design

in which the author describes some interesting or intriguing observations that occurred for a small number of patients.

Case–series studies frequently lead to the generation of hypotheses that are subsequently investigated in a case–control, cross-sectional, or cohort study. These three types of studies are defined by the period of time the study covers and by the direction or focus of the research question. Cohort and case–control studies generally involve an extended period of time defined by the point when the study begins and the point when it ends; some process occurs, and a certain amount of time is required to assess it. For this reason, both cohort and case–control studies are sometimes also called longitudinal studies. The major difference between them is the direction of the inquiry or the focus of the research question: Cohort studies are forward-looking, from a risk factor to an outcome, whereas case–control studies are backward-looking, from an outcome to risk factors. The cross-sectional study analyzes data collected on a group of subjects at one time. Kleinbaum and colleagues (1997) describe a number of hybrids or combinations of these designs if you are interested in more detail than we give in this chapter. If you would like a more detailed discussion of study designs used in medicine, see the companion text on epidemiology by Greenberg and coworkers (2000). A book by Hulley and Cummings (2001) is devoted entirely to the design of clinical research. Garb (1996) and Burns and Grove (2002) discuss study design in medicine and nursing, respectively.

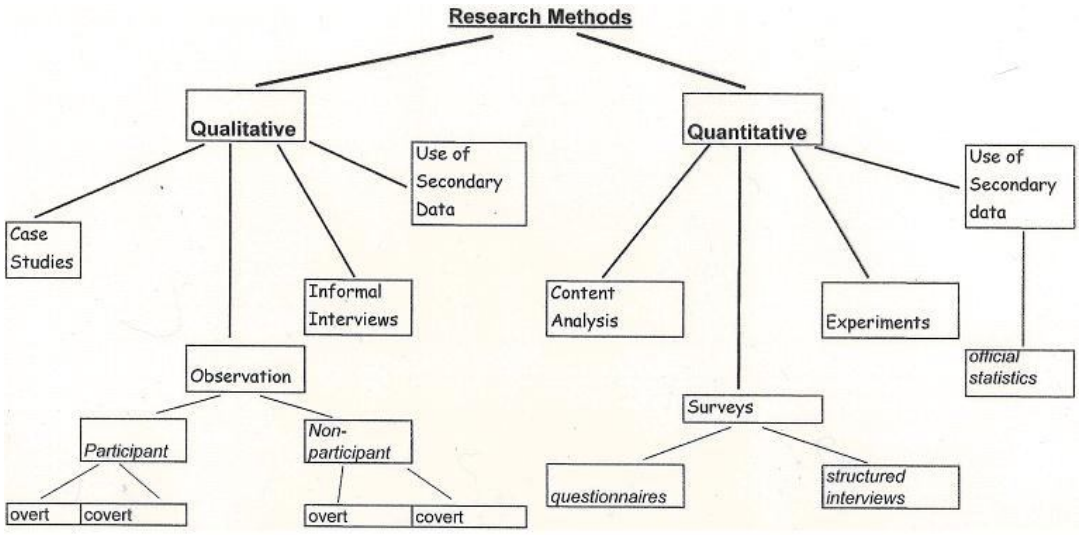
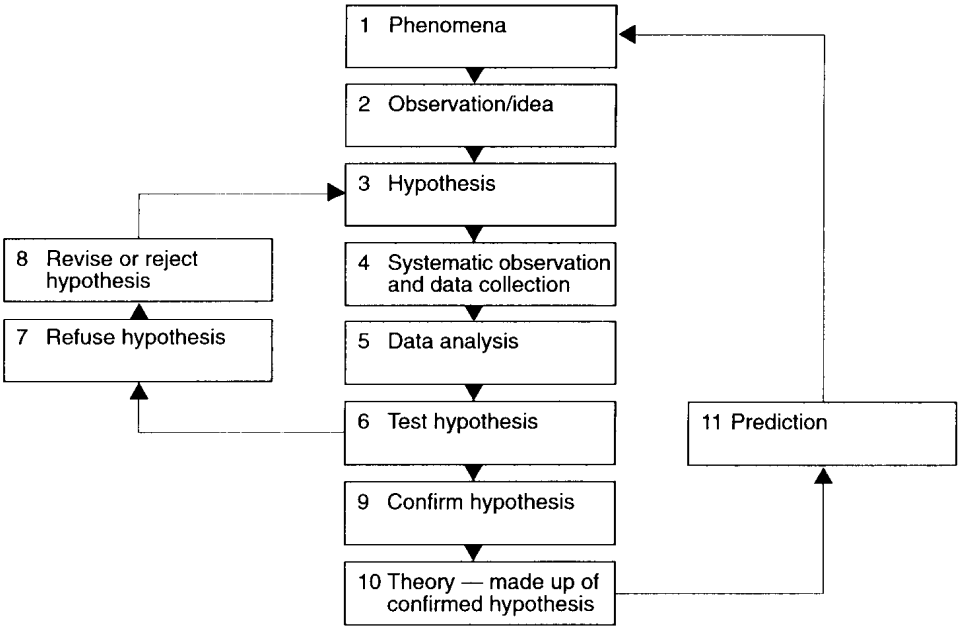


Figure 2. Qualitative and quantitative research methodologies.

Figure 3. Research Procedure.



A Case–Series Studies/ Retrospective study

Study conducted over events that have already occurred in past, to find some common link or scientific reason. These studies rely on patient memory and medical record to warrant prospective examination of a problem.

A case–series report is a simple descriptive account of interesting characteristics observed in a group of patients. For example, Alexandrov and coworkers (1997) presented information on a series of 40 patients who had been referred for evaluation of stroke, transient ischemic attack, or carotid bruit. The authors wanted to compare two methods to see which better predicted peak systolic velocity. They concluded that the relationship between both methods and peak systolic velocity was very strong.

Case–series reports generally involve patients seen over a relatively short time. Generally case–series studies do not include control subjects, persons who do not have the disease or condition being described. Some investigators would not include case–series in a list of types of studies because they are generally not planned studies and do not involve any research hypotheses. On occasion, however, investigators do include control subjects. We mention case–series studies because of their important descriptive role as a precursor to other studies.

B. Case–Control Studies

Case–control studies begin with the absence or presence of an outcome and then look backward in time to try to detect possible causes or risk factors that may have been suggested in a case–series report. The cases in case–control studies are individuals selected on the basis of some disease or outcome; the controls are individuals without the disease or outcome. The history or previous events of both cases and controls are analyzed in an attempt to identify a characteristic or risk factor present in the cases' histories but not in the controls' histories.

In case–control designs, the nature of the inquiry is backward in time to illustrate the backward, or retrospective, nature of the research process. We can characterize case–control studies as studies that ask "What happened?" In fact, they are sometimes called retrospective studies because of the direction of inquiry. Case–control studies are longitudinal as well, because the inquiry covers a period of time.

During a study project patients who had a surgical site infection following laminectomy or spinal fusion (cases) were compared with patients who developed no infection (controls). The investigators found that length of hospital stay and readmission rates were greater with patients with infections. Furthermore, postoperative incontinence was one of the risk factors associated with the development of infection.

Investigators sometimes use matching to associate controls with cases on characteristics such as age and sex. If an investigator feels that such characteristics are so important that an imbalance between the two groups of patients would affect any conclusions, he or she should employ matching. This process ensures that both groups will be similar with respect to important characteristics that may otherwise cloud or confound the conclusions.

Deciding whether a published study is a case–control study or a case–series report is not always easy. Confusion arises because both types of studies are generally conceived and written after the fact rather than having been planned. The easiest way to differentiate between them is to ask whether the author's purpose was to describe a phenomenon or to attempt to explain it by evaluating previous events. If the purpose is simple description, chances are the study is a case–series report.

C. Cross-Sectional Studies

The third type of observational study goes by all of the following names: cross-sectional studies, surveys, epidemiologic studies, and prevalence studies. We use the term "cross-sectional" because it is descriptive of the time line and does not have the connotation that the terms "surveys" and "prevalence" do. Cross-sectional studies analyze data collected on a group of subjects at one time rather than over a period of time. Cross-sectional studies are designed to determine "What is happening?" right now. Subjects are selected and information is obtained in a short period of time (Figure 2-2; note the short time line). Because they focus on a point in time, they are sometimes also called prevalence studies. Surveys and polls are generally cross-sectional studies, although surveys can be part of a cohort or case–control study. Cross-sectional studies may be designed to address research questions raised by a case–series, or they may be done without a previous descriptive study.

Diagnosing or Staging a Disease

In a study problem investigators were interested in learning more about the relationship between demographic measures that might be helpful in identifying trauma patients who have an elevated blood alcohol concentration. They wanted to develop a simple scoring system that could be used to detect these patients when they come to an emergency department. These patients could be targeted for assessment of alcohol abuse and dependence and other possible substance abuse. They chose to look at the time of day (day or night), the day of the week (weekday or weekend), race (white or nonwhite), and age (40 years or older versus younger than 40). Using these four simple measures, the investigators were able to construct four models: for men whose injury was intentional, men whose injury was not intentional, women whose injury was intentional, and women whose injury was not intentional.

Evaluating Different Methods of Doing the Same Thing

A presenting problem in Chapter 5 is a cross-sectional study designed to examine the relationship between histology slides and magnetic resonance imaging (MRI) to study characteristics of diseased carotid arteries. The

histology slides were evaluated by a pathologist who was blinded to the imaging results. It is important to establish the level of agreement between the MRI findings and histology, and the level of agreement was found to be relatively high. Cross-sectional studies are used in all fields of medicine, but they are especially common in examinations of the usefulness of a new diagnostic procedure.

Establishing Norms

Knowledge of the range within which most patients fit is very useful to clinicians. Laboratories, of course, establish and then provide the normal limits of most diagnostic tests when they report the results for a given patient. Often these limits are established by testing people who are known to have normal values. We would not, for example, want to use people with diabetes mellitus to establish the norms for serum glucose levels. The results from the people known to have normal values are used to define the range that separates the lowest 2½% of the values and the highest 2½% of the values from the middle 95%. These values are called normal values, or norms.

Outside of the laboratory there are many qualities for which normal ranges have not been established. This was true for two measures of the autoimmune nervous system function. These two measures, heart variation to deep breathing and the Valsalva ratio, are noninvasive tests that can help clinicians evaluate patients with diabetes mellitus and other neuropathic disorders. Gelber and colleagues (1997) analyzed data from subjects recruited from 63 centers throughout North America to develop normative values for these two measurements. After comparing certain demographic groups, such as males versus females, the investigators established the normative values for heart rate variation to deep breathing and the Valsalva.

Surveys

Surveys are especially useful when the goal is to gain insight into a perplexing topic or to learn how people think and feel about an issue. Surveys are generally cross-sectional in design, but they can be used in case–control and cohort studies as well.

Some investigators wanted to know the factors that influence fellows to select a specific general internal residency fellowship program. Because they did not know the names and addresses of the fellows, the authors sent a questionnaire to the program directors and asked them to distribute the questionnaires to the fellows.

Many times investigators use preexisting surveys rather than creating their own, especially if good questionnaires already exist. During a clinical trial the researcher asked medical students at a Canadian medical school to complete a questionnaire on moral reasoning (the Kohlberg Moral Judgment Interview). They wanted to learn how moral reasoning progressed over time, so they gave the questionnaire at the beginning of medical school and again at the end of the third year. They learned that the stage of moral development did not change in about 70% of the students, whereas it either decreased or increased in 15%. The authors had expected the level of moral reasoning to increase, and the results of the study prompted them to raise questions about the possible features of medical education that might inhibit its development.

Interviews are sometimes used in surveys, especially when it is important to probe reasons or explanations more deeply than is possible with a written questionnaire. Kendler and colleagues (2003) wanted to investigate the role of genetic and environmental risk factors for substance abuse. They studied six classes of illicit substances to learn whether substance use disorders are substance-specific. After interviewing almost 1200 sets of adult male twins, they concluded that environmental experiences unique to a given individual are primarily responsible for whether the person misuses one class of psychoactive substances over another. Increasingly, surveys are performed using existing databases of information. Researchers used survey data from the National Ambulatory Medical Care Survey to examine the relationship between demographics and clinical characteristics of women who visit primary care physicians and specialists for urinary tract infection. Using preexisting databases can have a number of advantages, such as saving time and effort, but many national surveys use complicated designs; and it is important to know what these are.

Many countries and states collect data on a variety of conditions to develop tumor registries and databases of cases of infectious disease. The analyzed epidemiologic surveillance data from the State of Oregon and reported an increase in the overall incidence rate of meningococcal disease from 2 cases/100,000 population during 1987–1992 to 4.5 cases/100,000 in 1994. Epidemiologists from Oregon and the Centers for Disease Control in Atlanta, Georgia, wanted to know if the increased number of cases of meningococcal disease indicated a transition from endemic to epidemic disease. They also sought these other features of an epidemic: the predominance of a single bacterial strain rather than a heterogeneous mix of strains and a shift in age distribution of cases toward older age groups.

D. Cohort Studies/ prospective studies

This type of studies look forward in time to a particular problem/ question to seek the solution / answer. It can be observational or experimental. The term *retrospective study* is sometimes used as another term for a case-control study. Most of the clinical trials are actually the prospective studies.

1 *Superiority trials* are designed to demonstrate that one treatment is more effective than another.
2 *Non-inferiority trials* are designed to demonstrate that a treatment is at least not appreciably worse than another.

3 *Equivalence trials* are designed to demonstrate that one treatment is as effective as another.
4 When using "parallel groups", each patient receives one treatment; in a "crossover study", each patient receives several treatments.
5 A longitudinal study research subjects over two or more points in time; by contrast, while a cross-sectional study assesses research subjects at one point in time.

A cohort is a group of people who have something in common and who remain part of a group over an extended time. In medicine, the subjects in cohort studies are selected by some defining characteristic (or characteristics) suspected of being a precursor to or risk factor for a disease or health effect. Cohort studies ask the question "What will happen?" and thus, the direction in cohort studies is forward in time. Figure 2-3 illustrates the study design. Researchers select subjects at the onset of the study and then determine whether they have the risk factor or have been exposed. All subjects are followed over a certain period to observe the effect of the risk factor or exposure. Because the events of interest transpire after the study is begun, these studies are sometimes called prospective studies.

Typical Cohort Studies

A classical cohort study with which most of you are probably familiar is the Framingham study of cardiovascular disease. This study was begun in 1948 to investigate factors associated with the development of atherosclerotic and hypertensive cardiovascular disease, for which Gordon and Kannel (1970) reported a comprehensive 20-year follow-up. More than 6000 citizens in Framingham, Massachusetts, agreed to participate in this long-term study that involved follow-up interviews and physical examinations every 2 years. Many journal articles have been written about this cohort, and some of the children of the original subjects are now being followed as well.

Cohort studies often examine what happens to the disease over time—the natural history of the disease. Many studies have been based on the Framingham cohort; hundreds of journal articles are indexed by MEDLINE. Many studies deal with cardiovascular-related conditions for which the study was designed, such as blood pressure and pulse pressure as predictors of congestive heart failure (Haider et al, 2003), but this very rich source of data is being used to study many other conditions as well. For instance, two recent articles examined the life expectancy of adults who are obese (Peeters et al, 2003) and the relation of bone mass to development of prostate cancer (Zhang et al, 2002).

Although the Framingham Heart Study is very long term, many cohort studies follow subjects for a much shorter period. A presenting problem in Chapters 5 describes a cohort study to determine the effect of cholecystectomy on bowel habits and bile acid absorption (Sauter et al, 2002). Fifty-one patients undergoing cholecystectomy were evaluated before, 1 month after, and 3 months after surgery to detect changes such as abdominal pain, flatulence, and dyspepsia.

Outcome Assessment

Increasingly, studies that assess medical outcomes are reported in the medical literature. Patient outcomes have always been of interest to health care providers; physicians and others in the health field are interested in how patients respond to different therapies and management regimens. There continues to be a growing focus on the ways in which patients view and value their health, the care they receive, and the results or outcomes of this care. The reasons for the increase in patient-focused health outcomes are complex, and some of the major ones are discussed later in this chapter. Kane (1997) provides information on reading outcomes research articles.

Interest in outcome assessment was spurred by the Medical Outcomes Study (MOS), designed to determine whether variations in patient outcomes were related to the system of care, clinician specialty, and the technical and interpersonal skill of the clinician (Tarlov et al, 1989). Many subsequent studies looked at variations in outcomes in different geographic locations or among different ethnic groups that might result from access issues. In a cross-sectional study, Santora and colleagues (2003) studied variations in breast cancer screening among primary care clinicians by geographic location. They found that written breast cancer guidelines were used less in suburban and urban areas than in rural areas. Lurie and colleagues (2003) reported over five-fold variation in rates of advanced spinal imaging across geographic areas. Different rates of spinal imaging, in turn, accounted for a significant proportion of geographic variation in spine surgery. Other studies focus on variation in resource use among different medical specialties and systems of health care. Specific focus on the health care organizations reported that poor and elderly patients with chronic illnesses had worse outcomes in health maintenance organizations (HMO) systems than with fee-for-service systems and recommended that health care plans carefully monitor patient outcomes (Ware et al, 1995). There are many kinds of patient outcomes: economic, functional status, and satisfaction, among others.

Functional status refers to a person's ability to perform his or her daily activities. Some researchers subdivide functional status into physical, emotional, mental, and social components (Gold et al, 1996). The 6-min walk test (how far a person can walk in 6 min) was studied by Enright and colleagues (2003), and they recommended that the standards be adjusted for age, gender, height, and weight. Many instruments used to measure physical functional status have been developed to evaluate the extent of a patient's rehabilitation following injury or illness.

These instruments are commonly called measures of activities of daily living (ADL). Kretser and colleagues (2003) used the activities of daily living (ADL) to compare with models of nutritional intervention. Subjects eligible for Meals-on-Wheels were randomized to receive either the traditional program of five hot meals per week, or a new program of three meals and two snacks every day of the week. The group receiving the new program gained significantly more weight from baseline at both the 3-month and 6-month measurements.

Quality of life (QOL) is a broadly defined concept that includes subjective or objective judgments about all aspects of an individual's existence: health, economic status, environmental, and spiritual. Interest in measuring QOL was heightened when researchers realized that living a long time does not necessarily imply living a good life. QOL measures can help determine a patient's preferences for different health states and are often used to help decide among alternative approaches to medical management (Wilson and Cleary, 1995).

Patient satisfaction has been discussed for many years and has been shown to be highly associated with whether patients remain with the same physician provider and the degree to which they adhere to their treatment plan (Weingarten et al, 1995).

Patient satisfaction with medical care is influenced by a number of factors, not all of which are directly related to quality of care. Examples include time spent in the office waiting for the doctor and waiting for resolution after being seen; ease of access to the doctor, including phone contact; appointment desk activity; parking; building directions; waiting room setting; and friendliness of the staff in general (Lledo et al, 1995).

Cost-effectiveness and cost–benefit analysis are methods used to evaluate economic outcomes of interventions or different modes of treatment. Brown (2002), a Chapter 12 presenting problem, investigated the costs and benefits of housing policy strategies to prevent childhood lead poisoning. Using standard methods, she compared the number of children identified with lead poisoning where limited building code enforcement occurred with children living where enforcement was strict. She found that children living in the former environment had a four-fold increase in lead poisoning and that $46,000 could be saved per building if these structures were brought into compliance. Cost-effectiveness analysis gives policy makers and health providers critical data needed to make informed judgments about interventions (Gold et al, 1996). A large number of questionnaires or instruments have been developed to measure outcomes. For quality of life, the most commonly used general-purpose instrument is the Medical Outcomes Study MOS 36-Item Short-Form Health Survey (SF-36). Originally developed at the RAND Corporation (Stewart et al, 1988), a refinement of the instrument has been validated and is now used worldwide to provide baseline measures and to monitor the results of medical care. The SF-36 provides a way to collect valid data and does not require very much time to complete. The 36 items are combined to produce a patient profile on eight concepts in addition to summary physical and mental health measures. Another instrument that focuses specifically on QOL is the EuroQol Questionnaire developed and widely used in Europe and the UK (Kind, 1996).

Many instruments are problem-specific. Cramer and Spilker (1998) provide a broad overview of approaches to QOL assessment, evaluations of outcomes, and pharmacoeconomic methods—both general purpose and disease-specific.

Some outcome studies address a whole host of topics, and we have used several as presenting problems in upcoming chapters. As efforts continue to contain costs of medical care while maintaining a high level of patient care, we expect to see many additional studies focusing on patient outcomes. The journal Medical Care is devoted exclusively to outcome studies.

E. Historical Cohort Studies

Many cohort studies are prospective; that is, they begin at a specific time, the presence or absence of the risk factor is determined, and then information about the outcome of interest is collected at some future time, as in the two studies described earlier. One can also undertake a cohort study by using information collected in the past and kept in records or files.

For example, Shipley and his coinvestigators (1999) wanted to assess study outcomes in men with prostate cancer treated with a specific type of radiation therapy (see Chapter 4). Six medical centers had consistently followed a group of patients who had previously been treated with this therapy. Shipley used existing records to look at survival and tumor recurrence in 1607 men who were treated between 1988 and 1995 and had had at least four prostate-specific antigen measurements after radiation. This approach to a study is possible if the records on follow-up are complete and adequately detailed and if the investigators can ascertain the current status of the patients.

Some investigators call this type of study a historical cohort study or retrospective cohort study because historical information is used; that is, the events being evaluated actually occurred before the onset of the study (Figure 2-4). Note that the direction of the inquiry is still forward in time, from a possible cause or risk factor to an outcome. Studies that merely describe an investigator's experience with a group of patients and attempt to identify features associated with a good or bad outcome fall into this category, and many such studies are published in the medical literature.

The time relationship among the different observation study designs is illustrated in Figure 2-5. The figure shows the timing of surveys, which have no direction of inquiry, case–control designs, which look backward in time, and cohort studies, which look forward in time.

Comparison of Case–Control and Cohort Studies

Both case–control and cohort studies evaluate risks and causes of disease, and the design an investigator selects depends in part on the research question.

Henderson and colleagues (1997) undertook a cohort study to look at the risk factors for depression in the elderly. After an initial interview to collect information on potential risk factors, the investigators reinterviewed the subjects 3–6 years later to reassess their status. The investigators could have designed a case–control study had they asked the research question as: "Among elderly people exhibiting dementia or cognitive decline, what are the likely precursors or risk factors?" They would need to ascertain the patients' mental status in the past and any other potential reasons that might be associated with their present condition. As this illustration shows, a cohort study starts with a risk factor or exposure and looks at consequences; a case–control study takes the outcome as the starting point of the inquiry and looks for precursors or risk factors.

Generally speaking, results from a well-designed cohort study carry more weight in understanding a disease than do results from a case–control study. A large number of possible biasing factors can play a role in case–control studies.

In spite of their shortcomings with respect to establishing causality, case–control studies are frequently used in medicine and can provide useful insights if well designed. They can be completed in a much shorter time than cohort studies and are correspondingly less expensive to undertake. Case–control studies are especially useful for studying rare conditions or diseases that may not manifest themselves for many years. In addition, they are valuable for testing an original premise; if the results of the case–control study are promising, the investigator can design and undertake a more involved cohort study.

II. EXPERIMENTAL STUDIES OR CLINICAL TRIALS

Experimental studies are generally easier to identify than observational studies in the medical literature. Authors of medical journal articles reporting experimental studies tend to state explicitly the type of study design used more often than do authors reporting observational studies. Experimental studies in medicine that involve humans are called clinical trials because their purpose is to draw conclusions about a particular procedure or treatment. Table 2-1 indicates that clinical trials fall into two categories: those with and those without controls.

In health care, clinical trials are conducted to allow safety and efficacy data to be collected for new drugs or devices. These trials can only take place once satisfactory information has been gathered on the quality of the product and its non-clinical safety, and Health Authority/Ethics Committee approval is granted in the country where the trial is taking place.

Depending on the type of product and the stage of its development, investigators enroll healthy volunteers and/or patients into small pilot studies initially, followed by larger scale studies in patients that often compare the new product with the currently prescribed treatment. As positive safety and efficacy data are gathered, the number of patients is typically increased. Clinical trials can vary in size from a single center in one country to multicenter trials in multiple countries.

Due to the sizable investment a full series of clinical trials may become, the burden of paying for all the necessary people and services is usually borne by the sponsor who may be the pharmaceutical or biotechnology company that developed the agent under study. Since the diversity of roles may exceed resources of the sponsor, often a clinical trial is managed by an outsourced partner such as a contract research organization (CRO).

In planning a clinical trial, the sponsor or investigator first identifies the medication or device to be tested. Usually, one or more pilot experiments are conducted to gain insights for design of the clinical trial to follow.

In coordination with a panel of expert investigators (usually physicians well-known for their publications and clinical experience), the sponsor decides what to compare the new agent with (one or more existing treatments or a placebo), and what kind of patients might benefit from the medication/device. If the sponsor cannot obtain enough patients with this specific disease or condition at one location, then investigators at other locations who can obtain the same kind of patients to receive the treatment would be recruited into the study.

During the clinical trial, the investigators: recruit patients with the predetermined characteristics, administer the treatment(s), and collect data on the patients' health for a defined time period. These data include measurements like vital signs, amount of study drug in the blood, and whether the patient's health gets better or not. The researchers send the data to the trial sponsor who then analyzes the pooled data using statistical tests.

Some examples of what a clinical trial may be designed to do:

1 assess the safety and effectiveness of a new medication or device on a specific kind of patient (e.g., patients who have been diagnosed with Alzheimer's disease)
2 assess the safety and effectiveness of a different dose of a medication than is commonly used (e.g., 10 mg dose instead of 5 mg dose)
3 assess the safety and effectiveness of an already marketed medication or device for a new indication, i.e. a disease for which the drug is not specifically approved

4 assess whether the new medication or device is more effective for the patient's condition than the already used, standard medication or device ("the gold standard" or "standard therapy")
5 compare the effectiveness in patients with a specific disease of two or more already approved or common interventions for that disease (e.g., Device A vs. Device B, Therapy A vs. Therapy B)

Note that while most clinical trials compare two medications or devices, some trials compare three or four medications, doses of medications, or devices against each other.

Except for very small trials limited to a single location, the clinical trial design and objectives are written into a document called a clinical trial protocol. The protocol is the 'operating manual' for the clinical trial, and ensures that researchers in different locations all perform the trial in the same way on patients with the same characteristics. (This uniformity is designed to allow the data to be pooled.) A protocol is always used in multicenter trials.

Because the clinical trial is designed to test hypotheses and rigorously monitor and assess what happens, clinical trials can be seen as the application of the scientific method to understanding human or animal biology.

Synonyms for 'clinical trials' include clinical studies, research protocols and clinical research.

The most commonly performed clinical trials evaluate new drugs, medical devices (like a new catheter), biologics, psychological therapies, or other interventions. Clinical trials may be required before the national regulatory authority approve marketing of the drug or device, or a new dose of the drug, for use on patients.

Beginning in the 1980s, harmonization of clinical trial protocols was shown as feasible across countries of the European Union. At the same time, coordination between Europe, Japan and the United States led to a joint regulatory-industry initiative on international harmonization named after 1990 as the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH)

Currently, most clinical trial programs follow ICH guidelines, aimed at "ensuring that good quality, safe and effective medicines are developed and registered in the most efficient and cost-effective manner. These activities are pursued in the interest of the consumer and public health, to prevent unnecessary duplication of clinical trials in humans and to minimize the use of animal testing without compromising the regulatory obligations of safety and effectiveness.

HISTORY OF CLINICAL TRIALS

Clinical trials were first introduced in Avicenna's *The Canon of Medicine* in 1025 AD, in which he laid down rules for the experimental use and testing of drugs and wrote a precise guide for practical experimentation in the process of discovering and proving the effectiveness of medical drugs and substances. He laid out the following rules and principles for testing the effectiveness of new drugs and medications, which still form the basis of modern clinical trials:

1. "The drug must be free from any extraneous accidental quality."
2. "It must be used on a simple, not a composite, disease."
3. "The drug must be tested with two contrary types of diseases, because sometimes a drug cures one disease by its essential qualities and another by its accidental ones."
4. "The quality of the drug must correspond to the strength of the disease. For example, there are some drugs whose heat is less than the coldness of certain diseases, so that they would have no effect on them."
5. "The time of action must be observed, so that essence and accident are not confused."
6. "The effect of the drug must be seen to occur constantly or in many cases, for if this did not happen, it was an accidental effect."
7. "The experimentation must be done with the human body, for testing a drug on a lion or a horse might not prove anything about its effect on man."

One of the most famous clinical trials was James Lind's demonstration in 1747 that citrus fruits cure scurvy. He compared the effects of various different acidic substances, ranging from vinegar to cider, on groups of afflicted sailors, and found that the group who were given oranges and lemons had largely recovered from scurvy after 6 days.

Frederick Akbar Mahomed (d. 1884), who worked at Guy's Hospital in London, made substantial contributions to the process of clinical trials during his detailed clinical studies, where "he separated chronic nephritis with secondary hypertension from what we now term essential hypertension." He also founded "the Collective Investigation Record for the British Medical Association; this organization collected data from physicians practicing outside the hospital setting and was the precursor of modern collaborative clinical trials.

TYPES OF CLINICAL TRIALS

One way of classifying clinical trials is by the way the researchers behave.

1 In an observational study, the investigators observe the subjects and measure their outcomes. The researchers do not actively manage the experiment. This is also called a natural experiment. An example is the Nurses' Health Study.
2 In an interventional study, the investigators give the research subjects a particular medicine or other intervention. Usually, they compare the treated subjects to subjects who receive no treatment or standard treatment. Then the researchers measure how the subjects' health changes.

Another way of classifying trials is by their purpose. The U.S. National Institutes of Health (NIH) organizes trials into five (5) different types:

1 **Prevention trials**: look for better ways to prevent disease in people who have never had the disease or to prevent a disease from returning. These approaches may include medicines, vitamins, vaccines, minerals, or lifestyle changes.

2 **Screening trials**: test the best way to detect certain diseases or health conditions.

3 **Diagnostic trials**: conducted to find better tests or procedures for diagnosing a particular disease or condition.

4 **Treatment trials**: test experimental treatments, new combinations of drugs, or new approaches to surgery or radiation therapy.

5 **Quality of life trials**: explore ways to improve comfort and the quality of life for individuals with a chronic illness (a.k.a. Supportive Care trials).

6 **Compassionate use trials**: provide experimental therapeutics prior to final FDA approval to patients whose options with other remedies have been unsuccessful. Usually, case by case approval must be granted by the FDA for such exceptions.

7 **Open trial/ Open-label trial**

In an open trial, also called an open-label trial, the researcher knows the full details of the treatment and so does the patient. These trials are open to challenge for bias, and they do nothing to reduce the placebo effect. However, sometimes they are unavoidable, as placebo treatments are not always possible. Usually this kind of study design is used in bioequivalence studies.

An open-label trial or open trial is a type of clinical trial in which both the researchers and participants know which treatment is being administered. This contrasts with single blind and double blind experimental designs, where participants are not aware of what treatment they are receiving (researchers are also unaware in a double blind trial).

Open-label trials may be appropriate for comparing two very similar treatments to determine which is most effective. An open-label trial may be unavoidable under some circumstances, such as comparing the effectiveness of a medication to intensive physical therapy sessions.
An open-label trial may still be randomized. Open-label trials may also be uncontrolled, with all participants receiving the same treatment.

8 **Blind trials**

Single-blind trial

In a single-blind trial, the researcher knows the details of the treatment but the patient does not. Because the patient does not know which treatment is being administered (the new treatment or another treatment) there might be no placebo effect. In practice, since the researcher knows, it is possible for him to treat the patient differently or to subconsciously hint to the patient important treatment-related details, thus influencing the outcome of the study.

Double-blind trial

In a double-blind trial, one researcher allocates a series of numbers to 'new treatment' or 'old treatment'. The second researcher is told the numbers, but not what they have been allocated to. Since the second researcher does not know, he cannot possibly tell the patient, directly or otherwise, and cannot give in to patient pressure to give him the new treatment. In this system, there is also often a more realistic distribution of sexes and ages of patients. Therefore double-blind trials are preferred, as they tend to give the most accurate results.

Triple-blind trial

Some randomized controlled trials are considered triple-blinded, although the meaning of this may vary according to the exact study design. The most common meaning is that the subject, researcher and person administering the treatment (often a pharmacist) are blinded to what is being given. Alternately, it may mean that the patient, researcher and statistician are blinded. The team monitoring the response may be unaware of the intervention being given in the control and study groups. These additional precautions are often in place with the more commonly accepted term "double blind trials", and thus the term "triple-blinded" is infrequently used. However, it connotes an additional layer of security to prevent undue influence of study results by anyone directly involved with the study.

DESIGNING THE CLINICAL TRIALS

A fundamental distinction in evidence-based medicine is between observational studies and randomized controlled trials. Types of observational studies in epidemiology such as the cohort study and the case-control study provide less compelling evidence than the randomized controlled trial. In observational studies, the investigators only observe associations (correlations) between the treatments experienced by participants and their health status or diseases.
A randomized controlled trial is the study design that can provide the most compelling evidence that the study treatment causes the expected effect on human health.

Currently, some Phase II and most Phase III drug trials are designed as randomized, double blind, and placebo-controlled.

1 Randomized: Each study subject is randomly assigned to receive either the study treatment or a placebo.

2 Blind: The subjects involved in the study do not know which study treatment they receive. If the study is double-blind, the researchers also do not know which treatment is being given to any given subject. This 'blinding' is to prevent biases, since if a physician knew which patient was getting the study treatment and which patient was getting the placebo, he/she might be tempted to give the (presumably helpful) study drug to a patient who could more easily benefit from it. In addition, a physician might give extra care to only the patients who receive the placebos to compensate for their ineffectiveness. A form of double-blind study called a "double-dummy" design allows additional insurance against bias or placebo effect. In this kind of study, all patients are given both placebo and active doses in alternating periods of time during the study.

3 Placebo-controlled: The use of a placebo (fake treatment) allows the researchers to isolate the effect of the study treatment.

4 Active comparator/ active control: Of note, during the last ten years or so it has become a common practice to conduct "active comparator" studies (also known as "active control" trials). In other words, when a treatment exists that is clearly better than doing nothing for the subject (*i.e.* giving them the placebo), the alternate treatment would be a standard-of-care therapy. The study would compare the 'test' treatment to standard-of-care therapy.

Although the term "clinical trials" is most commonly associated with the large, randomized studies typical of Phase III, many clinical trials are small. They may be "sponsored" by single physicians or a small group of physicians, and are designed to test simple questions. In the field of rare diseases sometimes the number of patients might be the limiting factor for a clinical trial. Other clinical trials require large numbers of participants (who may be followed over long periods of time), and the trial sponsor is a private company, a government health agency, or an academic research body such as a university.

CLINICAL TRIAL PROTOCOL

A clinical trial protocol is a document used to gain confirmation of the trial design by a panel of experts and adherence by all study investigators, even if conducted in various countries.

The protocol describes the scientific rationale, objective(s), design, methodology, statistical considerations, and organization of the planned trial. Details of the trial are also provided in other documents referenced in the protocol such as an Investigator's Brochure.

The protocol contains a precise study plan for executing the clinical trial, not only to assure safety and health of the trial subjects, but also to provide an exact template for trial conduct by investigators at multiple locations (in a "multicenter" trial) to perform the study in exactly the same way. This harmonization allows data to be combined collectively as though all investigators (referred to as "sites") were working closely together. The protocol also gives the study administrators (often a contract research organization) as well as the site team of physicians, nurses and clinic administrators a common reference document for site responsibilities during the trial.

The format and content of clinical trial protocols sponsored by pharmaceutical, biotechnology or medical device companies in the United States, European Union, or Japan has been standardized to follow Good Clinical Practice guidance issued by the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH). Regulatory authorities in Canada and Australia also follow ICH guidelines.

DESIGN FEATURES

Informed consent

An essential component of initiating a clinical trial is to recruit study subjects following procedures using a signed document called "informed consent.

Informed consent is a legally-defined process of a person being told about key facts involved in a clinical trial before deciding whether or not to participate. To fully describe participation to a candidate subject, the doctors and nurses involved in the trial explain the details of the study. Foreign language translation is provided if the participant's native language is not the same as the study protocol.

The research team provides an informed consent document that includes trial details, such as its purpose, duration, required procedures, risks, potential benefits and key contacts. The participant then decides whether or not to sign the document in agreement. Informed consent is not an immutable contract, as the participant can withdraw at any time.

Statistical power

In designing a clinical trial, a sponsor must decide on the target number of patients who will participate. The sponsor's goal usually is to obtain a statistically significant result showing a significant difference in outcome (e.g., number of deaths after 28 days in the study) between the groups of patients who receive the study treatments. The number of patients required to give a statistically significant

result depends on the question the trial wants to answer. For example, to show the effectiveness of a new drug in a non-curable disease as metastatic kidney cancer requires many fewer patients than in a highly curable disease as seminoma if the drug is compared to a placebo.
The number of patients enrolled in a study has a large bearing on the ability of the study to reliably detect the size of the effect of the study intervention. This is described as the "power" of the trial. The larger the sample size or number of participants in the trial, the greater the statistical power.
However, in designing a clinical trial, this consideration must be balanced with the fact that more patients make for a more expensive trial. The power of a trial is not a single, unique value; it estimates the ability of a trial to detect a difference of a particular size (or larger) between the treated (tested drug/device) and control (placebo or standard treatment) groups. By example, a trial of a lipid-lowering drug versus placebo with 100 patients in each group might have a power of .90 to detect a difference between patients receiving study drug and patients receiving placebo of 10 mg/dL or more, but only have a power of .70 to detect a difference of 5 mg/dL.

PHASES OF CLINICAL TRIALS

Clinical trials involving new drugs are commonly classified into four phases. Each phase of the drug approval process is treated as a separate clinical trial. The drug-development process will normally proceed through all four phases over many years. If the drug successfully passes through Phases I, II, and III, it will usually be approved by the national regulatory authority for use in the general population. Phase IV are 'post-approval' studies.
Before pharmaceutical companies start clinical trials on a drug, they conduct extensive pre-clinical studies.

Pre-clinical studies

Pre-clinical studies involve in vitro (test tube) and in vivo (animal) experiments using wide-ranging doses of the study drug to obtain preliminary efficacy, toxicity and pharmacokinetic information. Such tests assist pharmaceutical companies to decide whether a drug candidate has scientific merit for further development as an investigational new drug.

Phase 0

Phase 0 is a recent designation for exploratory, first-in-human trials conducted in accordance with the U.S. Food and Drug Administration's (FDA) 2006 Guidance on Exploratory Investigational New Drug (IND) Studies. Phase 0 trials are also known as human microdosing studies and are designed to speed up the development of promising drugs or imaging agents by establishing very early on whether the drug or agent behaves in human subjects as was expected from preclinical studies. Distinctive features of Phase 0 trials include the administration of single subtherapeutic doses of the study drug to a small number of subjects (10 to 15) to gather preliminary data on the agent's pharmacokinetics (how the body processes the drug) and pharmacodynamics (how the drug works in the body).
A Phase 0 study gives no data on safety or efficacy, being by definition a dose too low to cause any therapeutic effect. Drug development companies carry out Phase 0 studies to rank drug candidates in order to decide which has the best pharmacokinetic parameters in humans to take forward into further development. They enable go/no-go decisions to be based on relevant human models instead of relying on sometimes inconsistent animal data.
Questions have been raised by experts about whether Phase 0 trials are useful, ethically acceptable, feasible, speed up the drug development process or save money, and whether there is room for improvement.

Phase I

Phase I trials are the first stage of testing in human subjects. Normally, a small (20-80) group of healthy volunteers will be selected. This phase includes trials designed to assess the safety (pharmacovigilance), tolerability, pharmacokinetics, and pharmacodynamics of a drug. These trials are often conducted in an inpatient clinic, where the subject can be observed by full-time staff. The subject who receives the drug is usually observed until several half-lives of the drug have passed. Phase I trials also normally include dose-ranging, also called dose escalation, studies so that the appropriate dose for therapeutic use can be found. The tested range of doses will usually be a fraction of the dose that causes harm in animal testing. Phase I trials most often include healthy volunteers. However, there are some circumstances when real patients are used, such as patients who have end-stage disease and lack other treatment options. This exception to the rule most often occurs in oncology (cancer) and HIV drug trials. Volunteers are paid an inconvenience fee for their time spent in the volunteer centre. Pay ranges from a small amount of money for a short period of residence, to a larger amount of up to approx £4000 depending on length of participation.
There are different kinds of Phase I trials:
SAD: Single Ascending Dose studies are those in which small groups of subjects are given a single dose of the drug while they are observed and tested for a period of time. If they do not exhibit any adverse side effects, and the pharmacokinetic data is roughly in line with predicted safe values, the dose is escalated, and a new group of subjects is then given a higher dose. This is continued until pre-calculated pharmacokinetic safety levels are reached, or intolerable side effects start showing up (at which point the drug is said to have reached the Maximum tolerated dose (MTD).
MAD: Multiple Ascending Dose studies are conducted to better understand the pharmacokinetics &

pharmacodynamics of multiple doses of the drug. In these studies, a group of patients receives multiple low doses of the drug, whilst samples (of blood, and other fluids) are collected at various time points and analyzed to understand how the drug is processed within the body. The dose is subsequently escalated for further groups, up to a predetermined level.

Food effect: A short trial designed to investigate any differences in absorption of the drug by the body, caused by eating before the drug is given. These studies are usually run as a crossover study, with volunteers being given two identical doses of the drug on different occasions; one while fasted, and one after being fed.

Phase II

Once the initial safety of the study drug has been confirmed in Phase I trials, Phase II trials are performed on larger groups (20-300) and are designed to assess how well the drug works, as well as to continue Phase I safety assessments in a larger group of volunteers and patients. When the development process for a new drug fails, this usually occurs during Phase II trials when the drug is discovered not to work as planned, or to have toxic effects.
Phase II studies are sometimes divided into Phase IIA and Phase IIB. Phase IIA is specifically designed to assess dosing requirements (how much drug should be given), whereas Phase IIB is specifically designed to study efficacy (how well the drug works at the prescribed dose(s)).
Some trials combine Phase I and Phase II, and test both efficacy and toxicity.

Trial design

Some Phase II trials are designed as case series, demonstrating a drug's safety and activity in a selected group of patients. Other Phase II trials are designed as randomized clinical trials, where some patients receive the drug/device and others receive placebo/standard treatment. Randomized Phase II trials have far fewer patients than randomized Phase III trials.

Phase III

Phase III studies are randomized controlled multicenter trials on large patient groups (300–3,000 or more depending upon the disease/medical condition studied) and are aimed at being the definitive assessment of how effective the drug is, in comparison with current 'gold standard' treatment. Because of their size and comparatively long duration, Phase III trials are the most expensive, time-consuming and difficult trials to design and run, especially in therapies for chronic medical conditions.
It is common practice that certain Phase III trials will continue while the regulatory submission is pending at the appropriate regulatory agency. This allows patients to continue to receive possibly lifesaving drugs until the drug can be obtained by purchase. Other reasons for performing trials at this stage include attempts by the sponsor at "label expansion" (to show the drug works for additional types of patients/diseases beyond the original use for which the drug was approved for marketing), to obtain additional safety data, or to support marketing claims for the drug. Studies in this phase are by some companies categorised as "Phase IIIB studies.
While not required in all cases, it is typically expected that there be at least two successful Phase III trials, demonstrating a drug's safety and efficacy, in order to obtain approval from the appropriate regulatory agencies (FDA (USA), TGA (Australia), EMEA (European Union), etc.).
Once a drug has proved satisfactory after Phase III trials, the trial results are usually combined into a large document containing a comprehensive description of the methods and results of human and animal studies, manufacturing procedures, formulation details, and shelf life. This collection of information makes up the "regulatory submission" that is provided for review to the appropriate regulatory authorities in different countries. They will review the submission, and, it is hoped, give the sponsor approval to market the drug.
Most drugs undergoing Phase III clinical trials can be marketed under FDA norms with proper recommendations and guidelines, but in case of any adverse effects being reported anywhere, the drugs need to be recalled immediately from the market. While most pharmaceutical companies refrain from this practice, it is not abnormal to see many drugs undergoing Phase III clinical trials in the market.

Phase IV

Phase IV trial is also known as Post Marketing Surveillance Trial. Phase IV trials involve the safety surveillance (pharmacovigilance) and ongoing technical support of a drug after it receives permission to be sold. Phase IV studies may be required by regulatory authorities or may be undertaken by the sponsoring company for competitive (finding a new market for the drug) or other reasons (for example, the drug may not have been tested for interactions with other drugs, or on certain population groups such as pregnant women, who are unlikely to subject themselves to trials). The safety surveillance is designed to detect any rare or long-term adverse effects over a much larger patient population and longer time period than was possible during the Phase I-III clinical trials. Harmful effects discovered by Phase IV trials may result in a drug being no longer sold, or restricted to certain uses: recent examples involve cerivastatin (brand names Baycol and Lipobay), troglitazone (Rezulin) and rofecoxib (Vioxx).

A. Controlled trials:

Control trials are studies in which the experimental drug or procedure is compared with another drug or procedure,

sometimes a placebo and sometimes the previously accepted treatment. Uncontrolled trials are studies in which the investigators' experience with the experimental drug or procedure is described, but the treatment is not compared with another treatment, at least not formally. Because the purpose of an experiment is to determine whether the intervention (treatment) makes a difference, studies with controls are much more likely than those without controls to detect whether the difference is due to the experimental treatment or to some other factor. Thus, controlled studies are viewed as having far greater validity in medicine than uncontrolled studies. The consolidated standard of reporting trials (CONSORT) guidelines reflect an effort to improve the reporting of clinical trials. A comprehensive discussion and illustration of the standard is given by Altman and colleagues (2001).

Trials in healthcare

In the hierarchy of evidence that influences healthcare policy and practice, RCTs are considered by most to be the top individual unit of research. They are considered the most reliable form of scientific evidence because they eliminate spurious causality and bias.

Sellers of medicines throughout the ages have had to convince their consumers that the medicine works. As science has progressed, public expectations have risen, and government health budgets have become ever tighter, pressure has grown for a reliable system to do this. Moreover, the public's concern for the dangers of medical interventions has spurred both legislators and administrators to provide an evidential basis for licensing or paying for new procedures and medications. In most modern health-care systems all new medicines and surgical procedures therefore have to undergo trials before being approved.

Trials are used to establish average efficacy of a treatment as well as learn about its most frequently occurring side-effects. This is meant to address the following concerns. First, effects of a treatment may be small and therefore undetectable except when studied systematically on a large population. Second, biological organisms (including humans) are complex, and do not react to the same stimulus in the same way, which makes inference from single clinical reports very unreliable and generally unacceptable as scientific evidence. Third, some conditions will spontaneously go into remission, with many extant reports of miraculous cures for no discernible reason. Finally, it is well-known and has been proven that the act of administering the treatment itself may have direct, sometimes very powerful, psychological effects on the patient, which is known as the placebo effect.

Trials with parallel or Independent Concurrent Controls

Parallel study designed is protocol in which two or more patient groups are studied concurrently. The groups are treated identically except for one variable i.e. drug therapy.

One way a trial can be controlled is to have two groups of subjects: one that receives the experimental procedure (the experimental group) and the other that receives the placebo or standard procedure (the control group) (Figure 2-6). The experimental and control groups should be treated alike in all ways except for the procedure itself so that any differences between the groups will be due to the procedure and not to other factors. The best way to ensure that the groups are treated similarly is to plan interventions for both groups for the same time period in the same study. In this way, the study achieves concurrent control. To reduce the chances that subjects or investigators see what they expect to see, researchers can design double-blind trials in which neither subjects nor investigators know whether the subject is in the treatment or the control group. When only the subject is unaware, the study is called a blind trial. In some unusual situations, the study design may call for the investigator to be blinded even when the subject cannot be blinded. Blindedness is discussed in detail in Chapter 13. Another issue is how to assign some patients to the experimental condition and others to the control condition; the best method of assignment is random assignment. Methods for randomization are discussed in Chapter 4.

Aspects of control in research studies

Traditionally the *control* in randomized controlled studies refers to studying a group of treated patient's not in isolation but in comparison to other groups of patients, the *control groups*, who by not receiving the treatment under study give investigators important clues to the effectiveness of the treatment, its side effects, and the parameters that modify these effects.

Other aspects of control include having other members of the research team, who will typically review the test to try to remove any factors which might skew the results. For example, it is important to have a test group which is reasonably balanced for ages and sexes of the subjects (unless this is a treatment which will never be used on a particular sex or age group). Additionally, peer review and/or review by government regulators can be seen as another source of control. These bodies examine the results when they are presented for publication or when the drug manufacturer applies for a license for the drug.

The importance of having a control group cannot be overstated. Merely being told that one is receiving a miraculous cure can be enough to cure a patient—even if the pill contains nothing more than sugar. Additionally, the procedure itself can produce ill effects. For example, in one study on rabbits where these subjects were receiving daily injections of a drug, it was found that they were developing cancer. If this was a result of the treatment, it would obviously be unsuitable for testing in humans. Because this result was reflected equally between the control and test groups, the source of the problem was investigated and it

was shown in this case that the administration of daily injections was the cancer risk—not the drug itself.
The analysis of the results requires knowledge of medicine, epidemiology, and in particular statistics. The branch of statistics that deals specifically with biomedical research is biostatistics. Pharmaceutical firms employ groups of biostatisticians to try to make sense of the data. Likewise, regulators pay keen attention to the appropriateness of statistical methods used to analyze results.

Types of control groups

1 Placebo concurrent control group
2 Dose-response concurrent control group
3 Active concurrent control group
4 No treatment concurrent control group
5 Historical control

Randomized Controlled Trials

A randomized controlled study or randomized controlled trial (RCT) is a type of scientific experiment most commonly used in testing the efficacy or effectiveness of healthcare services (such as medicine or nursing) or health technologies (such as pharmaceuticals, medical devices or surgery). RCTs are also employed in other research areas, such as judicial, educational, and social research. As their name suggests, RCTs involve the random allocation of different interventions (treatments or conditions) to subjects. As long as numbers of subjects are sufficient, this ensures that both known and unknown confounding factors are evenly distributed between treatment groups.
The randomized controlled trial is the epitome of all research designs because it provides the strongest evidence for concluding causation; it provides the best insurance that the result was due to the intervention.
One of the more noteworthy randomized trials is the Physicians' Health Study (Steering Committee of the Physicians' Health Study Research Group, 1989), which investigated the role of aspirin in reducing the risk of cardiovascular disease. One purpose was to learn whether aspirin in low doses reduces the mortality rate from cardiovascular disease. Participants in this clinical trial were over 22,000 healthy male physicians who were randomly assigned to receive aspirin or placebo and were followed over an average period of 60 months.
The investigators found that fewer physicians in the aspirin group experienced a myocardial infarction during the course of the study than did physicians in the group receiving placebo. We discuss several randomized trials as presenting problems. For instance, Borghi and colleagues (2002) compared a traditional low-calcium diet with a diet containing a normal amount of calcium but reduced amount of animal protein and salt for the prevention of recurrent kidney stone formation. The primary outcome was the time to the first recurrence of a symptomatic or presence of a radiographically identified stone. Results indicated that a diet with a normal amount of calcium but reduced animal protein and salt is more effective than the traditional low-calcium diet in reducing the risk of recurrent stones in men with hypercalciuria.

Randomization in research studies

There are two processes involved in randomizing patients to different interventions. First is choosing a *randomization procedure* to generate a random and unpredictable sequence of allocations. This may be a simple random assignment of patients to any of the groups at equal probabilities, or may be complex and adaptive. A second and more practical issue is *allocation concealment*, which refers to the stringent precautions taken to ensure that the group assignment of patients are not revealed to the study investigators prior to definitively allocating them to their respective groups.

Randomization procedures

There are a couple of statistical issues to consider in generating the randomization sequences.

Balance: since most statistical tests are most powerful when the groups being compared have equal sizes, it is desirable for the randomization procedure to generate similarly-sized groups.

Selection bias: depending on the amount of structure in the randomization procedure, investigators may be able to infer the next group assignment by guessing which of the groups has been assigned the least up to that point. This breaks allocation concealment (see below) and can lead to bias in the selection of patients for enrollment in the study.

Accidental bias: if important covariates that are related to the outcome are ignored in the statistical analysis, estimates arising from that analysis may be biased. The potential magnitude of that bias, if any, will depend on the randomization procedure.

Complete randomization

In this commonly used and intuitive procedure, each patient is effectively randomly assigned to any one of the groups. It is simple and optimal in the sense of robustness against both selection and accidental biases. However, its main drawback is the possibility of imbalances between the groups. In practice, imbalance is only a concern for small sample sizes ($n < 200$).

Permuted block randomization

In this form of restricted randomization, blocks of k patients are created such that balance is enforced within each block. For instance, let E stand for experimental group and C for control group, then a block of $k = 4$ patients may be assigned to one of *EECC*, *ECEC*, *ECCE*, *CEEC*, *CECE*, and *CCEE*, with equal probabilities of 1/6 each. Note that there are equal numbers of patients assigned to the experiment and the control group in each block.

Permuted block randomization has several advantages. In addition to promoting group balance at the end of the trial, it also promotes *periodic balance* in the sense that sequential patients are distributed equally between groups. This is particularly important because clinical trials enroll patients sequentially, such that there may be systematic differences between patients entering at different times during the study.

Unfortunately, by enforcing within-block balance, permuted block randomization is particularly susceptible to selection bias. That is, since toward the end of each block the investigators know the group with the least assignment up to that point must be assigned proportionally more of the remainder, predicting future group assignment becomes progressively easier. The remedy for this bias is to blind investigator from group assignments and from the randomization procedure itself.

Strictly speaking, permuted block randomization should be followed by statistical analysis that takes the blocking into account. However, for small block sizes this may become infeasible. In practice it is recommended that intra-block correlation be examined as a part of the statistical analysis.

A special case of permuted block randomization is *random allocation*, in which the entire sample is treated as one block.

Covariate-adaptive randomization

When there are a number of variables that may influence the outcome of a trial (for example, patient age, gender or previous treatments) it is desirable to ensure a balance across each of these variables. This can be done with a separate list of randomization blocks for each combination of values - although this is only feasible when the number of lists is small compared to the total number of patients. When the number of variables or possible values are large a statistical method known as Minimization can be used to minimize the imbalance within each of the factors.

Outcome-adaptive randomization

For a randomized trial in human subjects to be ethical, the investigator must believe before the trial begins that all treatments under consideration are equally desirable. At the end of the trial, one treatment may be selected as superior if a statistically significant difference was discovered. Between the beginning and end of the trial is an ethical grey zone. As patients are treated, evidence may accumulate that one treatment is superior, and yet patients are still randomized equally between all treatments until the trial ends.

Outcome-adaptive randomization is a variation on traditional randomization designed to address the ethical issue raised above. Randomization probabilities are adjusted continuously throughout the trial in response to the data. The probability of a treatment being assigned increases as the probability of that treatment being superior increases. The statistical advantages of randomization are retained, while on average more patients are assigned to superior treatments.

Allocation concealment

In practice, in taking care of individual patients, clinical investigators often find it difficult to maintain impartiality. Stories abound of investigators holding up sealed envelopes to lights or ransacking offices to determine group assignments in order to dictate the assignment of their next patient. This introduces selection bias and confounders and distorts the results of the study. Breaking allocation concealment in randomized controlled trials is that much more problematic because in principle the randomization should have minimized such biases.

Some standard methods of ensuring allocation concealment include:

1 Sequentially-Numbered, Opaque, Sealed Envelopes (SNOSE)
2 Sequentially-numbered containers
3 Pharmacy controlled
4 Central randomization

Great care for allocation concealment must go into the clinical trial protocol and reported in detail in the publication. Recent studies have found that not only do most publications not report their concealment procedure, most of the publications that do not report also have unclear concealment procedures in the protocols.

Nonrandomized Trials

Subjects are not always randomized to treatment options. Studies that do not use randomized assignment are generally referred to as nonrandomized trials or simply as clinical trials or comparative studies, with no mention of randomization. Many investigators believe that studies with nonrandomized controls are open to so many sources of bias that their conclusions are highly questionable. Studies using nonrandomized controls are considered to be much weaker because they do nothing to prevent bias in patient assignment. For instance, perhaps it is the stronger patients who receive the more aggressive treatment and the higher risk patients who are treated conservatively. An example is a nonrandomized study of the use of a paracervical block to diminish cramping and pain associated with cryosurgery for cervical neoplasia (Harper, 1997; Chapter 6 presenting problem). This investigator enrolled the first 40 women who met the inclusion criteria in the group treated in the usual manner (no anesthetic block before cryosurgery) and enrolled the next 45 women in the group receiving the paracervical block. This design is not as subject to bias as a study in which patients are treated without regard to any plan; however, it does not qualify as a randomized study and does present some potential problems in interpretation. Whenever patients are assigned to treatments within big blocks of time, there is always the possibility that an important event occurred between the

two time periods, such as a change in the method used for cryotherapy. Although that may not have been true in this study, a randomized design would have been more persuasive.

Trials with Self-Controls

A moderate level of control can be obtained by using the same group of subjects for both experimental and control options. The study by Sauter and colleagues (2002) involved patients who underwent cholecystectomy. Follow-up occurred 1 and 3 months after cholecystectomy to detect changes such as abdominal pain, flatulence, and dyspepsia. This type of study uses patients as their own controls and is called a self-controlled study.

Studies with self-controls and no other control group are still vulnerable to the well-known Hawthorne effect, described by Roethlisberger and colleagues (1946), in which people change their behavior and sometimes improve simply because they receive special attention by being in a study and not because of the study intervention. These studies are similar to cohort studies except for the intervention or treatment that is involved.

The self-controlled study design can be modified to provide a combination of concurrent and self-controls. This design uses two groups of patients: One group is assigned to the experimental treatment, and the second group is assigned to the placebo or control treatment (Figure 2-7). After a time, the experimental treatment and placebo are withdrawn from both groups for a "washout" period. During the washout period, the patients generally receive no treatment. The groups are then given the alternative treatment; that is, the first group now receives the placebo, and the second group receives the experimental treatment. This design, called a crossover study, is powerful when used appropriately.

Crossover study

The study design used as an additional control for inter-patient and intra-patient variability called crossover study. In this type of study each patient group undergoes each type of treatment. The sequence in which the subjects undergo treatment is reversed for one group. Crossover study reduce the possibility that the results were strongly influenced by the order in which therapy was given. And because both group of patient receive both type of treatments, any difference in responsiveness between the groups due to patient selection will be uncovered.

Trials with External Controls

The third method for controlling experiments is to use controls external to the study. Sometimes, the result of another investigator's research is used as a comparison. On other occasions, the controls are patients the investigator has previously treated in another manner, called historical controls. The study design is illustrated in Figure 2-8.

Historical controls are frequently used to study diseases for which cures do not yet exist and are used in oncology studies, although oncologic studies use concurrent controls when possible. In studies involving historical controls, researchers should evaluate whether other factors may have changed since the time the historical controls were treated; if so, any differences may be due to these other factors and not to the treatment.

B. Uncontrolled Studies

Not all studies involving interventions have controls, and by strict definition they are not really experiments or trials. For example, Crook and associates (1997) (a presenting problem in Chapter 9) reported the results of a trial of radiotherapy for prostate carcinoma in which patients were followed for at least 12 and for as long as 70 months. The investigators wanted to determine the length of time a patient had no recurrence of the tumor as well as how long the patients survived. They found some differences in the probability of long-term survival in patients who had different tumor classification scores (scores that measure the severity of the tumor). This study was an uncontrolled study because there were no comparisons with patients treated in another manner.

Uncontrolled studies are more likely to be used when the comparison involves a procedure than when it involves a drug. The major shortcoming of such studies is that investigators assume that the procedure used and described is the best one. The history of medicine is filled with examples in which one particular treatment is recommended and then discontinued after a controlled clinical trial is undertaken. One significant problem with uncontrolled trials is that unproved procedures and therapies can become established, making it very difficult for researchers to undertake subsequent controlled studies. Another problem is finding a significant difference when it may be unfounded. Guyatt and colleagues (2000) identified 13 randomized trials and 17 observational studies in adolescent pregnancy prevention. Six of eight outcomes they examined showed a significant intervention effect in the observational studies, whereas the randomized studies showed no benefit.

III. QUASI-EXPERIMENTAL STUDY

A quasi-experiment is a scientific research method primarily used in the social sciences. "Quasi" means likeness or resembling, so therefore quasi-experiments share characteristics of true experiments which seek interventions or treatments. The key difference in this empirical approach is the lack of random assignment. Another unique element often involved in this experimentation method is use of time series analysis: interrupted and non-interrupted.

Design

The first part of creating a quasi-experimental design is to identify the variables. The quasi-independent variable will be the x-variable. This is the variable that is manipulated in order to affect the outcome. "X" is generally a grouping variable with different levels. Grouping means two or more groups such as a treatment group and a placebo group. The predicted outcome is the dependent variable which is the y-variable. In a time series analysis, the dependent variable is observed over time for any changes that may take place. Once the variables have been identified and defined, a procedure should then be implemented and group differences should be examined.

Advantages

Since quasi-experimental designs are used when randomization is impossible and/or impractical, they are typically easier to set up than true experimental designs; it takes much less effort to study and compare subjects or groups of subjects that are already naturally organized than to have to conduct random assignment of subjects. Additionally, utilizing quasi-experimental designs minimizes threats to external validity. Since quasi-experiments are natural experiments, findings in one may be applied to other subjects and settings, allowing for some generalizations to be mad
about population. Also, this experimentation method is efficient in longitudinal research that involves longer time periods which can be followed up in different environments.

Disadvantages

The control allowed through the manipulation of the x-variable can lead to unnatural circumstances. Also, the lack of random assignment in the quasi-experimental design method may allow studies to be more feasible, but this also poses many challenges for the investigator. This deficient in randomization makes it harder to rule out confounds and introduces new threats to internal validity. Because randomization is absent, some knowledge about the data can be approximated, but cause-effect conclusions are difficult to determine. Moreover, even if these threats to internal validity are assessed, causation still cannot be fully established because the experimenter does not have total control over variables.

IV. META-ANALYSIS & REVIEW PAPERS

A type of study that does not fit specifically in either category of observation studies or experiments is called meta-analysis. Meta-analysis uses published information from other studies and combines the results so as to permit an overall conclusion. Meta-analysis is similar to review articles, but additionally includes a quantitative assessment and summary of the findings. It is possible to do a meta-analysis of observational studies or experiments; however, a meta-analysis should report the findings for these two types of study designs separately. This method is especially appropriate when the studies that have been reported have small numbers of subjects or come to different conclusions.

Veenstra and colleagues (1999) (a presenting problem in Chapter 10) performed a meta-analysis of infection and central venous catheters. The investigators wanted to know whether catheters impregnated with antiseptic were effective in preventing catheter-related bloodstream infection, compared with untreated catheters. They found 12 randomized trials that had addressed this question and combined the results in a statistical manner to reach an overall conclusion about their effectiveness—mainly that the impregnated catheters appear to be effective in reducing the incidence of infection in high-risk patients.

ADVANTAGES & DISADVANTAGES OF DIFFERENT STUDY DESIGNS

The previous sections introduced the major types of study designs used in medical research, broadly divided into experimental studies, or clinical trials, and observational studies (cohort, case–control, cross-sectional, and case–series designs). Each study design has certain advantages over the others as well as some specific disadvantages, which we discuss in the following sections.

Advantages & Disadvantages of Clinical Trials

The randomized clinical trial is the gold standard, or reference, in medicine; it is the design against which others are judged—because it provides the greatest justification for concluding causality and is subject to the least number of problems or biases. Clinical trials are the best type of study to use when the objective is to establish the efficacy of a treatment or a procedure. Clinical trials in which patients are randomly assigned to different treatments, or "arms," are the strongest design of all. One of the treatments is the experimental condition; another is the control condition. The control may be a placebo or a sham procedure; often, it is the treatment or procedure commonly used, called the standard of care or reference standard. For example, patients with coronary artery disease in the Coronary Artery Surgery Study (CASS Principal Investigators and Associates, 1983) were randomized to receive either surgical or medical care; no patient was left untreated or given a placebo.

A number of published articles have shown the tendency for nonrandomized studies, especially those using historical controls, to be more likely to show a positive outcome, compared with randomized studies. In some situations, however, historical controls can and should be used. For instance, historical controls may be useful when preliminary studies are needed or when researchers are dealing with late treatment for an intractable disease, such as advanced cancer. Although clinical trials provide the greatest justification for determining causation, obstacles to using them include their great expense and long duration. For instance, a randomized trial comparing various treatments for carcinoma requires the investigators to

follow the subjects for a long time. Another potential obstacle to using clinical trials occurs when certain practices become established and accepted by the medical community, even though they have not been properly justified. As a result, procedures become established that may be harmful to many patients, as evidenced by the controversy over silicone breast implants and the many different approaches to managing hypertension, many of which have never been subjected to a clinical trial that includes the most conservative treatment, diuretics.

Advantages & Disadvantages of Cohort Studies

Cohort studies are the design of choice for studying the causes of a condition, the course of a disease, or the risk factors because they are longitudinal and follow a group of subjects over a period of time. Causation generally cannot be proved with cohort studies because they are observational and do not involve interventions. However, because they follow a cohort of patients forward through time, they possess the correct time sequence to provide strong evidence for possible causes and effects, as in the smoking and lung cancer controversy. In well-designed cohort studies, investigators can control many sources of bias related to patient selection and recorded measurements.

The length of time required in a cohort study depends on the problem studied. With diseases that develop over a long period of time or with conditions that occur as a result of long-term exposure to some causative agent, many years are needed for study. Extended time periods make such studies costly. They also make it difficult for investigators to argue causation because other events occurring in the intervening period may have affected the outcome. For example, the long time between exposure and effect is one of the reasons it is difficult to study the possible relationship between environmental agents and various carcinomas. Cohort studies that require a long time to complete are especially vulnerable to problems associated with patient follow-up, particularly patient attrition (patients stop participating in the study) and patient migration (patients move to other communities). This is one reason that the Framingham study, with its rigorous methods of follow-up, is such a rich source of important information.

Advantages & Disadvantages of Case–Control Studies

Case–control studies are especially appropriate for studying rare diseases or events, for examining conditions that develop over a long time, and for investigating a preliminary hypothesis. They are generally the quickest and least expensive studies to undertake and are ideal for investigators who need to obtain some preliminary data prior to writing a proposal for a more complete, expensive, and time-consuming study. They are also a good choice for someone who needs to complete a clinical research project in a specific amount of time.

The advantages of case–control studies lead to their disadvantages. Of all study methods, they have the largest number of possible biases or errors, and they depend completely on high-quality existing records. Data availability for case–control studies sometimes requires compromises between what researchers wish to study and what they are able to study. One of the authors was involved in a study of elderly burn patients in which the goal was to determine risk factors for survival. The primary investigator wanted to collect data on fluid intake and output. He found, however, that not all of the existing patient records contained this information, and thus it was impossible to study the effect of this factor.

One of the greatest problems in a case–control study is selection of an appropriate control group. The cases in a case–control study are relatively easy to identify, but deciding on a group of persons who provide a relevant comparison is more difficult. Because of the problems inherent in choosing a control group in a case–control study, some statisticians have recommended the use of two control groups: one control group similar in some ways to the cases (eg, having been hospitalized during the same period of time) and another control group of healthy subjects.

Advantages & Disadvantages of Cross-Sectional Studies

Cross-sectional studies are best for determining the status quo of a disease or condition, such as the prevalence of HIV in given populations, and for evaluating diagnostic procedures. Cross-sectional studies are similar to case–control studies in being relatively quick to complete, and they may be relatively inexpensive as well. Their primary disadvantage is that they provide only a “snapshot in time” of the disease or process, which may result in misleading information if the research question is really one of disease process. For example, clinicians used to believe that diastolic blood pressure, unlike systolic pressure, does not increase as patients grow older. This belief was based on cross-sectional studies that had shown mean diastolic blood pressure to be approximately 80 mm Hg in all age groups. In the Framingham cohort study, however, the patients who were followed over a period of several years were observed to have increased diastolic blood pressure as they grew older (Gordon et al, 1959).

This apparent contradiction is easier to understand if we consider what happens in an aging cohort. For example, suppose that the mean diastolic pressure in men aged 40 years is 80 mm Hg, although there is individual variation, with some men having a blood pressure as low as 60 mm Hg and others having a pressure as high as 100 mm Hg. Ten years later there is an increase in diastolic pressure, although it is not an even increase; some men experience a greater increase than others. The men who were at the upper end of the blood pressure distribution 10 years earlier and who had experienced a larger increase have

died in the intervening period, so they are no longer represented in a cross-sectional study. As a result, the mean diastolic pressure of the men still in the cohort at age 50 is about 80 mm Hg, even though individually their pressures are higher than they were 10 years earlier. Thus, a cohort study, not a cross-sectional study, provides the information leading to a correct understanding of the relationship between normal aging and physiologic processes such as diastolic blood pressure.
Surveys are generally cross-sectional studies. Most of the voter polls done prior to an election are one-time samplings of a group of citizens, and different results from week to week are based on different groups of people; that is, the same group of citizens is not followed to determine voting preferences through time. Similarly, consumer-oriented studies on customer satisfaction with automobiles, appliances, health care, and so on are cross-sectional.

A common problem with survey research is obtaining sufficiently large response rates; many people asked to participate in a survey decline because they are busy, not interested, and so forth. The conclusions are therefore based on a subset of people who agree to participate, and these people may not be representative of or similar to the entire population. The problem of representative participants is not confined to cross-sectional studies; it can be an issue in other studies whenever subjects are selected or asked to participate and decline or drop out. Another issue is the way questions are posed to participants; if questions are asked in a leading or emotionally inflammatory way, the responses may not truly represent the participants' feelings or opinions.

Advantages & Disadvantages of Case–Series Studies
Case–series reports have two advantages: They are easy to write, and the observations may be extremely useful to investigators designing a study to evaluate causes or explanations of the observations. But as we noted previously, case–series studies are susceptible to many possible biases related to subject selection and characteristics observed. In general, you should view them as hypothesis-generating and not as conclusive.

V. DIFFICULTIES

Outside pressure

A major difficulty in dealing with trial results comes from commercial, political and/or academic pressure. Most trials are expensive to run, and will be the result of significant previous research, which is itself not cheap. There may be a political issue at stake (compare MMR vaccine) or vested interests (compare homeopathy). In such cases there is great pressure to interpret results in a way which suits the viewer, and great care must be taken by researchers to maintain emphasis on clinical facts.

Statistical error

Most studies start with a 'null hypothesis' which is being tested (usually along the lines of 'Our new treatment *x* cures as many patients as existing treatment *y*') and an alternative hypothesis ('*x* cures more patients than *y*'). The analysis at the end will give a statistical likelihood, based on the facts, of whether the null hypothesis can be safely rejected (saying that the new treatment does, in fact, result in more cures). Nevertheless this is only a statistical likelihood, so false negatives and false positives are possible. These are generally set an acceptable level (e.g., 1% chance that it was a false result). However, this risk is cumulative, so if 200 trials are done (often the case for contentious matters) about 2 will show contrary results. There is a tendency for these two to be seized on by those who need that proof for their point of view.

Blinding problems
Ideally, studies should be blinded (see above) by giving placebo treatments, to avoid bias caused by placebo effects. However, for some treatments placebos are not possible. Examples:
1 treatments where a convincing placebo treatment would be too dangerous to be ethically acceptable (e.g., surgery)
2 treatments where active participation of the patient is necessary (e.g., physical therapy, dieting)

Thus, some treatments can by their nature not be subjected to blinded studies.

Single-blind trials

Single-blind describes experiments wherein information that could introduce bias or otherwise skew the result is withheld from the participants, but the experimenter will be in full possession of the facts.
In a single-blind experiment, the individual subjects do not know whether they are so-called "test" subjects or members of an "experimental control" group. Single-blind experimental design is used where the experimenters either must know the full facts (for example, when comparing sham to real surgery) and so the experimenters cannot themselves be blind, or where the experimenters will not introduce further bias and so the experimenters need not be blind. However, there is a risk that subjects are influenced by interaction with the researchers — known as the experimenter's bias. Single-blind trials are especially risky in psychology and social science research, where the experimenter has an expectation of what the outcome should be, and may consciously or subconsciously influence the behavior of the subject.

Double-blind trials

Double-blind describes an especially stringent way of conducting an experiment, usually on human subjects, in an attempt to eliminate subjective bias on the part of both experimental subjects and the experimenters. In most

cases, double-blind experiments are held to achieve a higher standard of scientific rigour.

In a double-blind experiment, neither the individuals nor the researchers know who belongs to the control group and the experimental group. Only after all the data have been recorded (and in some cases, analyzed) do the researchers learn which individuals are which. Performing an experiment in double-blind fashion is a way to lessen the influence of the prejudices and unintentional physical cues on the results (the placebo effect, observer bias, and experimenter's bias). Random assignment of the subject to the experimental or control group is a critical part of double-blind research design. The key that identifies the subjects and which group they belonged to is kept by a third party and not given to the researchers until the study is over.

Double-blind methods can be applied to any experimental situation where there is the possibility that the results will be affected by conscious or unconscious bias on the part of the experimenter.

Computer-controlled experiments are sometimes also referred to as double-blind experiments, since software should not cause any bias. In analogy to the above, the part of the software that provides interaction with the human is the blinded researcher, while the part of the software that defines the key is the third party. An example is the ABX test, where the human subject has to identify an unknown stimulus X as being either A or B.

Triple-blind trials

Triple-blind trials are double-blind trials in which the statistician interpreting the results also does not know which intervention has been given. Sometimes triple-blind is used to mean that multiple investigators are all blinded to the protocol (such as the clinician giving the treatment and a radiologist or pathologist who interprets the results.) The use of the term triple-blind experiments is disputed.

Medical applications

Double-blinding is relatively easy to achieve in drug studies, by formulating the investigational drug and the control (either a placebo or an established drug) to have identical appearance (color, taste, etc.). Patients are randomly assigned to the control or experimental group and given random numbers by a study coordinator, who also encodes the drugs with matching random numbers. Neither the patients nor the researchers monitoring the outcome know which patient is receiving which treatment, until the study is over and the random code is broken.

Effective blinding can be difficult to achieve where the treatment is notably effective (indeed, studies have been suspended in cases where the tested drug combinations were so effective that it was deemed unethical to continue withholding the findings from the control group, and the general population) or where the treatment is very distinctive in taste or has unusual side-effects that allow the researcher and/or the subject to guess which group they were assigned to. It is also difficult to use the double blind method to compare surgical and non-surgical interventions (although sham surgery, involving a simple incision, might be ethically permitted). A good clinical protocol will foresee these potential problems to ensure blinding is as effective as possible.

Evidence-based medicine practitioners prefer blinded randomized controlled trials (RCTs), where that is a possible experimental design. These are high on the hierarchy of evidence; only a meta analysis of several well designed RCTs is considered more reliable.

Forensic application

In a police photo lineup, an officer shows a group of photos to a witness or crime victim and asks him or her to pick out the suspect. This is basically a single-blind test of the witness' memory, and may be subject to subtle or overt influence by the officer. There is a growing movement in law enforcement to move to a double blind procedure in which the officer who shows the photos to the witness does not know which photo is of the suspect.

Study duration

Clinical trials are only a small part of the research that goes into developing a new treatment. Potential drugs, for example, first have to be discovered, purified, characterized, and tested in labs (in cell and animal studies) before ever undergoing clinical trials. In all, about 1,000 potential drugs are tested before just one reaches the point of being tested in a clinical trial. For example, a new cancer drug has, on average, at least 6 years of research behind it before it even makes it to clinical trials. But the major holdup in making new cancer drugs available is the time it takes to complete clinical trials themselves. On average, about 8 years pass from the time a cancer drug enters clinical trials until it receives approval from regulatory agencies for sale to the public. Drugs for other diseases have similar timelines. Some reasons a clinical trial might last several years:

1. For chronic conditions like cancer, it takes months, if not years, to see if a cancer treatment has an effect on a patient.
2. For drugs that are not expected to have a strong effect (meaning a large number of patients must be recruited to observe *any* effect), recruiting enough patients to test the drug's effectiveness (i.e., getting statistical power) can take several years.
3. Only certain people who have the target disease condition are eligible to take part in each clinical trial. Researchers who treat these particular patients must participate in the trial. Then they must identify the desirable patients and obtain consent from them or their families to take part in the trial.

The biggest barrier to completing studies is the shortage of people who take part. All drug and many device trials target

a subset of the population, meaning not everyone can participate. Some drug trials require patients to have unusual combinations of disease characteristics. It is a challenge to find the appropriate patients and obtain their consent, especially when they may receive no direct benefit (because they are not paid, the study drug is not yet proven to work, or the patient may receive a placebo). In the case of cancer patients, fewer than 5% of adults with cancer will participate in drug trials. According to the Pharmaceutical Research and Manufacturers of America (PhRMA), about 400 cancer medicines were being tested in clinical trials in 2005. Not all of these will prove to be useful, but those that are may be delayed in getting approved because the number of participants is so low.

Clinical trials that do not involve a new drug usually have a much shorter duration. (Exceptions are epidemiological studies like the Nurses' Health Study.)

Administration of clinical trials

Clinical trials designed by a local investigator and (in the U.S.) federally funded clinical trials are almost always administered by the researcher who designed the study and applied for the grant. Small-scale device studies may be administered by the sponsoring company. Phase III and Phase IV clinical trials of new drugs are usually administered by a contract research organization (CRO) hired by the sponsoring company. (The sponsor provides the drug and medical oversight.) A CRO is a company that is contracted to perform all the administrative work on a clinical trial. It recruits participating researchers, trains them, provides them with supplies, coordinates study administration and data collection, sets up meetings, monitors the sites for compliance with the clinical protocol, and ensures that the sponsor receives 'clean' data from every site. Recently, site management organizations have also been hired to coordinate with the CRO to ensure rapid IRB/IEC approval and faster site initiation and patient recruitment.

At a participating site, one or more research assistants (often nurses) do most of the work in conducting the clinical trial. The research assistant's job can include some or all of the following: providing the local Institutional Review Board (IRB) with the documentation necessary to obtain its permission to conduct the study, assisting with study start-up, identifying eligible patients, obtaining consent from them or their families, administering study treatment(s), collecting data, maintaining data files, and communicating with the IRB, as well as the sponsor (if any) and CRO (if any).

Ethical conduct

Clinical trials are closely supervised by appropriate regulatory authorities. All studies that involve a medical or therapeutic intervention on patients must be approved by a supervising ethics committee before permission is granted to run the trial. The local ethics committee has discretion on how it will supervise noninterventional studies (observational studies or those using already collected data). In the U.S., this body is called the Institutional Review Board (IRB). Most IRBs are located at the local investigator's hospital or institution, but some sponsors allow the use of a central (independent/for profit) IRB for investigators who work at smaller institutions.

To be ethical, researchers must obtain the full and informed consent of participating human subjects. (One of the IRB's main functions is ensuring that potential patients are adequately informed about the clinical trial.) If the patient is unable to consent for him/herself, researchers can seek consent from the patient's legally authorized representative. In California, the state has prioritized the individuals who can serve as the legally authorized representative.

In some U.S. locations, the local IRB must certify researchers and their staff before they can conduct clinical trials. They must understand the federal patient privacy (HIPAA) law and good clinical practice. International Conference of Harmonisation Guidelines for Good Clinical Practice (ICH GCP) is a set of standards used internationally for the conduct of clinical trials. The guidelines aim to ensure that the "rights, safety and well being of trial subjects are protected".

The notion of informed consent of participating human subjects exists in many countries all over the world, but its precise definition may still vary.

Informed consent is clearly a *necessary* condition for ethical conduct but does not *ensure* ethical conduct. The final objective is to serve the community of patients or future patients in a best-possible and most responsible way. However, it may be hard to turn this objective into a well-defined quantified objective function. In some cases this can be done, however, as for instance for questions of when to stop sequential treatments (see Odds algorithm), and then quantified methods may play an important role.

Safety

Responsibility for the safety of the subjects in a clinical trial is shared between the sponsor, the local site investigators (if different from the sponsor), the various IRBs that supervise the study, and (in some cases, if the study involves a marketable drug or device) the regulatory agency for the country where the drug or device will be sold.

Assuring the sponsorship

1. For safety reasons, many clinical trials of drugs are designed to exclude women of childbearing age, pregnant women, and/or women who become pregnant during the study. In some cases the male partners of these women are also excluded or required to take birth control measures.
2. Throughout the clinical trial, the sponsor is responsible for accurately informing the local site investigators of

the true historical safety record of the drug, device or other medical treatments to be tested, and of any potential interactions of the study treatment(s) with already approved medical treatments. This allows the local investigators to make an informed judgment on whether to participate in the study or not.

3 The sponsor is responsible for monitoring the results of the study as they come in from the various sites, as the trial proceeds. In larger clinical trials, a sponsor will use the services of a Data Monitoring Committee (DMC, known in the U.S. as a Data Safety Monitoring Board). This is an independent group of clinicians and statisticians. The DMC meets periodically to review the unblended data that the sponsor has received so far. The DMC has the power to recommend termination of the study based on their review, for example if the study treatment is causing more deaths than the standard treatment, or seems to be causing unexpected and study-related serious adverse events.

4 The sponsor is responsible for collecting adverse event reports from all site investigators in the study, and for informing all the investigators of the sponsor's judgment as to whether these adverse events were related or not related to the study treatment. This is an area where sponsors can slant their judgment to favor the study treatment.

5 The sponsor and the local site investigators are jointly responsible for writing a site-specific informed consent that accurately informs the potential subjects of the true risks and potential benefits of participating in the study, while at the same time presenting the material as briefly as possible and in ordinary language. FDA regulations and ICH guidelines both require that “the information that is given to the subject or the representative shall be in language understandable to the subject or the representative." If the participant's native language is not English, the sponsor must translate the informed consent into the language of the participant.

Assuring safety by Local site investigators

1 A physician's first duty is to his/her patients, and if a physician investigator believes that the study treatment may be harming subjects in the study, the investigator can stop participating at any time. On the other hand, investigators often have a financial interest in recruiting subjects, and can act unethically in order to obtain and maintain their participation.

2 The local investigators are responsible for conducting the study according to the study protocol, and supervising the study staff throughout the duration of the study.

3 The local investigator or his/her study staff are responsible for ensuring that potential subjects in the study understand the risks and potential benefits of participating in the study; in other words, that they (or their legally authorized representatives) give truly informed consent.

4 The local investigators are responsible for reviewing all adverse event reports sent by the sponsor. (These adverse event reports contain the opinion of both the investigator at the site where the adverse event occurred, and the sponsor, regarding the relationship of the adverse event to the study treatments). The local investigators are responsible for making an independent judgment of these reports, and promptly informing the local IRB of all serious and study-treatment-related adverse events.

5 When a local investigator is the sponsor, there may not be formal adverse event reports, but study staff at all locations is responsible for informing the coordinating investigator of anything unexpected.

6 The local investigator is responsible for being truthful to the local IRB in all communications relating to the study.

Institutional review board (IRBs)

Approval by an IRB, or ethics board, is necessary before all but the most informal medical research can begin.

1 In commercial clinical trials, the study protocol is not approved by an IRB before the sponsor recruits sites to conduct the trial. However, the study protocol and procedures have been tailored to fit generic IRB submission requirements. In this case, and where there is no independent sponsor, each local site investigator submits the study protocol, the consent(s), the data collection forms, and supporting documentation to the local IRB. Universities and most hospitals have in-house IRBs. Other researchers (such as in walk-in clinics) use independent IRBs.

2 The IRB scrutinizes the study for both medical safety and protection of the patients involved in the study, before it allows the researcher to begin the study. It may require changes in study procedures or in the explanations given to the patient. A required yearly "continuing review" report from the investigator updates the IRB on the progress of the study and any new safety information related to the study.

Role of regulatory agencies

1 If a clinical trial concerns a new regulated drug or medical device (or an existing drug for a new purpose), the appropriate regulatory agency for each country where the sponsor wishes to sell the drug or device is supposed to review all study data before allowing the drug/device to proceed to the next phase, or to be marketed. However, if the sponsor withholds negative data, or misrepresents data it has acquired from clinical trials, the regulatory agency may make the wrong decision.

2 In the U.S., the FDA can audit the files of local site investigators after they have finished participating in a

study, to see if they were correctly following study procedures. This audit may be random, or for cause (because the investigator is suspected of fraudulent data). Avoiding an audit is an incentive for investigators to follow study procedures.

Different countries have different regulatory requirements and enforcement abilities. "An estimated 40 percent of all clinical trials now take place in Asia, Eastern Europe, central and south America. “There is no compulsory registration system for clinical trials in these countries and many do not follow European directives in their operations”, says Dr. Jacob Sijtsma of the Netherlands-based WEMOS, an advocacy health organization tracking clinical trials in developing countries."

Accidents

In March 2006 the drug TGN1412 caused catastrophic systemic organ failure in the individuals receiving the drug during its first human clinical trials (Phase I) in Great Britain. Following this, an Expert Group on Phase One Clinical Trials published a report.

The TGN1412 study is only one among a number of recent industry-funded clinical trials where financial interests have arguably placed research subjects at risk.

Financial issues

Sponsor

The cost of a study depends on many factors, especially the number of sites that are conducting the study, the number of patients required, and whether the study treatment is already approved for medical use. Clinical trials follow a standardized process.

The costs to a pharmaceutical company of administering a Phase III or IV clinical trial may include, among others:

1. manufacturing the drug(s)/device(s) tested
2. staff salaries for the designers and administrators of the trial
3. payments to the contract research organization, the site management organization (if used) and any outside consultants
4. payments to local researchers (and their staffs) for their time and effort in recruiting patients and collecting data for the sponsor
5. study materials and shipping
6. communication with the local researchers, including onsite monitoring by the CRO before and (in some cases) multiple times during the study
7. one or more investigator training meetings
8. costs incurred by the local researchers such as pharmacy fees, IRB fees and postage.
9. any payments to patients enrolled in the trial (all payments are strictly overseen by the IRBs to ensure that patients do not feel coerced to take part in the trial by overly attractive payments)

These costs are incurred over several years.

In the U.S. there is a 50% tax credit for sponsors of certain clinical trials.

National health agencies such as the U.S. National Institutes of Health offer grants to investigators who design clinical trials that attempt to answer research questions that interest the agency. In these cases, the investigator who writes the grant and administers the study acts as the sponsor, and coordinates data collection from any other sites. These other sites may or may not be paid for participating in the study, depending on the amount of the grant and the amount of effort expected from them.

Investigators

Many clinical trials do not involve any money. However, when the sponsor is a private company or a national health agency, investigators are almost always paid to participate. These amounts can be small, just covering a partial salary for research assistants and the cost of any supplies (usually the case with national health agency studies), or be substantial and include 'overhead' that allows the investigator to pay the research staff during times in between clinical trials.

Patients

In Phase I drug trials; participants are paid because they give up their time (sometimes away from their homes) and are exposed to unknown risks, without the expectation of any benefit. In most other trials, however, patients are not paid, in order to ensure that their motivation for participating is the hope of getting better or contributing to medical knowledge, without their judgment being skewed by financial considerations. However, they are often given small payments for study-related expenses like travel or as compensation for their time in providing follow-up information about their health after they are discharged from medical care.

Participating criteria, in a clinical trial

Phase 0 and Phase I drug trials seek healthy volunteers. Most other clinical trials seek patients who have a specific disease or medical condition. Depending on the kind of participants required, sponsors of clinical trials use various recruitment strategies, including patient databases, newspaper and radio advertisements, flyers, posters in places the patients might go (such as doctor's offices), and personal recruitment of patients by investigators.

Other resources are available for individuals who want to participate in a clinical trial:

1. A patient may ask their physician about available clinical trials of treatments for their disease or medical condition.
2. The US National Institutes of Health, World Health Organization and commercial organizations allow people to search for clinical trials.
3. The nonprofit Center for Information and Study on Clinical Research Participation (CISCRP) works with

both the medical community and the public to bring together a general understanding of clinical trial research.

Criticism

Marcia Angell has been a stern critic of U.S. health care in general and the pharmaceutical industry in particular. She is scathing on the topic of how clinical trials are conducted in her country:

Many drugs that are assumed to be effective are probably little better than placebos, but there is no way to know because negative results are hidden.... Because favorable results were published and unfavorable results buried ... the public and the medical profession believed these drugs were potent.... Clinical trials are also biased through designs for research that are chosen to yield favorable results for sponsors. For example, the sponsor's drug may be compared with another drug administered at a dose so low that the sponsor's drug looks more powerful. Or a drug that is likely to be used by older people will be tested in young people, so that side effects are less likely to emerge. A common form of bias stems from the standard practice of comparing a new drug with a placebo, when the relevant question is how it compares with an existing drug. In short, it is often possible to make clinical trials come out pretty much any way you want, which is why it's so important that investigators be truly disinterested in the outcome of their work.... It is simply no longer possible to believe much of the clinical research that is published, or to rely on the judgment of trusted physicians or authoritative medical guidelines. I take no pleasure in this conclusion, which I reached slowly and reluctantly over my two decades as an editor of the *New England Journal of Medicine*.

Angell believes that members of medical school faculties who conduct clinical trials should not accept any payments from drug companies except research support, and that that support should have no strings attached, including control by the companies over the design, interpretation, and publication of research results.

Chapter 6.

PHARMACOTHERAPY

Pharmacotherapy evolved to assure the safety and efficacy of new medications. Every individual is different in responding to chemotherapeutical agent, therefore each patient should be considered as an experiment, with hypothesis that could be tested. Pharmacologic agents also expose certain risks. Therefore basic principles of drug therapy provide a conceptual framework for deploying drugs with maximal efficacy while minimizing the risk of adverse effects. Optimal therapeutic decisions are based on an evaluation of the individual patient in concert with assessment of the evidence for efficacy and safety of the treatment under consideration. An understanding of the pharmacokinetics and pharmacodynamics of the drug should be integrated for the implementation of treatment strategies. We have precise the treatment protocols to conceive the rational approach to eradicate the diseases. The therapeutical measures are discussed systematically with accordance of complications that might be introduced in each physiological system. There also more than one treatment protocols available to provide a good choice to clinical pharmacists, physicians and researchers.

Chapter 6.

PHARMACOTHERAPY

CARDIOVASCULAR DISORDERS
- ST-segment elevation myocardial infarction
- Non-ST segment elevation myocardial infarction (NSTEMI) and Unstable angina
- Congestive heart failure
- Supraventricular tachycardia
- Ventricular arrhythmias
- Hypertensive emergencies
- Hypertension
- Syncope

PULMONARY DISORDERS
- Asthma
- Chronic obstructive pulmonary disease
- Hemoptysis
- Anaphylaxis
- Pleural effusion
- Deep venous thrombosis
- Pulmonary embolism
- Sickle cell crisis
- Infectious diseases
- Meningitis
- Infective endocarditis
- Pneumonia
- Pneumocystis carinii pneumonia and hiv
- Septic arthritis
- Septic shock
- Peritonitis
- Diverticulitis
- Lower urinary tract infection
- Pyelonephritis
- Osteomyelitis
- Active pulmonary tuberculosis
- Cellulitis
- Pelvic inflammatory disease

GASTROINTESTINAL DISORDERS
- Gastroesophageal reflux disease (gerd)
- Peptic ulcer disease
- Gastrointestinal bleeding
- Cirrhotic ascites and edema
- Viral hepatitis
- Cholecystitis and cholangitis
- Acute pancreatitis
- Acute diarrhea
- Crohn's disease
- Ulcerative colitis
- Parenteral nutrition
- Hepatic encephalopathy
- Alcohol withdrawal

TOXICOLOGY
- Poisoning and drug overdose
- Acetaminophen overdose
- Theophylline overdose
- Tricyclic antidepressant overdose

NEUROLOGIC DISORDERS
- Ischemic stroke
- Transient ischemic attack
- Subarachnoid hemorrhage
- Seizure and status epilepticus

ENDOCRINOLOGIC DISORDERS
- Diabetic ketoacidosis
- Nonketotic hyperosmolar syndrome
- Thyroid storm and hyperthyroidism
- Myxedema coma and hypothyroidism

NEPHROLOGIC DISORDERS
- Renal failure
- Nephrolithiasis
- Hypercalcemia
- Hypocalcemia
- Hyperkalemia
- Hypokalemia
- Hypermagnesemia
- Hypomagnesemia
- Hypernatremia
- Hyponatremia
- Hyperphosphatemia

RHEUMATOLOGIC DISORDERS
- Systemic lupus erythematosus
- Acute gout attack

CARDIOVASCULAR DISORDERS

ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION

1. Admission: Coronary care unit
2. Diagnosis: Rule out myocardial infarction
3 Conditions:
4. Vital Signs: q1h. Call physician if pulse >90, <60; BP >150/90, <90/60; R>25, <12; T >38.5°C.
5. Activity: Bed rest with bedside commode.

7. Nursing: Guaiacum stools. If patient has chest pain, obtain 12-lead ECG and call physician.
8. Diet: Cardiac diet, 1-2 gm sodium, low-fat, low cholesterol diet. No caffeine or temperature extremes.
9. IV Fluids: D5W at TKO
10. Special Medications:
Oxygen: 2-4 L/min by NC.
Aspirin: 325 mg PO, chew and swallow immediately, then aspirin EC 162 mg PO qd OR Clopidogrel (Plavix): 75 mg PO qd (if allergic to aspirin).
Nitroglycerin: 10 mcg/min infusion (50 mg in 250-500 mL D5W, 100-200 mcg/mL). Titrate to control symptoms in 5-10 mcg/min steps, up to 1-3 mcg/kg/min; maintain systolic BP >90 OR
Nitroglycerin SL: 0.4 mg (0.15-0.6 mg) SL q5min until pain free (up to 3 tabs) OR
Nitroglycerin spray: (0.4 mg/aerosol spray) 1-2 sprays under the tongue q 5min; may repeat x 2.
Heparin: 60 U/kg IV (max 4000 U) push, then 12 U/kg/hr (max 1000 U/hr) by continuous IV infusion for 48 hours to maintain aPTT of 50-70 seconds. Check aPTTq6h x 4, then qd. Repeat aPTT 6 hours after each heparin dosage change.
Thrombolytic Therapy
(within first 6 hours of onset of chest pain)
Absolute Contraindications: Active internal bleeding, suspected aortic dissection, known intracranial neoplasm, previous intracranial hemorrhagic stroke at any time, other strokes or cerebrovascular events within 1 year, head trauma, pregnancy, recent non-compressible vascular puncture, uncontrolled hypertension (>180/110 mm Hg).
Relative Contraindications:
Severe hypertension, cerebrovascular disease, recent surgery (within 2 weeks), cardiopulmonary resuscitation.
A. Alteplase
(tPA, tissue plasminogen activator, Activase):
1. 15 mg IV push over 2 min, followed by 0.75 mg/kg (max 50 mg) IV infusion over 30 min, followed by 0.5 mg/kg (max 35 mg) IV infusion over 60 min (max total dose 100 mg).
2. Labs: INR/PTT, CBC, fibrinogen.
B. Reteplase (Retavase):
1. 10 U IV push over 2 min; repeat second 10 U IV push after 30 min.
2. **Labs:** INR, aPTT, CBC, fibrinogen.
C. Tenecteplase (TNKase):
<60 kg 30 mg IVP
60-69 kg 35 mg IVP
70-79 kg 40 mg IVP
80-89 kg 45 mg IVP
$90 kg 50 mg IVP
C. Streptokinase (Streptase):
1. 1.5 million IU in 100 mL NS IV over 60 min. Pretreat with diphenhydramine (Benadryl) 50 mg IV push AND Methylprednisolone (Soln-Medrol) 250 mg IV push.
2. Check baseline fibrinogen level and q6h for 24h until level >100 mg/dL.
3. No IM or arterial punctures, watch IV for bleeding.
Beta-Blockers
(within the first 12 hours of onset of chest pain)**:** Contraindicated in cardiogenic shock.
Metoprolol (Lopressor): 5 mg IV q2-5min x 3 doses; then 25 mg PO q6h for 48h, then 100 mg PO q12h; hold if heart rate <60/min or systolic BP <100 mm Hg OR
Atenolol (Tenormin): 5 mg IV, repeated in 5 minutes, followed by 50-100 mg PO qd OR
Esmolol (Brevibloc): 500 mcg/kg IV over 1 min, then 50 mcg/kg/min IV infusion, titrated to heart rate >60 bpm (max 300 mcg/kg/min).
Angiotensin Converting Enzyme Inhibitor
(within the first 24 hours of onset of chest pain)**:**
Lisinopril (Zestril, Prinivil): 2.5-5 mg PO qd; titrate to 10- 20 mg qd.
Long-Acting Nitrates:
Nitroglycerin patch: 0.2 mg/hr qd. Allow for nitrate-free period to prevent tachyphylaxis.
Isosorbide dinitrate (Isordil): 10-60 mg PO tid [5,10,20, 30,40 mg] OR
Isosorbide mononitrate (Imdur): 30-60 mg PO qd.

pFOX (partial fatty acid oxidation) inhibitors
Ranolazine (Ranexa): 500 mg twice daily, which can be increased to a maximum of 1000 mg twice daily as needed; contraindicated in hepatic impairment or pre-existing QT prolongation.
Aldosterone Receptor Blocker if EF <40%:
Eplerenone (Inspra): 24 mg PO qd
Spironolactone (Aldactone): 25 mg PO qd
Statins:
Rosuvastatin (Crestor): 10 mg PO qhs OR
Atorvastatin (Lipitor): 10 mg PO qhs OR
Pravastatin (Pravachol): 40 mg PO qhs OR
Simvastatin (Zocor): 40 mg PO qhs OR
Lovastatin (Mevacor): 20 mg PO qhs OR
Fluvastatin (Lescol):10-20 mg PO qhs.
11. Symptomatic Medications:
Morphine sulfate: 2-4 mg IV push prn chest pain.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
Lorazepam (Ativan): 1-2 mg PO tid-qid prn anxiety
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.
Docusate (Colace): 100 mg PO bid.
Ondansetron (Zofran): 2-4 mg IV q4h prn nausea or vomiting.
Famotidine (Pepcid): 20 mg IV/PO bid OR
Lansoprazole (Prevacid): 30 mg qd.
12. Extras: ECG stat and in 12h and in AM, portable CXR, impedance cardiography, echocardiogram. Cardiology consult.
13. Labs: SMA7 and 12, magnesium. Cardiac enzymes: CPK, CPK-MB, troponin T, myoglobin STAT and q8h x 3. CBC, INR/PTT, UA.

NON-ST SEGMENT ELEVATION MYOCARDIAL INFARCTION (NSTEMI) AND UNSTABLE ANGINA

1. Admission: Coronary care unit
2. Diagnosis: Acute coronary syndrome
3 Condition:
4. Vital Signs: q1h. Call physician if pulse >90,<60; BP >150/90, <90/60; R>25, <12; T >38.5°C.
5. Activity: Bed rest with bedside commode.
7. Nursing: Guaiac stools. If patient has chest pain, obtain 12-lead ECG and call physician.
8. Diet: Cardiac diet, 1-2 gm sodium, low fat, low cholesterol. No caffeine or temperature extremes.
9. IV Fluids: D5W at TKO
10. Special Medications:
Oxygen: 2-4 L/min by NC.
Aspirin: 325 mg PO, chew and swallow immediately, then aspirin EC 162 mg PO qd OR
Clopidogrel (Plavix): 75 mg PO qd (if allergic to aspirin)
OR
Aspirin: 325 mg to chew and swallow, then 81-162 mg PO qd PLUS clopidogrel 300 mg PO x 1, then 75 mg PO qd.
Nitroglycerin infusion: 10 mcg/min infusion (50 mg in 250-500 mL D5W, 100-200 mcg/mL). Titrate to control symptoms in 5-10 mcg/min steps, up to 1-3 mcg/kg/min; maintain systolic BP >90 OR
Nitroglycerin SL: 0.4 mg mg SL q5min until pain-free (up to 3 tabs) OR
Nitroglycerin spray: (0.4 mg/aerosol spray) 1-2 sprays under the tongue q 5min; may repeat 2 times.
Heparin: 60 U/kg IV push, then 15 U/kg/hr by continuous IV infusion for 48 hours to maintain aPTT of 50-70 seconds. Check aPTTq6h x 4, then qd. Repeat aPTT 6 hours after each dosage change.
Glycoprotein IIb/IIIa Blockers in High-Risk Patients and Those with Planned Percutaneous Coronary Intervention (PCI):
-Eptifibatide (Integrilin) 180 mcg/kg IVP, then 2 mcg/kg/min for 48-72 hours OR
Tirofiban (Aggrastat) 0.4 mcg/kg/min for 30 min, then 0.1 mcg/kg/min for 48-108 hours.
Glycoprotein IIb/IIIa Blockers for Use During PCI:
Abciximab (ReoPro): 0.25 mg/kg IVP, then 0.125 mcg/kg/min IV infusion for 12 hours OR
Eptifibatide (Integrilin): 180 mcg/kg IVP, then 2 mcg/kg/min for 18-24 hours.
Beta-Blockers: Contraindicated in cardiogenic shock.
Metoprolol (Lopressor): 5 mg IV q2-5min x 3 doses; then 25 mg PO q6h for 48h, then 100 mg PO q12h; keep HR <60/min, hold if systolic BP <100 mm Hg OR
Atenolol (Tenormin): 5 mg IV, repeated in 5 minutes, followed by 50-100 mg PO qd OR
Esmolol (Brevibloc): 500 mcg/kg IV over 1 min, then 50 mcg/kg/min IV infusion, titrated to heart rate >60 bpm (max 300 mcg/kg/min).
Angiotensin Converting Enzyme Inhibitors:
Lisinopril (Zestril, Prinivil): 2.5-5 mg PO qd; titrate to 10-20 mg qd.
Benazepril (Lotensin): 10 mg qd OR
Rampril (Altace): 5-10 mg qd OR
Perindopril (Aceon): 4-8 mg qd.
Long-Acting Nitrates:
Nitroglycerin patch: 0.2 mg/hr qd. Allow for nitrate-free period to prevent tachyphylaxis.
Isosorbide dinitrate (Isordil): 10-60 mg PO tid [5,10,20, 30,40 mg] OR
Isosorbide mononitrate (Imdur): 30-60 mg PO qd.
Statins:
Rosuvastatin (Crestor): 10 mg PO qd OR
Atorvastatin (Lipitor): 10 mg PO qhs OR
Pravastatin (Pravachol): 40 mg PO qhs OR
Simvastatin (Zocor): 40 mg PO qhs OR
Lovastatin (Mevacor): 20 mg PO qhs OR
Fluvastatin (Lescol):10-20 mg PO qhs.
11. Symptomatic Medications:
Morphine sulfate: 2-4 mg IV push prn chest pain.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
Lorazepam (Ativan):1-2 mg PO tid-qid prn anxiety.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.
Docusate (Colace): 100 mg PO bid.
Ondansetron (Zofran): 2-4 mg IV q4h prn N/V.
Famotidine (Pepcid): 20 mg IV/PO bid OR
Lansoprazole (Prevacid): 30 mg qd.
12. Extras: ECG stat and in 12h and in AM, portable CXR, impedance cardiography, echocardiogram. Cardiology consult.
13. Labs: SMA7 and 12, magnesium. Cardiac enzymes: CPK, CPK-MB, troponin T, myoglobin STAT and q6h for 24h. CBC, INR/PTT, UA.

CONGESTIVE HEART FAILURE

1. Admission: Cardiololgy care unit
2. Diagnosis: Congestive Heart Failure
3. Condition:
4. Vital Signs: q1h. Call physician if P >120; BP >150/100 <80/60; T >38.5EC; R >25, <10.
5. Activity: Bed rest with bedside commode.
6. Nursing: Daily weights, measure inputs and outputs. Head-of-bed at 45 degrees, legs elevated.
7. Diet: 1-2 gm salt, cardiac diet.
8. IV Fluids: Heparin lock with flush q shift.
9. Special Medications:
Oxygen: 2-4 L/min by NC.
Diuretics:
Furosemide (Lasix): 10-160 mg IV qd-bid or 20-80 mg PO qAM-bid [20, 40, 80 mg] or 10-40 mg/hr IV infusion OR
Torsemide (Demadex): 10-40 mg IV or PO qd; max 200 mg/day [5, 10, 20, 100 mg] OR

Bumetanide (Bumex): 0.5-1 mg IV q2-3h until response; then 0.5-1.0 mg IV q8-24h (max 10 mg/d); or 0.5-2.0 mg PO qAM.
Metolazone (Zaroxolyn):2.5-10 mg PO qd, max 20 mg/d; 30 min before loop diuretic [2.5, 5, 10 mg].

ACE Inhibitors:
Quinapril (Accupril): 5-10 mg PO qd x 1 dose, then 20-80 mg PO qd in 1 to 2 divided doses [5, 10, 20, 40 mg] OR
Lisinopril (Zestril, Prinivil): 5-40 mg PO qd [5, 10, 20, 40 mg] OR
Benazepril (Lotensin): 10-20 mg PO qd-bid, max 80 mg/d [5, 10, 20, 40 mg] OR
Fosinopril (Monopril): 10-40 mg PO qd, max 80 mg/d [10, 20 mg] OR
Ramipril (Altace): 2.5-10 mg PO qd, max 20 mg/d [1.25, 2.5, 5, 10 mg].
Captopril (Capoten): 6.25-50 mg PO q8h [12.5, 25,50,100 mg] OR
Enalapril (Vasotec): 1.25-5 mg slow IV push q6h or 2.5- 20 mg PO bid [5,10,20 mg] OR
Moexipril (Univasc): 7.5 mg PO qd x 1 dose, then 7.5-15 mg PO qd-bid [7.5, 15 mg tabs] OR
Trandolapril (Mavik): 1 mg qd x 1 dose, then 2-4 mg qd [1, 2, 4 mg tabs].
Angiotensin-II Receptor Blockers:
Irbesartan (Avapro): 150 mg qd, max 300 mg qd [75, 150, 300 mg].
Losartan (Cozaar): 25-50 mg bid [25, 50 mg].
Valsartan (Diovan): 80 mg qd; max 320 mg qd [80, 160 mg].
Candesartan (Atacand): 8-16 mg qd-bid [4, 8, 16, 32 mg].
Telmisartan (Micardis): 40-80 mg qd [40, 80 mg].
Adosterone Receptor Blockers:
Spironolactose (Aldactone): 25 mg PO qd
Eplerenone (Inspra): 25 mg PO qd.
Beta-Blockers:
Carvedilol (Coreg) 1.625-3.125 mg PO bid, then slowly increase the dose every 2 weeks to target dose of 25- 50 mg bid [tab 3.125, 6.25, 12.5, 25 mg] OR
Metoprolol (Lopressor): start at 12.5 mg bid, then slowly increase to target dose of 100 mg bid [50, 100 mg] OR
Bisoprolol (Zebeta): start at 1.25 mg qd, then slowly increase to target of 10 mg qd [5,10 mg] OR
Metoprolol XL (Toprol XL): 50-100 mg PO qd.
Digoxin (Lanoxin) 0.125-0.25 mg PO or IV qd [0.125, 0.25, 0.5 mg].
Inotropic Agents:
Dobutamine (Dobutrex): 2.5-10 mcg/kg/min IV, max of 14 mcg/kg/min (500 mg in 250 mL D5W, 2 mcg/mL) OR
Dopamine (Intropin): 3-15 mcg/kg/min IV (400 mg in 250 cc D5W, 1600 mcg/mL), titrate to CO >4, CI >2; systolic >90 OR
Milrinone (Primacor): 0.375 mcg/kg/min IV infusion (40 mg in 200 mL NS, 0.2 mg/mL); titrate to 0.75 mgc/kg/min; arrhythmogenic; may cause hypotension.
Vasodilators:
Nitroglycerin: 5 mcg/min IV infusion (50 mg in 250 mL D5W). Titrate in increments of 5 mcg/min to control symptoms and maintain systolic BP >90 mmHg.
Nesiritide (Natrecor): 2 mcg/kg IV load over 1 min, then 0.010 mcg/kg/min IV infusion. Titrate in increments of 0.005 mcg/kg/min q3h to max 0.03 mcg/kg/min IV
infusion.
Isosorbide dinitrate/hydralazine (BiDil): 20 mg/37.5 mg tabs, 1-2 tabs tid; shown to decrease mortality in black patients with heart failure when added to
standard treatment.
Potassium:
KCL (Micro-K): 20-60 mEq PO qd if the patient is taking loop diuretics.
Pacing:
Synchronized biventricular pacing: if ejection fraction <40% and QRS duration >135 msec.
10. Symptomatic Medications:
Morphine sulfate: 2-4 mg IV push prn dyspnea or anxiety.
Heparin: 5000 U SQ q12h or enoxaparin (Lovenox) 1 mg/kg SC q12h.
Docusate (Colace): 100-200 mg PO qhs.
Famotidine (Pepcid): 20 mg IV/PO q12h OR
Lansoprazole (Prevacid): 30 mg qd.
11. Extras: CXR PA and LAT, ECG now and repeat if chest pain or palpitations, impedance cardiography, echocardiogram.
12. Labs: SMA 7&12, CBC; B-type natriuretic peptide (BNP), cardiac enzymes: CPK, CPK-MB, troponin T, myoglobin STAT and q6h for 24h. Repeat SMA 7 in AM. UA.

SUPRAVENTRICULAR TACHYCARDIA

1. Admission: Cardiology Care Unit
2. Diagnosis: PSVT
3. Condition:
4. Vital Signs: q1h. Call physician if BP >160/90, <90- /60; apical pulse >130, <50; R >25, <10; T >38.5EC
5. Activity: Bedrest with bedside commode.
6. Nursing:
7. Diet: Low fat, low cholesterol, no caffeine.
8. IV Fluids: D5W at TKO.
9. Special Medications:
Attempt vagal maneuvers (Valsalva maneuver) before drug therapy.
Cardioversion (if unstable or refractory to drug therapy):
1. NPO for 6h, digoxin level must be less than 2.4 and potassium and magnesium must be normal.
2. Midazolam (Versed) 2-5 mg IV push.
3. If stable, cardiovert with synchronized 10-50 J, and increase by 50 J increments if necessary. If unstable, start with 100 J, then increase to 200 J and 360 J.
Pharmacologic Therapy of Supraventricular Tachycardia:

Adenosine (Adenocard): 6 mg rapid IV over 1-2 sec, followed by saline flush, may repeat 12 mg IV after 2-3 min, up to max of 30 mg total OR
Verapamil (Isoptin): 2.5-5 mg IV over 2-3 min (may give calcium gluconate 1 gm IV over 3-6 min prior to verapamil); then 40-120 mg PO q8h [40, 80, 120 mg] or verapamil SR 120-240 mg PO qd [120, 180, 240 mg] OR
Esmolol(Brevibloc): 500 mcg/kg IV over 1 min, then 50 mcg/kg/min IV infusion, titrated to HR of <80 (max of 300 mcg/kg/min) OR
Diltiazem (Cardizem): 0.25 mg/kg IV over 2-5 minutes, followed by 5 mg/h IV infusion. Titrate to max 15 mg/h; then diltiazem-CD (Cardizem-CD) 120-240 mg PO qd OR
Metoprolol (Lopressor): 5 mg IVP q4-6h; then 50-100 mg PO bid, or metoprolol XL (Toprol-XL) 50-100 mg PO qd OR
Digoxin (Lanoxin): 0.25 mg q4h as needed; up to 1.0- 1.5 mg; then 0.125-0.25 mg PO qd.

10.Symptomatic Medications:
Lorazepam (Ativan): 1-2 mg PO tid prn anxiety.
11.Extras: Portable CXR, ECG; repeat if chest pain.
Cardiology consult.
12.Labs: CBC, SMA 7 & 12, Mg, thyroid panel. UA.

VENTRICULAR ARRHYTHMIAS

1. Ventricular Fibrillation and Tachycardia:
If unstable (see ACLS protocol)**:** Defibrillate with unsynchronized 200 J, then 300 J.
Oxygen: 100% by mask.
Lidocaine (Xylocaine): loading dose 75-100 mg IV, then 2-4 mg/min IV OR
Amiodarone (Cordarone): 300 mg in 100 mL of D5W, IV infusion over 10 min, then 900 mg in 500 mL of D5W, at 1 mg/min for 6 hrs, then at 0.5 mg/min thereafter; or 400 mg PO q8h x 14 days, then 200- 400 mg qd.

OTHER ANTIARRHYTHMICS

2. Torsades de Pointes Ventricular Tachycardia:
Correct underlying causes:
including hypomagnesemia, and hypokalemia, and consider discontinuing quinidine, procainamide, disopyramide, moricizine, amiodarone, sotalol, ibutilide, phenothiazine, haloperidol, tricyclic and tetracyclic antidepressants, ketoconazole, itraconazole, bepridil.
Magnesium sulfate: 1-4 gm in IV bolus over 5-15 min, or infuse 3-20 mg/min for 7-48h until QTc interval <440 msec.
Isoproterenol (Isuprel): 2-20 mcg/min (2 mg in 500 mL D5W, 4 mcg/mL).
Consider ventricular pacing and/or cardioversion.

3. Other Antiarrhythmics:

Class I:
Moricizine (Ethmozine): 200-300 mg PO q8h, max 900 mg/d [200, 250, 300 mg].

Class Ia:
Quinidine gluconate (Quinaglute): 324-648 mg PO q8-12h [324 mg].
Procainamide (Procan, Procanbid):
IV: 15 mg/kg IV loading dose at 20 mg/min, followed by 2-4 mg/min continuous IV infusion.
PO: 500 mg (nonsustained release) PO q2h x 2 doses, then Procanbid 1-2 gm PO q12h [500, 1000 mg].
Disopyramide (Norpace, Norpace CR): 100-300 mg PO q6-8h [100, 150, mg] or disopyramide CR 100- 150 mg PO bid [100, 150 mg].

Class Ib:
Lidocaine (Xylocaine): 75-100 mg IV, then 2-4 mg/min IV
Mexiletine (Mexitil): 100-200 mg PO q8h, max 1200 mg/d [150, 200, 250 mg].
Tocainide (Tonocard): loading 400-600 mg PO, then 400-600 mg PO q8-12h (1200-1800 mg/d) PO in divided doses q8-12h [400, 600 mg].
Phenytoin (Dilantin): loading dose 100-300 mg IV given as 50 mg in NS over 10 min IV q5min, then 100 mg IV q5min prn.

Class Ic:
Flecainide (Tambocor): 50-100 mg PO q12h, max 400 mg/d [50, 100, 150 mg].
Propafenone (Rythmol): 150-300 mg PO q8h, max 1200 mg/d [150, 225, 300 mg].

Class II:
Propranolol (Inderal): 1-3 mg IV in NS (max 0.15 mg/kg) or 20-80 mg PO tid-qid [10, 20, 40, 60, 80 mg]; propranolol-LA (Inderal-LA), 80-120 mg PO qd [60, 80, 120, 160 mg]
Esmolol (Brevibloc): loading dose 500 mcg/kg over 1 min, then 50-200 mcg/kg/min IV infusion
Atenolol (Tenormin): 50-100 mg/d PO [25, 50, 100mg].
Nadolol (Corgard): 40-100 mg PO qd-bid [20, 40, 80, 120, 160 mg].
Metoprolol (Lopressor): 50-100 mg PO bid-tid [50, 100 mg], or metoprolol XL (Toprol-XL) 50-200 mg PO qd [50, 100, 200 mg].

Class III:
Amiodarone (Cordarone): PO loading 400-1200 mg/d in divided doses for 2-4 weeks, then 200-400 mg PO qd (5-10 mg/kg) [200 mg] or amiodarone (Cordarone) 300 mg in 100 mL of D5W, IV infusion over 10-20 min, then 900 mg in 500 mL of D5W, at 1 mg/min for 6 hrs, then at 0.5 mg/min thereafter.
Sotalol (Betapace): 40-80 mg PO bid, max 320 mg/d in 2-3 divided doses [80, 160 mg].

4. Extras: CXR, ECG, Holter monitor, signal averaged ECG, cardiology consult.
5. Labs: SMA 7&12, Mg, calcium, CBC, drug levels. UA.

HYPERTENSIVE EMERGENCIES

1. Admission: Coronary Care Unit
2. Diagnosis: Hypertensive emergencies
3. Condition:
4. Vital Signs: q30min until BP controlled, then q4h.
5. Activity: Bed rest
6. Nursing: Intra-arterial BP monitoring, daily weights, inputs and outputs.
7. Diet: Clear liquids.
8. IV Fluids: D5W at TKO.
9. Special Medications:
Nitroprusside sodium: 0.25-10 mcg/kg/min IV (50 mg in 250 mL of D5W), titrate to desired BP -Labetalol (Trandate, Normodyne) 20 mg IV bolus (0.25 mg/kg), then 20-80 mg boluses IV q10- 15min, titrate to desired BP or continuous IV infusion
of 1.0-2.0 mg/min, titrate to desired BP. Ideal in patients with thoracic or aortic abdominal aneurysm.
Fenoldopam (Corlopam): 0.01mcg/kg/min IV infusion. Adjust dose by 0.025-0.05 mcg/kg/min q15min to max 0.3 mcg/kg/min. [10 mg in 250 mL D5W].
Nicardipine (Cardene IV): 5 mg/hr IV infusion, increase rate by 2.5 mg/hr every 15 min up to 15 mg/hr (25 mg in D5W 250 mL).
Enalaprilat (Vasotec IV): 1.25- 5.0 mg IV q6h. Do not use in presence of acute myocardial infarction or bilateral renal stenosis.
Esmolol (Brevibloc): 500 mcg/kg/min IV infusion for 1 minute, then 50 mcg/kg/min; titrate by 50 mcg/kg/min increments to 300 mcg/kg/min (2.5 gm in D5W 250 mL).
Clonidine (Catapres): initial 0.1-0.2 mg PO followed by 0.1 mg per hour until DBP <115 (max total dose of 0.8 mg).
Phentolamine (pheochromocytoma): 5-10 mg IV, repeated as needed up to 20 mg.
Trimethaphan (Arfonad [dissecting aneurysm]): 2-4 mg/min IV infusion (500 mg in 500 mL of D5W).
10. Symptomatic Medications:
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.
Docusate sodium (Colace): 100-200 mg PO qhs.
11. Extras: Portable CXR, ECG, impedance cardiography, echocardiogram.
12. Labs: CBC, SMA 7, UA with micro. TSH, free T4, 24h urine for metanephrine. Plasma catecholamines, urine drug screen.

HYPERTENSION

I. Initial Diagnostic Evaluation of ypertension

A. Lead electrocardiography may document evidence of ischemic heart disease, rhythm and conduction disturbances, or left ventricular hypertrophy.
B. Screening labs. Complete blood count, glucose, potassium, calcium, creatinine, BUN, uric acid, and fasting lipid panel.
C. Urinalysis. Glucose, protein, and hemoglobin.
D. Selected patients may require plasma rennin activity, 24 hour urine catecholamines.

II. Antihypertensive Drugs A. Thiazide Diuretics

1. Hydrochlorothiazide (HCTZ, HydroDiuril), 12.5-25 mg qd [25 mg].
2. Chlorothiazide (Diuril) 250 mg qd [250, 500 mg].
3. Thiazide/Potassium Sparing Diuretic
Combinations
a. Maxzide (hydrochlorothiazide 50/triamterene 75 mg) 1 tab qd.
b. Moduretic (hydrochlorothiazide 50 mg/amiloride 5 mg) 1 tab qd.
c. Dyazide (hydrochlorothiazide 25 mg/triamterene 37.5) 1 cap qd.

B. Beta-Adrenergic Blockers
1. Cardioselective Beta-Blockers
a. Atenolol (Tenormin) initial dose 50 mg qd, then 50-100 mg qd, max 200 mg/d [25, 50, 100 mg].
b. Metoprolol XL (Toprol XL) 100-200 mg qd [50, 100, 200 mg tab ER].
c. Bisoprolol (Zebeta) 2.5-10 mg qd; max 20 mg qd [5,10 mg].
2. Non-Cardioselective Beta-Blockers
a. Propranolol LA (Inderal LA), 80-160 mg qd [60, 80, 120, 160 mg].
b. Nadolol (Corgard) 40-80 mg qd, max 320 mg/d [20, 40, 80, 120, 160 mg].
c. Pindolol (Visken) 5-20 mg qd, max 60 mg/d [5, 10 mg].
d. Carteolol (Cartrol) 2.5-10 mg qd [2.5, 5 mg].

C. Angiotensin-Converting Enzyme (ACE) Inhibitors
1. Ramipril (Altace) 2.5-10 mg qd, max 20 mg/day [1.25, 2.5, 5, 10 mg].
2. Quinapril (Accupril) 20-80 mg qd [5, 10, 20, 40 mg].
3. Lisinopril (Zestril, Prinivil) 10-40 mg qd [2.5, 5, 10, 20, 40 mg].
4. Benazepril (Lotensin) 10-40 mg qd, max 80 mg/day [5, 10, 20, 40 mg].
5. Fosinopril (Monopril) 10-40 mg qd [10, 20 mg].
6. Enalapril (Vasotec) 5-40 mg qd, max 40 mg/day [2.5, 5, 10, 20 mg].
7. Moexipril (Univasc) 7.5-15 mg qd [7.5 mg].

D. Angiotensin Receptor Blockers
1. Losartan (Cozaar) 25-50 mg bid [25, 50 mg].
2. Valsartan (Diovan) 80-160 mg qd; max 320 mg qd [80, 160 mg].
3. Irbesartan (Avapro) 150 mg qd; max 300 mg qd [75, 150, 300 mg].
4. Candesartan (Atacand) 8-16 mg qd-bid [4, 8, 16, 32 mg].
5. Telmisartan (Micardis) 40-80 mg qd [40, 80 mg].

E. Calcium Channel Blockers

1. Diltiazem SR (Cardizem SR) 60-120 mg bid [60, 90, 120 mg] or Cardizem CD 180-360 mg qd [120, 180, 240, 300 mg].
2. Nifedipine XL (Procardia-XL, Adalat-CC) 30- 90 mg qd [30, 60, 90 mg].
3. Verapamil SR (Calan SR, Covera-HS) 120- 240 mg qd [120, 180, 240 mg].
4. Amlodipine (Norvasc) 2.5-10 mg qd [2.5, 5, 10 mg].
5. Felodipine (Plendil) 5-10 mg qd [2.5, 5, 10 mg].

SYNCOPE

1. Admission: Monitored ward
2. Diagnosis: Syncope
3. Condition:
4. Vital Signs: q1h, postural BP and pulse q12h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10
5. Activity: Bed rest.
6. Nursing: Fingerstick glucose.
7. Diet: Regular
8. IV Fluids: Normal saline at TKO.
9. Special medications:
High-Grade AV Block with Syncope:
Atropine: 1 mg IV x 2.
Isoproterenol: 0.5-1 mcg/min initially, then slowly titrate to 10 mcg/min IV infusion (1 mg in 250 mL NS).
Transthoracic pacing**.**
Drug-Induced Syncope:
Discontinue vasodilators: centrally acting hypotensive agents, tranquilizers, antidepressants, and alcohol use.
Vasovagal Syncope:
Scopolamine:1.5 mg transdermal patch q3 days.
Postural Syncope:
Midodrine (ProAmatine): 2.5 mg PO tid, then increase to 5-10 mg PO tid [2.5, 5 mg]; contraindicated in coronary artery disease.
Fludrocortisone: 0.1-1.0 mg PO qd.
10. Symptomatic Medications:
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
Docusate sodium (Colace): 100-200 mg PO qhs.
11. Extras: CXR, ECG, 24h Holter monitor, electrophysiologic study, tilt test, CT/MRI, EEG, impedance cardiography, echocardiogram.
12. Labs: CBC, SMA 7&12, CPK, CK-MB, troponin T, myoglobin, Mg, calcium, drug levels. UA, urine drug screen.

PULMONARY DISORDERS

ASTHMA

1. Admission: Respiratory Care Unit
2. Diagnosis: Exacerbation of asthma
3. Condition:
4. Vital Signs: q6h. Call physician if P >140; R >30, <10; T >38.5EC; pulse oximeter <90%
5. Activity: Up as tolerated.
6. Nursing: Pulse oximeter, bedside peak flow rate before and after bronchodilator treatments.
7. Diet: Regular, no caffeine.
8. IV Fluids: D5 ½ NS at 125 cc/h.
9. Special Medications:
Oxygen: 2 L/min by NC. Keep O2 sat >90%.
Beta-Agonists, Acute Treatment:
Albuterol (Ventolin): 0.5 mg and ipratropium (Atrovent) 0.5 mg in 2.5 mL NS q1-2h until peak flow meter $200-250 L/min and sat $90%, then q4h OR
Levalbuterol (Xopenex): 0.63-1.25 mg by nebulization q6-8h prn.
Albuterol (Ventolin): MDI 3-8 puffs, then 2 puffs q3-6h prn, or powder 200 mcg/capsule inhaled qid.
Albuterol/Ipratropium (Combivent): 2-4 puffs qid.
Systemic Corticosteroids:
Methylprednisolone (Solu-Medrol): 60-125 mg IV q6h; then 30-60 mg PO qd. OR
Prednisone: 20-60 mg PO qAM.
Aminophylline and Theophylline (second-line therapy)**:**
Aminophylline: load dose: 5.6 mg/kg total body weight in 100 mL D5W IV over 20 min. Maintenance of 0.5-0.6 mg/kg ideal body weight/h (500 mg in 250 mL D5W); reduce if elderly, heart/liver failure (0.2-0.4 mg/kg/hr). Reduce load 50-75% if taking theophylline (1 mg/kg of aminophylline will raise levels 2 mcg/mL) OR
Theophylline: IV solution loading dose 4.5 mg/kg total body weight, then 0.4-0.5 mg/kg ideal body weight/hr.
Theophylline: (Theo-Dur) 100-400 mg PO bid (3 mg/kg q8h); 80% of total daily IV aminophylline in 2- 3 doses.
Maintenance Inhaled Corticosteroids (adjunct therapy)**:**
Advair Diskus: (fluticasone/salmeterol) one puff bid [doses of 100/50 mcg, 250/50 mcg, and 500/50 mcg]. Not appropriate for acute attacks.
Beclomethasone (Beclovent): MDI 4-8 puffs bid, with spacer 5 min after bronchodilator, followed by gargling with water.
Triamcinolone (Azmacort): MDI 2 puffs tid-qid or 4 puffs bid.
Flunisolide (AeroBid): MDI 2-4 puffs bid.
Fluticasone (Flovent): 2-4 puffs bid (44 or 110 mcg/puff).

Maintenance Treatment:
Salmeterol (Serevent): 2 puffs bid; not effective for acute asthma because of delayed onset of action.
Pirbuterol (Maxair) MDI 2 puffs q4-6h prn.
-Bitolterol (Tornalate) MDI 2-3 puffs q1-3min, then 2-3 puffs q4-8h prn.
Fenoterol (Berotec): MDI 3 puffs, then 2 bid-qid.
Ipratropium (Atrovent): MDI 2-3 puffs tid-qid.
Prevention and Prophylaxis:
Cromolyn (Intal): 2-4 puffs tid-qid.
Nedocromil (Tilade): 2-4 puffs bid-qid.

Montelukast (Singulair): 10 mg PO qd.
Zafirlukast (Accolate): 20 mg PO bid.
Zileuton (Zyflo): 600 mg PO qid.

Acute Bronchitis

Ampicillin/sulbactam (Unasyn): 1.5 gm IV q6h OR
Cefuroxime (Zinacef): 750 mg IV q8h OR
Cefuroxime axetil (Ceftin): 250-500 mg PO bid OR
Trimethoprim/sulfamethoxazole (Bactrim DS): 1 tab PO bid OR
Levofloxacin (Levaquin): 500 mg PO/IV PO qd [250, 500 mg].
Amoxicillin 875 mg/clavulanate 125 mg (Augmentin 875): 1 tab PO bid.

10. Symptomatic Medications:

Docusate sodium (Colace): 100 mg PO qhs.
Famotidine (Pepcid): 20 mg IV/PO q12h OR
Lansoprazole (Prevacid): 30 mg qd.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.

11. Extras: Portable CXR, ECG, pulmonary function tests before and after bronchodilators; pulmonary rehabilitation; impedance cardiography, echocardiogram.

12. Labs: ABG, CBC with eosinophil count, SMA7, Btype natriuretic peptide (BNP). Theophylline level stat and after 24h of infusion. Sputum Gram stain, C&S.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

1. Admission: Respiratory Care Unit
2. Diagnosis: Exacerbation of COPD
3. Condition:
4. Vital Signs: q4h. Call physician if P >130; R >30, <10; T >38.5EC; O2 saturation <90%.
5. Activity: Up as tolerated; bedside commode.
6. Nursing: Pulse oximeter. Measure peak flow with portable peak flow meter bid and chart with vital signs. No sedatives.
7. Diet: No added salt, no caffeine. Push fluids.
8. IV Fluids: D5 1/2 NS with 20 mEq KCL/L at 125 cc/h.
9. Special Medications:

Oxygen: 1-2 L/min by NC or 24-35% by Venturi mask, keep O2 saturation 90-91%.

Beta-Agonists, Acute Treatment:

Albuterol (Ventolin): 0.5 mg and ipratropium (Atrovent) 0.5 mg in 2.5 mL NS q1-2h until peak flow meter $200-250 L/min, then q4h prn OR
Levalbuterol (Xopenex): 0.63-1.25 mg by nebulization q6-8h prn.
Albuterol (Ventolin): MDI 2-4 puffs q4-6h.
Albuterol/Ipratropium (Combivent): 2-4 puffs qid.

Maintenance Corticosteroids and Anticholinergics:

Methylprednisolone (Solu-Medrol): 60-125 mg IV q6h or 30-60 mg PO qd. Followed by:
Prednisone: 20-60 mg PO qd.
Triamcinolone (Azmacort): MDI 2 puffs qid or 4 puffs bid.
Beclomethasone (Beclovent): MDI 4-8 puffs bid with spacer, followed by gargling with water OR
Flunisolide (AeroBid): MDI 2-4 puffs bid OR
Ipratropium (Atrovent): MDI 2 puffs tid-qid OR
Fluticasone (Flovent): 2-4 puffs bid (44 or 110 mcg/puff).

Aminophylline and Theophylline (second line therapy)**:**

Aminophylline: loading dose, 5.6 mg/kg total body weight over 20 min (if not already on theophylline); then 0.5-0.6 mg/kg ideal body weight/hr (500 mg in 250 mL of D5W); reduce if elderly, or heart or liver disease (0.2-0.4 mg/kg/hr). Reduce loading to 50-
75% if already taking theophylline (1 mg/kg of aminophylline will raise levels by 2 mcg/mL) OR
Theophylline: IV solution loading dose, 4.5 mg/kg total body weight, then 0.4-0.5 mg/kg ideal body weight/hr.
Theophylline: long acting (Theo-Dur) 100-400 mg PO bid-tid (3 mg/kg q8h); 80% of daily IV aminophylline in 2-3 doses.

Acute Bronchitis

Trimethoprim/sulfamethoxazole (Septra DS): 160/800 mg PO bid or 160/800 mg IV q12h (10-15 mL in 100 cc D5W tid) **OR**
-Cefuroxime (Zinacef) 750 mg IV q8h **OR**
-Ampicillin/sulbactam (Unasyn) 1.5 gm IV q6h **OR**
Doxycycline (Vibra-tabs): 100 mg PO/IV bid **OR**
Azithromycin (Zithromax): 500 mg x 1, then 250 mg PO qd x 4 or 500 mg IV q24h **OR**
Clarithromycin (Biaxin): 250-500 mg PO bid **OR**
Levofloxacin (Levaquin): 500 mg PO/IV qd [250, 500 mg].

10. Symptomatic Medications:

Docusate sodium (Colace): 100 mg PO qhs.
Famotidine (Pepcid): 20 mg IV/PO bid **OR**
Lansoprazole (Prevacid): 30 mg qd.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.

11. Extras: Portable CXR, PFTs with bronchodilators, ECG, impedance cardiography, echocardiogram.

12. Labs: ABG, CBC, SMA7, UA. Theophylline level stat and after 12-24h of infusion. Sputum Gram stain and C&S, alpha 1 antitrypsin level**.**

HEMOPTYSIS

1. Admission: Intensive care unit
2. Diagnosis: Hemoptysis
3. Condition:
4. Vital Signs: q1-6h. Orthostatic BP and pulse bid. Call physician if BP >160/90, <90/60; P >130, <50; R>25, <10; T >38.5EC; O2 sat <90%.

5. Activity: Bed rest with bedside commode. Keep patient in lateral decubitus, Trendelenburg's position, bleeding side down.
6. Nursing: Quantify all sputum and expectorated blood, suction prn. O2 at 100% by mask, pulse oximeter. Discontinue narcotics and sedatives. Have double lumen endotracheal tube available for use. Foley to closed drainage.
7. Diet: NPO
8. IV Fluids: 1 L of NS wide open ($6 gauge), then transfuse PRBC. Then infuse D5 1/2 NS at 125 cc/h.
9. Special Medications:
Transfuse: 2-4 U PRBC wide open.
Promethazine/codeine (Phenergan with codeine): 5 cc PO q4-6h prn cough. Contraindicated in massive hemoptysis.
Initiate empiric antibiotics if bronchitis or infection is present.
10. Extras: CXR PA, LAT, ECG, VQ scan, contrast CT, bronchoscopy. PPD, pulmonary and thoracic surgery consults.
11. Labs: Type and cross 2-4 U PRBC. ABG, CBC, platelets, SMA7 and 12, ESR. Anti-glomerular basement antibody, rheumatoid factor, complement, anti-nuclear cytoplasmic antibody. Sputum Gram stain, C&S, AFB, fungal culture, and cytology qAM for 3 days. UA, INR/PTT, von Willebrand Factor. Repeat CBC q6h.

ANAPHYLAXIS

1. Admission: Respiratory Care Unit
2. Diagnosis: Anaphylaxis
3. Condition:
4. Vital Signs: q1-4h; call physician if BP systolic >160, <90; diastolic >90, <60; P >120, <50; R>25, <10; T >38.5EC
5. Activity: Bedrest
6. Nursing: O2 at 6 L/min by NC or mask. Keep patient in Trendelenburg's position, No. 4 or 5 endotracheal tube at bedside. Foley to closed drainage.
7. Diet: NPO
8. IV Fluids: 2 IV lines. Normal saline or LR 1 L over 1-2h, then D5 ½ NS at 125 cc/h.
9. Special Medications:
Gastrointestinal Decontamination:
Gastric lavage: with normal saline until clear fluid if indicated for recent oral ingestion.
Activated charcoal: 50-100 gm, followed by magnesium citrate 6% solution 150-300 mL PO.
Bronchodilators:
Epinephrine: (1:1000) 0.3-0.5 mL SQ or IM q10min or 1-4 mcg/min IV OR in severe life-threatening reactions, give 0.5 mg (5.0 mL of 1: 10,000 solution) IV q5-10min prn. Epinephrine, 0.3 mg of 1:1000 solution, may be injected SQ at site of
allergen injection OR
Albuterol (Ventolin): 0.5%, 0.5 mL in 2.5 mL NS q30min by nebulizer prn OR
Aerosolized: 2% racemic epinephrine, 0.5-0.75 mL in 2-3 mL saline nebulized q1-6h.
Corticosteroids:
Methylprednisolone (Solu-Medrol): 250 mg IV x 1,
then 125 mg IV q6h OR
Hydrocortisone sodium succinate: 200 mg IV x 1, then 100 mg q6h, followed by oral prednisone 60 mg PO qd, tapered over 5 days.
Antihistamines:
Diphenhydramine (Benadryl): 25-50 mg PO/IV q4-6h OR
Hydroxyzine (Vistaril): 25-50 mg IM or PO q2-4h.
Cetrizine (Zyrtec): 5-10 mg PO qd.
Cimetadine (Tagamet): 300 mg PO/IV q6-8h.
Pressors and Other Agents:
Norepinephrine (Levophed): 8-12 mcg/min IV, titrate to systolic 100 mm Hg (8 mg in 500 mL D5W) OR
Dopamine (Intropin): 5-20 mcg/kg/min IV.
10. Extras: Portable CXR, ECG, allergy consult.
11. Labs: CBC, SMA 7&12.

PLEURAL EFFUSION

1. Admission: Respiratory Care Unit
2. Diagnosis: Pleural effusion
3. Condition:
4. Vital Signs: q shift. Call physician if BP >160/90, <90/60; P>120, <50; R>25, <10; T >38.5EC
5. Activity:
6. Diet: Regular.
7. IV Fluids: D5W at TKO
8. Extras: CXR PA and LAT, repeat after thoracentesis; left and right lateral decubitus x-rays, ECG, ultrasound, PPD; pulmonary consult.
9. Labs: CBC, SMA 7&12, protein, albumin, amylase, ANA, ESR, INR/PTT, UA. Cryptococcal antigen, histoplasma antigen, fungal culture.
Thoracentesis:
Tube 1: LDH, protein, amylase, triglyceride, glucose (10 mL).
Tube 2: Gram stain, C&S, AFB, fungal C&S (20-60 mL, heparinized).
Tube 3: Cell count and differential (5-10 mL, EDTA).
Syringe: pH (2 mL collected anaerobically, heparinized on ice).
Bag or Bottle: Cytology.
Hematologic Disorders
Anticoagulant Overdose

Unfractionated Heparin Overdose:
1. Discontinue heparin infusion.
2. Protamine sulfate, 1 mg IV for every 100 units of heparin infused in preceding hour, dilute in 25 mL fluid, and give IV over 10 min (max 50 mg in 10 min period).

Low-Molecular-Weight Heparin (Enoxaparin)
Overdose:
Protamine sulfate: 1 mg IV for each 1 mg of enoxaparin given. Repeat protamine 0.5 mg IV for each 1 mg of enoxaparin, if bleeding continues after 2-4 hours. Measure factor Xa.

Warfarin (Coumadin) Overdose:
Gastric lavage: with normal saline until clear fluid and activated charcoal if recent oral ingestion. Discontinue coumadin and heparin, and monitor hematocrit q2h.

Partial Reversal:
Vitamin K (Phytonadione): 0.5-1.0 mg IV/SQ. Check INR in 24 hours, and repeat vitamin K dose if INR remains elevated.

Minor Bleeds:
Vitamin K (Phytonadione): 5-10 mg IV/SQ q12h, titrated to desired INR.

Serious Bleeds:
Vitamin K (Phytonadione): 10-20 mg in 50-100 mL fluid IV over 30-60 min (check INR q6h until corrected) AND
Fresh frozen plasma: 2-4 units x 1. -Type and cross match for 2 units of PRBC, and
transfuse wide open.
Cryoprecipitate: 10 U x 1 if fibrinogen is less than 100 mg/dL.

Labs: CBC, platelets, PTT, INR.

DEEP VENOUS THROMBOSIS

1. Admission: Intensive Care Unit
2. Diagnosis: Deep vein thrombosis
3. Condition:
4. Vital Signs: q shift. Call physician if BP systolic >160, <90 diastolic, >90, <60; P >120, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest with legs elevated; bedside commode.
6. Nursing: Guaiac stools, warm packs to leg prn; measure calf and thigh circumference qd; no intramuscular injections.
7. Diet: Regular
8. IV Fluids: D5W at TKO
9. Special Medications:
Anticoagulation:
Heparin (unfractionated): 80 U/kg IVP, then 18 U/kg/hr IV infusion. Check PTT 6 hours after initial bolus; adjust q6h until PTT 1.5-2.0 times control (50-80 sec). Overlap heparin and warfarin (Coumadin) for at least 4 days and discontinue heparin when INR has been 2.0-3.0 for two consecutive days OR
Enoxaparin (Lovenox): outpatient: 1 mg/kg SQ q12h for DVT without pulmonary embolism. Overlap enoxaparin and warfarin for 4-5 days until INR is 2- 3.
Enoxaparin (Lovenox): inpatient: 1 mg/kg SQ q12h or 1.5 mg/kg SQ q24 h for DVT with or without pulmonary embolism. Overlap enoxaparin and warfarin (Coumadin) for at least 4 days and discontinue heparin when INR has been 2.0-3.0 for two consecutive days.
Warfarin (Coumadin): 5-10 mg PO qd x 2-3 d; maintain INR 2.0-3.0. Coumadin is initiated on the first or second day only if the PTT is 1.5-2.0 times control [tab 1, 2, 2.5, 3, 4, 5, 6, 7.5, 10 mg].
10. Symptomatic Medications:
Propoxyphene/acetaminophen (Darvocet N100): 1-2 tab PO q3-4h prn pain OR
Hydrocodone/acetaminophen (Vicodin): 1-2 tab q4- 6h PO prn pain.
Docusate sodium (Colace): 100 mg PO qhs.
-Famotidine (Pepcid) 20 mg IV/PO q12h OR
Lansoprazole (Prevacid): 30 mg qd.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.
11. Extras: CXR PA and LAT, ECG; Doppler scan of legs. V/Q scan, chest CT scan.
12. Labs: CBC, INR/PTT, SMA 7. Protein C, protein S, antithrombin III, anticardiolipin antibody. UA with dipstick for blood. PTT 6h after bolus and q4-6h until PTT 1.5-2.0 x control then qd. INR at initiation of warfarin and qd.

PULMONARY EMBOLISM

1. Admission: Dept. of pulmonatyr/ chest diseases
2. Diagnosis: Pulmonary embolism
3. Condition:
4. Vital Signs: q1-4h. Call physician if BP >160/90, <90/60; P >120, <50; R >30, <10; T >38.5EC; O2 sat < 90%
5. Activity: Bedrest with bedside commode
6. Nursing: Pulse oximeter, guaiac stools, O2 at 2 L by NC. Antiembolism stockings. No intramuscular injections. Foley to closed drainage.
7. Diet: Regular
8. IV Fluids: D5W at TKO.
9. Special Medications:
Anticoagulation:
Heparin: IV bolus 5000-10,000 Units (100 U/kg) IVP, then 1000-1500 U/h IV infusion (20 U/kg/h) [25,000 U in 500 mL D5W (50 U/mL)]. Check PTT 6 hours after initial bolus; adjust q6h until PTT 1.5-2 times control (60-80 sec). Overlap heparin and Coumadin for at least 4 days and discontinue heparin when INR has been 2.0-3.0 for twoconsecutive days.

Enoxaparin (Lovenox): 1 mg/kg SQ q12h for 5 days for uncomplicated pulmonary embolism. Overlap warfarin as outlined above.
Warfarin (Coumadin): 5-10 mg PO qd for 2-3 d, then 2-5 mg PO qd. Maintain INR of 2.0-3.0. Coumadin is initiated on second day if the PTT is 1.5-2.0 times control. Check INR at initiation of warfarin and qd [tab 1, 2, 2.5, 3, 4, 5, 6, 7.5, 10 mg].
Thrombolytics (indicated for hemodynamic compromise)**:**
Baseline Labs: CBC, INR/PTT, fibrinogen q6h.
Alteplase (recombinant tissue plasminogen activator, Activase)**:** 100 mg IV infusion over 2 hours, followed by heparin infusion at 15 U/kg/h to maintain PTT 1.5-2.5 x control OR
Streptokinase (Streptase): Pretreat with methylprednisolone 250 mg IV push and diphenhydramine (Benadryl) 50 mg IV push. Then give streptokinase, 250,000 units IV over 30 min, then 100,000 units/h for 24-72 hours. Initiate heparin infusion at 10 U/kg/hour; maintain PTT 1.5-2.5 x control.
10. Symptomatic Medications:
Meperidine (Demerol): 25-100 mg IV prn pain.
Docusate sodium (Colace): 100 mg PO qhs.
Famotidine (Pepcid): 20 mg IV/PO q12h OR
Lansoprazole (Prevacid): 30 mg qd.
11. Extras: CXR PA and LAT, ECG, VQ scan; chest CT scan, pulmonary angiography; Doppler scan of lower extremities, impedance cardiography.
12. Labs: CBC, INR/PTT, SMA7, ABG, cardiac enzymes. Protein C, protein S, antithrombin III, anticardiolipin antibody. UA . PTT 6 hours after bolus and q4-6h. INR now and qd.

SICKLE CELL CRISIS

1. Admission: Respiratory Care Unit
2. Diagnosis: Sickle Cell Crisis
3. Condition:
4. Vital Signs: q shift.
5. Activity: Bedrest with bathroom privileges.
6. Nursing:
7. Diet: Regular diet, push oral fluids.
8. IV Fluids: D5 ½ NS at 100-125 mL/h.
9. Special Medications:
Oxygen: 2 L/min by NC or 30-100% by mask.
Meperidine (Demerol): 50-150 mg IM/IV q4-6h prn pain.
Hydroxyzine (Vistaril): 25-100 mg IM/IV/PO q3-4h prn pain.
Morphine sulfate: 10 mg IV/IM/SC q2-4h prn pain OR
Ketorolac (Toradol): 30-60 mg IV/IM, then 15-30 mg IV/IM q6h prn pain (maximum of 3 days).
Acetaminophen/codeine (Tylenol 3): 1-2 tabs PO q4- 6h prn.
Folic acid:1 mg PO qd.
Penicillin V (prophylaxis): 250 mg PO qid [tabs 125,250,500 mg].
Ondansetron (Zofran): 4 mg PO/IV q4-6h prn nausea or vomiting.
10. Symptomatic Medications:
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.
Docusate sodium (Colace): 100-200 mg PO qhs.
Vaccination:
Pneumovax: before discharge 0.5 cc IM x 1 dose.
Influenza vaccine (Fluogen): 0.5 cc IM once a year in the Fall.
11. Extras: CXR.
12. Labs: CBC, SMA 7, blood C&S, reticulocyte count, blood type and screen, parvovirus titers. UA.

INFECTIOUS DISEASES

MENINGITIS

1. Admission: Medical ward
2. Diagnosis: Meningitis.
3. Condition:
4. Vital Signs: q1h. Call physician if BP systolic >160/90, <90/60; P >120, <50; R>25, <10; T >39EC or less than 36EC
5. Activity: Bed rest with bedside commode.
6. Nursing: Respiratory isolation, inputs and outputs, lumbar puncture tray at bedside.
7. Diet: NPO
8. IV Fluids: D5 ½ NS at 125 cc/h with KCL 20 mEq/L.
9. Special Medications:
Empiric Therapy 15-50 years old:
Vancomycin: 1 gm IV q12h AND EITHER
Ceftriaxone (Rocephin): 2 gm IV q12h (max 4 gm/d)
OR
Cefotaxime (Claforan): 2 gm IV q4h.
Empiric Therapy >50 years old (Alcoholic, Corticosteroids or Hematologic Malignancy or other Debilitating Condition)**:**
Ampicillin: 2 gm IV q4h AND EITHER
Cefotaxime (Claforan): 2 gm IV q6h OR Ceftriaxone (Rocephin) 2 gm IV q12h.
Use Vancomycin: 1 gm IV q12h in place of ampicillin if drug-resistant pneumococcus is suspected.
10. Symptomatic Medications:
Dexamethasone (Decadron): 0.4 mg/kg IV q12h x 2 days to commence with first dose of antibiotic.
Heparin: 5000 U SC q12h or pneumatic compression stockings.
Famotidine (Pepcid): 20 mg IV/PO q12h.
Acetaminophen (Tylenol): 650 mg PO/PR q4-6h prn temp >39°C.
Docusate sodium: 100-200 mg PO qhs.
11. Extras: CXR, ECG, PPD, CT scan.
12. Labs: CBC, SMA 7&12. Blood C&S x 2. UA with micro, urine C&S. Antibiotic levels peak and trough after 3rd dose, VDRL.
Lumbar Puncture:

CSF Tube 1: Gram stain, C&S for bacteria (1-4 mL).
CSF Tube 2: Glucose, protein (1-2 mL).
CSF Tube 3: Cell count and differential (1-2 mL).
CSF Tube 4: Latex agglutination or counterimmunoelectrophoresis antigen tests for S. pneumoniae, H. influenzae (type B), N. meningitides, E. coli, group
B strep, VDRL, cryptococcal antigen, toxoplasma titers. India ink, fungal cultures, AFB (8-10 mL).

INFECTIVE ENDOCARDITIS

1. Admission: Medical Care Unit
2. Diagnosis: Infective endocarditis
3. Condition:
4. Vital Signs: q4h. Call physician if BP systolic >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC
5. Activity: Up ad lib, bathroom privileges.
6. Diet: Regular
7. IV Fluids: Heparin lock with flush q shift.
8. Special Medications:
Subacute Bacterial Endocarditis Empiric Therapy:
Penicillin G: 3-5 million U IV q4h or ampicillin 2 gm IV q4h AND
Gentamicin: 1-1.5/mg/kg IV q8h.
Acute Bacterial Endocarditis Empiric Therapy
Gentamicin: 2 mg/kg IV; then 1-1.5 mg/kg IV q8h AND Nafcillin or oxacillin 2 gm IV q4h OR Vancomycin: 1 gm IV q12h (1 gm in 250 mL of D5W over 1h).
Streptococci viridans/bovis:
Penicillin G: 3-5 million U IV q4h for 4 weeks OR Vancomycin: 1 gm IV q12h for 4 weeks AND Gentamicin: 1 mg/kg q8h for first 2 weeks.
Enterococcus:
Gentamicin: 1 mg/kg IV q8h for 4-6 weeks AND Ampicillin: 2 gm IV q4h for 4-6 weeks OR Vancomycin: 1 gm IV q12h for 4-6 weeks.

Staphylococcus aureus (methicillin sensitive, native valve)**:**
Nafcillin or Oxacillin: 2 gm IV q4h for 4-6 weeks OR Vancomycin 1 gm IV q12h for 4-6 weeks AND Gentamicin 1 mg/kg IV q8h for first 3-5 days.

Methicillin-resistant Staphylococcus aureus (native valve):
Vancomycin: 1 gm IV q12h (1 gm in 250 mL D5W over 1h) for 4-6 weeks AND
Gentamicin: 1 mg/kg IV q8h for 3-5 days.
Methicillin-resistant Staph aureus or epidermidis (prosthetic valve)**:**
Vancomycin: 1 gm IV q12h for 6 weeks AND Rifampin: 600 mg PO q8h for 6 weeks AND Gentamicin: 1 mg/kg IV q8h for 2 weeks.
Culture Negative Endocarditis:
Penicillin G: 3-5 million U IV q4h for 4-6 weeks OR Ampicillin: 2 gm IV q4h for 4-6 weeks AND Gentamicin: 1.5 mg/kg q8h for 2 weeks (or nafcillin, 2 gm IV q4h, and gentamicin if Staph aureussuspected in drug abuser or prosthetic valve).
Fungal Endocarditis:
Amphotericin B: 0.5 mg/kg/d IV plus flucytosine (5- FC) 150 mg/kg/d PO.
9. Symptomatic Medications:
Famotidine (Pepcid): 20 mg IV/PO q12h.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn temp >39N C.
Docusate sodium: 100-200 mg PO qhs.
10. Extras: CXR PA and LAT, echocardiogram, ECG.
11. Labs: CBC with differential, SMA 7&12. Blood C&S x 3-4 over 24h, serum cidal titers, minimum inhibitoryconcentration, minimum bactericidal concentration.
Repeat C&S in 48h, then once a week. Antibioticlevels peak and trough at 3rd dose. UA, urine C&S.

PNEUMONIA

1. Admission: Pulmonary Care Unit
2. Diagnosis: Pneumonia
3. Condition:
4. Vital Signs: q4-8h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC or O2 saturation <90%.
5. Activity: Up ad lib, bathroom privileges.
6. Nursing: Pulse oximeter, inputs and outputs, nasotracheal suctioning prn, incentive spirometry.
7. Diet: Regular.
8. IV Fluids: IV D5 ½ NS at 125 cc/hr.
9. Special Medications:
Oxygen: by NC at 2-4 L/min, or 24-50% by Ventimask, or 100% by non-rebreather (reservoir) to maintain O2 saturation >90%.

Moderately Ill Patients Without Underlying Lung Disease From the Community:
Cefuroxime (Zinacef): 0.75-1.5 gm IV q8h OR Ampicillin/sulbactam (Unasyn) 1.5 gm IV q6h AND EITHER - Erythromycin 500 mg IV/PO q6h OR Clarithromycin (Biaxin) 500 mg PO bid OR Azithromycin (Zithromax) 500 mg P O x 1, then 250 mg PO qd x 4 OR Doxycycline (Vibramycin) 100 mg IV/PO q12h.
Moderately Ill Patients With Recent Hospitalization or Debilitated Nursing Home Patient:
Ceftazidime (Fortaz): 1-2 gm IV q8h OR Cefepime (Maxipime) 1-2 gm IV q12h AND EITHER Gentamicin 1.5-2 mg/kg IV, then 1.0-1.5 mg/kg IV q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h OR-Ciprofloxacin (Cipro) 400 mg IV q12h or 500 mg PO q12h.

Critically Ill Patients:
Initial treatment should consist of a macrolide with 2 antipseudomonal agents for synergistic activity:
Erythromycin: 0.5-1.0 gm IV q6h AND EITHER
-Cefepime (Maxipime) 20 mg IV q12h OR Piperacillin/tazobactam (Zosyn) 3.75-4.50 gm IV q6h OR Ticarcillin/clavulanate (Timentin) 3.1 gm IV q6h OR Imipenem/cilastatin (Primaxin) 0.5-1.0 gm IV q6h AND EITHER -Levofloxacin (Levaquin) 500 mg IV q24h OR Ciprofloxacin (Cipro) 400 mg IV q12h OR Tobramycin 2.0 mg/kg IV, then 1.5 mg/kg IV q8h or 7 mg/kg IV q24h.

Aspiration Pneumonia (community acquired):
Clindamycin (Cleocin): 600-900 mg IV q8h (with gentamicin or 3rd gen cephalosporin) OR
mpicillin/sulbactam (Unasyn): 1.5-3 gm IV q6h (with gentamicin or 3rd gen cephalosporin)

Aspiration Pneumonia (nosocomial):
Tobramycin: 2 mg/kg IV then 1.5 mg/kg IV q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h OR Ceftazidime (Fortaz) 1-2 gm IV q8h AND EITHER -Clindamycin (Cleocin) 600-900 mg IV q8h OR Ampicillin/sulbactam or ticarcillin/clavulanate, or piperacillin/tazobactam or imipenem/cilastatin (see above) OR
Metronidazole (Flagyl) 500 mg IV q8h.

10. Symptomatic Medications:
Acetaminophen (Tylenol): 650 mg 2 tab PO q4-6h prn temp >38°C or pain.
Docusate sodium (Colace): 100 mg PO qhs.
Famotidine (Pepcid): 20 mg IV/PO q12h.
Heparin: 5000 U SQ q12h or pneumatic compression stockings.

11. Extras: CXR PA and LAT, ECG, PPD.

12. Labs: CBC with differential, SMA 7&12, ABG. Blood C&S x 2. Sputum Gram stain, C&S. Methenamine silver sputum stain (PCP); AFB smear/culture. Aminoglycoside levels peak and trough 3rd dose. UA, urine culture.

Specific Therapy for Pneumonia

Pneumococcus:
Ceftriaxone (Rocephin): 2 gm IV q12h OR
Cefotaxime (Claforan): 2 gm IV q6h OR
Erythromycin: 500 mg IV q6h OR
Levofloxacin (Levaquin): 500 mg IV q24h OR
Vancomycin:1 gm IV q12h if drug resistance.

Staphylococcus aureus:
Nafcillin: 2 gm IV q4h OR
Oxacillin: 2 gm IV q4h.

Klebsiella pneumoniae:
Gentamicin: 1.5-2 mg/kg IV, then 1.0-1.5 mg/kg IV q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h OR Ceftizoxime (Cefizox) 1-2 gm IV q8h OR Cefotaxime (Claforan) 1-2 gm IV q6h.

Methicillin-resistant staphylococcus aureus (MRSA):
Vancomycin: 1 gm IV q12h.

Vancomycin-Resistant Enterococcus:
Linezolid (Zyvox): 600 mg IV/PO q12h; active against MRSA as well OR
Quinupristin/dalfopristin (Synercid): 7.5 mg/kg IV q8h (does not cover E faecalis).

Haemophilus influenzae:
Ampicillin: 1-2 gm IV q6h (beta-lactamase negative) OR
Ampicillin/sulbactam (Unasyn): 1.5-3.0 gm IV q6h OR
Cefuroxime (Zinacef): 1.5 gm IV q8h (beta-lactamase pos) OR
Ceftizoxime (Cefizox): 1-2 gm IV q8h OR
Ciprofloxacin (Cipro): 400 mg IV q12h OR
Ofloxacin (Floxin): 400 mg IV q12h.
Levofloxacin (Levaquin): 500 mg IV q24h.

Pseudomonas aeruginosa:
Tobramycin: 1.5-2.0 mg/kg IV, then 1.5-2.0 mg/kg IV q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h AND EITHER
Piperacillin, ticarcillin, mezlocillin or azlocillin: 3 gm IV q4h OR
Cefepime (Maxipime): 2 gm IV q12h.

Enterobacter Aerogenes or Cloacae:
Gentamicin: 2.0 mg/kg IV, then 1.5 mg/kg IV q8h AND EITHER
Meropenem (Merrem): 1 gm IV q8h OR Imipenem/cilastatin (Primaxin): 0.5-1.0 gm IV q6h.

Serratia Marcescens:
Ceftizoxime (Cefizox): 1-2 gm IV q8h OR
Aztreonam (Azactam): 1-2 gm IV q6h OR
Imipenem/cilastatin (Primaxin): 0.5-1.0 gm IV q6h OR
Meropenem (Merrem): 1 gm IV q8h.

Mycoplasma pneumoniae:
Clarithromycin (Biaxin): 500 mg PO bid OR
Azithromycin (Zithromax): 500 mg PO x 1, then 250 mg PO qd for 4 days OR
Erythromycin: 500 mg PO or IV q6h OR
Doxycycline (Vibramycin): 100 mg PO/IV q12h OR
Levofloxacin (Levaquin): 500 mg PO/IV q24h.

Legionella pneumoniae:
Erythromycin: 1.0 gm IV q6h OR
Levofloxacin (Levaquin): 500 mg PO/IV q24h.
Rifampin: 600 mg PO qd may be added to erythromycin or levofloxacin.

Moraxella catarrhalis:
Trimethoprim/sulfamethoxazole (Bactrim, Septra): one DS tab PO bid or 10 mL IV q12h OR
Ampicillin/sulbactam (Unasyn): 1.5-3 gm IV q6h OR
Cefuroxime (Zinacef): 0.75-1.5 gm IV q8h OR
Erythromycin: 500 mg IV q6h OR
Levofloxacin (Levaquin): 500 mg PO/IV q24h.

Anaerobic Pneumonia:
Penicillin G: 2 MU IV q4h OR
Clindamycin (Cleocin): 900 mg IV q8h OR
Metronidazole (Flagyl): 500 mg IV q8h.

PNEUMOCYSTIS CARINII PNEUMONIA AND HIV

1. Admission: Medical Care Unit
2. Diagnosis: PCP pneumonia
3. Condition:
4. Vital Signs: q2-6h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; O2 sat <90%
5. Activity: Bedrest, bedside commode.
6. Nursing: Pulse oximeter.
7. Diet: Regular, encourage fluids.
8. IV Fluids: D5 ½ NS at 125 cc/h.

9. Special Medications:
Pneumocystis Carinii Pneumonia:
Oxygen: at 2-4 L/min by NC or by mask.
Trimethoprim/sulfamethoxazole (Bactrim, Septra): 15 mg of TMP/kg/day (20 mL in 250 mL of D5W IVPB q8h) for 21 days [inj: 80/400 mg per 5 mL].
If severe PCP (PaO2 <70 mm Hg): add prednisone 40 mg PO bid for 5 days, then 40 mg qd for 5 days, then 20 mg qd for 11 days OR Methylprednisolone (Solu-Medrol) 30 mg IV q12h for 5 days, then 30 mg IV qd for 5 days, then 15 mg IV qd for 11 days.
Pentamidine (Pentam): 4 mg/kg IV qd for 21 days, with prednisone as above. Pentamidine is an alternative if inadequate response or intolerant to TMP-SMX.
Pneumocystis Carinii Prophylaxis (previous PCP or CD4 <200, or constitutional symptoms):
-Trimethoprim/SMX DS (160/800 mg) PO qd OR
Pentamidine: 300 mg in 6 mL sterile water via Respirgard II nebulizer over 20-30 min q4 weeks OR
Dapsone (DDS): 50 mg PO bid or 100 mg twice a week; contraindicated in G-6-PD deficiency.
Antiretroviral Therapy:
A. Combination therapy: with 3 agents (two nucleoside analogs and a protease inhibitor) is recommended as initial therapy. Nucleotide analogs are similar to nucleosides and may be used interchangeably. Combination of atazanavir plus tenofovir or lamivudine plus abacavir plus tenofovir should be avoided because of the risk of treatment failure.
B. Nucleoside Analogs
1. Abacavir (Ziagen) 300 mg PO bid [300 mg, 20 mg/mL].
2. Didanosine (Videx, ddI) 200 mg bid for patients >60 kg; or 125 mg bid for patients <60 kg. [chewable tabs: 25, 50, 100, 150 mg; pwd 100, 167, 250 mg packets].
3. Emtricitabine (Emtriva) 200 mg PO qd.
4. Lamivudine (Epivir, 3TC) 150 mg twice daily [150 mg].
5. Stavudine (Zerit, D4T) 40 mg bid [15 mg, 20 mg, 30 mg and 40 mg capsules].
6. Zalcitabine (Hivid, ddC) 0.75 mg tid [0.375, 0.75].
7. Zidovudine (Retrovir, AZT) 200 mg tid (100, 200 mg caps, 50 mg/5 mL syrup).
C. Protease Inhibitors
1. Amprenavir (Agenerase) 1200 mg bid [50, 150 mg].
2. Atazanavir (Reyataz) 400 mg PO qd.
3. Indinavir (Crixivan) 800 mg tid [200, 400 mg].
4. Lopinavir/ritonavir (Kaletra) 400 mg/100 mg PO bid.
5. Nelfinavir (Viracept) 750 mg PO tid [250 mg].
6. Ritonavir (Norvir) 600 mg bid [100 mg, 80 mg/dL].
7. Saquinavir (Invirase) 600 mg tid with a meal [cap 200 mg].
D. Non-Nucleoside Reverse Transcriptase Inhibitors
1. Delavirdine (U-90) 400 mg tid.
2. Efavirenz (Sustiva) 600 mg PO qd [50, 100, 200 mg].
3. Nevirapine (Viramune) 200 mg qd for 2 weeks, then bid [200 mg].
E. Nucleotide Analogs
1. Tenofovir (Viread) 300 mg PO qd with food.
Postexposure HIV Prophylaxis
A. The injury should be immediately washed and scrubbed with soap and water.
B. Zidovudine 200 mg PO tid and lamivudine (3TC) 150 mg PO bid, plus indinavir (Crixivan) 800 mg PO tid for highest risk exposures. Treatment is continued for one month.
Zidovudine-Induced Neutropenia/ Ganciclovir- Induced Leucopenia
Recombinant human granulocyte colony-stimulating factor (G-CSF, Filgrastim, Neupogen): 1-2 mcg/kg SQ qd until absolute neutrophil count 500-1000; indicated only if endogenous erythropoietin level is low.
10. Symptomatic Medications:
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache or fever.
Docusate sodium: 100-200 mg PO qhs.
10. Extras: CXR PA and LAT.
11. Labs: ABG, CBC, SMA 7&12. Blood C&S x 2.
Sputum for Gram stain, C&S, AFB. Giemsa immunofluorescence for Pneumocystis. CD4 count, HIV RNA, VDRL, serum cryptococcal antigen, UA.
Opportunistic Infections in HIVInfected Patients Oral Candidiasis:
Fluconazole (Diflucan): 100-200 mg PO qd OR
Ketoconazole (Nizoral): 400 mg PO qd OR
Itraconazole (Sporanox): 200 mg PO qd OR
Clotrimazole (Mycelex): troches 10 mg dissolved slowly in mouth 5 times/d.
Candida Esophagitis:
Fluconazole (Diflucan): 200-400 mg PO qd for 14-21days OR
Ketoconazole (Nizoral): 200 mg PO bid OR
Itraconazole (Sporanox): 200 mg PO qd for 2 weeks.
Caspofungin (Cancidas): 50 mg IV qd x 2 weeks.
Primary or Recurrent Mucocutaneous HSV
Acyclovir (Zovirax): 200-400 mg PO 5 times a day for 10 days, or 5 mg/kg IV q8h OR in cases of acyclovir resistance, foscarnet, 40 mg/kg IV q8h for 21 days.
Herpes Simplex Encephalitis (or visceral disease):
Acyclovir (Zovirax): 10 mg/kg IV q8h for 10-21 days.
Herpes Varicella Zoster
Acyclovir (Zovirax): 10 mg/kg IV over 60 min q8h for 7-14 days OR 800 mg PO 5 times/d for 7-10 days OR

Famciclovir (Famvir): 500 mg PO q8h for 7 days [500 mg] OR
Valacyclovir (Valtrex): 1000 mg PO q8h for 7 days [500 mg] OR
Foscarnet (Foscavir): 40 mg/kg IV q8h.

Cytomegalovirus Retinitis:
Ganciclovir (Cytovene): 5 mg/kg IV (dilute in 100 mL D5W over 60 min) q12h for 14-21 days OR
Foscarnet (Foscavir): 60 mg/kg IV q8h for 2-3 weeks OR
Cidofovir (Vistide): 5 mg/kg IV over 60 min q week for 2 weeks. Administer probenecid, 2 g PO 3 hours prior to cidofovir, 1 g PO 2 hours after, and 1 g PO 8 hours after.

Suppressive Treatment for Cytomegalovirus Retinitis:
Ganciclovir (Cytovene): 5 mg/kg qd.
Foscarnet (Foscavir): 90-120 mg IV qd OR
Cidofovir (Vistide): 5 mg/kg IV over 60 min every 2 weeks with probenecid.

Acute Toxoplasmosis:
Pyrimethamine: 200 mg, then 50-75 mg qd, plus sulfadiazine 1.0-1.5 gm PO q6h, plus folinic acid 10 mg PO qd OR
Atovaquone (Mepron): 750 mg PO tid.

Suppressive Treatment for Toxoplasmosis:
Pyrimethamine: 25-50 mg PO qd plus sulfadiazine 0.5-1.0 gm PO q6h plus folinic acid 5 mg PO qd OR
Pyrimethamine: 50 mg PO qd, plus clindamycin 300 mg PO qid, plus folinic acid 5 mg PO qd.

Cryptococcus Neoformans Meningitis:
Amphotericin: B 0.7-1.0 mg/kg/d IV; total dosage of 2 g, with or without 5-flucytosine 100 mg/kg PO qd in divided doses, followed by fluconazole (Diflucan) 400 mg PO qd or itraconazole (Sporanox) 200 mg PO bid 6-8 weeks OR
Amphotericin B liposomal (Abelcet): 5 mg/kg IV q24h OR
Fluconazole (Diflucan): 400-800 mg PO qd for 8-12 weeks

Suppressive Treatment of Cryptococcus:
Fluconazole (Diflucan): 200 mg PO qd indefinitely.

Active Tuberculosis:
Isoniazid (INH): 300 mg PO qd; and rifampin 600 mg PO qd; and pyrazinamide 15-25 mg/kg PO qd (500 mg bid-tid); and ethambutol 15-25 mg/kg PO qd (400 mg bid-tid).
All four drugs are continued for 2 months; isoniazid and rifampin are continued for a period of at least 9 months and at least 6 months after the last negative cultures.
Pyridoxine (Vitamin B6): 50 mg PO qd concurrent with INH.

Prophylaxis for Inactive Tuberculosis:
Isoniazid: 300 mg PO qd; and pyridoxine 50 mg PO qd for 12 months.

Disseminated Mycobacterium Avium Complex (MAC):
Clarithromycin (Biaxin): 500 mg PO bid AND Ethambutol: 800-1000 mg qd; with or without rifabutin 450 mg qd.

Prophylaxis against Mycobacterium Avium Complex:
Azithromycin (Zithromax):1200 mg once a week.

Disseminated Coccidioidomycosis:
Amphotericin (Fungizone) B: 0.5-0.8 mg/kg IV qd, to a total dose 2.0 gm OR
Amphotericin B: liposomal (Abelcet) 5 mg/kg IV q24h OR
Fluconazole (Diflucan):400-800 mg PO or IV qd.

Disseminated Histoplasmosis:
Amphotericin B (Fungizone): 0.5-0.8 mg/kg IV qd, to a total dose 15 mg/kg OR
Amphotericin B liposomal (Abelcet): 5 mg/kg IV q24h OR
Fluconazole (Diflucan): 400 mg PO qd OR
Itraconazole (Sporanox): 300 mg PO bid for 3 days, then 200 mg PO bid.

Suppressive Treatment for Histoplasmosis:
Fluconazole (Diflucan): 400 mg PO qd OR
Itraconazole (Sporanox): 200 mg PO bid.

SEPTIC ARTHRITIS

1. Admission: Special Medical Care Unit
2. Diagnosis: Septic arthritis
3. Condition:
4. Vital Signs: q shift
5. Activity: Up in chair as tolerated. Bedside commode with assistance.
6. Nursing: Warm compresses prn, keep joint immobilized. Passive range of motion exercises of the affected joint bid.
7. Diet: Regular diet.
8. IV Fluids: Heparin lock
9. Special Medications:

Empiric Therapy for Adults without Gonorrhea Contact:
Nafcillin or oxacillin: 2 gm IV q4h AND Ceftizoxime (Cefizox): 1 gm IV q8h or ceftazidime 1 gm IV q8h or ciprofloxacin 400 mg IV q12h if Gram stain indicates presence of Gram negative organisms.

Empiric Therapy for Adults with Gonorrhea:
Ceftriaxone (Rocephin): 1 gm IV q12h OR
Ceftizoxime (Cefizox): 1 gm IV q8h OR
Ciprofloxacin (Cipro): 400 mg IV q12h.
Complete course of therapy with cefuroxime axetil (Ceftin) 400 mg PO bid.

10. Symptomatic Medications:
Acetaminophen and codeine (Tylenol 3): 1-2 PO q4- 6h prn pain.
Heparin: 5000 U SQ bid.
Famotidine (Pepcid): 20 mg IV/PO q12h.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.
Docusate sodium: 100-200 mg PO qhs.
11. Extras: X-ray views of joint (AP and lateral), CXR.
Synovial fluid culture. Physical therapy consult for exercise program.
12. Labs: CBC, SMA 7&12, blood C&S x 2, VDRL, UA. Gonorrhea cultures of urethra, cervix. Antibiotic levels. Blood cultures x 2 for gonorrhea.
Synovial fluid:

Tube 1 - Glucose, protein, lactate, pH.
Tube 2 - Gram stain, C&S.
Tube 3 - Cell count.

SEPTIC SHOCK

1. Admission: Medical Care Unit
2. Diagnosis: Sepsis
3. Condition:
4. Vital Signs: q1h; Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; urine output < 25 cc/hr for 4h, O2 saturation <90%.
5. Activity: Bed rest.
6. Nursing: Inputs and outputs, pulse oximeter. Foley catheter to closed drainage.
7. Diet: NPO
8. IV Fluids: 1 liter of normal saline wide open, then D5 ½ NS at 125 cc/h
9. Special Medications:
Oxygen: at 2-5 L/min by NC or mask.
Antibiotic Therapy
A. Initial treatment of life-threatening sepsis should include a third-generation cephalosporin (cefepime, ceftazidime, cefotaxime, ceftizoxime or ceftriaxone), or piperacillin/tazobactam, or ticarcillin/clavulanic acid or imipenem, each with an
aminoglycoside (gentamicin, tobramycin or amikacin). If Enterobacter aerogenes or cloacae is suspected, treatment should begin with meropenem or imipenem with an aminoglycoside.
B. Intra-abdominal or pelvic infections, likely to involve anaerobes, should be treated with ampicillin, gentamicin and metronidazole; or either ticarcillin/clavulanic acid, ampicillin/sulbactam, piperacillin/tazobactam, imipenem, cefoxitin or cefotetan, each with an aminoglycoside.
C. Febrile neutropenic patients with neutrop il counts <500/mm3 should be treated with vancomycin and ceftazidime, or piperacillin/tazobactam and tobramycin or imipenem and tobramycin.
D. Dosages for Antibiotics Used in Sepsis
Ampicillin: 1-2 gm IV q4h.
Cefepime (Maxipime): 2 gm IV q12h.
Cefotaxime (Claforan): 2 gm q4-6h.
Ceftizoxime (Cefizox): 1-2 gm IV q8h.
Ceftriaxone (Rocephin): 1-2 gm IV q12h (max 4 gm/d).
Cefoxitin (Mefoxin): 1-2 gm q6h.
Cefotetan (Cefotan): 1-2 gm IV q12h.
Ceftazidime (Fortaz): 1-2 g IV q8h.
Ticarcillin/clavulanate (Timentin): 3.1 gm IV q4-6h (200-300 mg/kg/d).
Ampicillin/sulbactam (Unasyn): 1.5-3.0 gm IV q6h.
Piperacillin/tazobactam (Zosyn): 3.375-4.5 gm IV q6h.
Piperacillin or ticarcillin: 3 gm IV q4-6h.
Imipenem/cilastatin (Primaxin): 1.0 gm IV q6h.
Meropenem (Merrem): 0.5-1.0 gm IV q8h.
Gentamicin, tobramycin:100-120 mg (1.5 mg/kg) IV, then 80 mg IV q8h (1 mg/kg) or 7 mg/kg in 50 mL of D5W over 60 min IV q24h.
Amikacin (Amikin): 7.5 mg/kg IV loading dose; then 5 mg/kg IV q8h.
Vancomycin: 1 gm IV q12h.
Metronidazole (Flagyl): 500 mg (7.5 mg/kg) IV q6- 8h.
Clindamycin (Cleocin): 900 mg IV q8h.
Aztreonam (Azactam): 1-2 gm IV q6-8h; max 8 g/day.
Nosocomial sepsis with IV catheter or IV drug abuse
Nafcillin or oxacillin: 2 gm IV q4h OR
Vancomycin:1 gm q12h (1 gm in 250 cc D5W over 60 min) AND Gentamicin or tobramycin as above AND EITHER Ceftazidime (Fortaz) or ceftizoxime (Cefizox)1-2 gm
IV q8h OR Piperacillin, ticarcillin or mezlocillin 3 gm IV q4-6h.
Recombinant human activated protein C
Drotrecogin alfa, (Xigris): 24 mg/kg/h IV infusion for 96 hours.
Blood Pressure Support
Dopamine: 4-20 mcg/kg/min (400 mg in 250 cc D5W, 1600 mcg/mL).
Norepinephrine: 2-8 mcg/min IV infusion (8 mg in 250 mL D5W).
Albumin: 25 gm IV (100 mL of 25% solution) OR
Hetastarch (Hespan): 500-1000 cc over 30-60 min (max 1500 cc/d).
Dobutamine:5 mcg/kg/min, and titrate blood pressure to keep systolic BP >90 mm Hg; max 10 mcg/kg/min.

10. Symptomatic Medications:
Acetaminophen (Tylenol): 650 mg PR q4-6h prn temp >39EC.
Famotidine (Pepcid): 20 mg IV/PO q12h.
Heparin: 5000 U SQ q12h or pneumatic compression stockings.
Docusate sodium: 100-200 mg PO qhs.
11. Extras: CXR, KUB, ECG. Ultrasound, lumbar puncture.
12. Labs: CBC with differential, SMA 7&12, blood C&S x 3, T&C for 3-6 units PRBC, INR/PTT, drug levels peak and trough at 3rd dose. UA. Cultures of urine, sputum,
wound, IV catheters, decubitus ulcers, pleural fluid.

PERITONITIS

1. Admission: Medical Care Unit
2. Diagnosis: Peritonitis
3. Condition:
4. Vital Signs: q1-6h. Call physician if BP >160/90, <90-/60; P >120, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest.
6. Nursing: Guaiac stools.
7. Diet: NPO
8. IV Fluids: D5 ½ NS at 125 cc/h.
9. Special Medications:
Primary Bacterial Peritonitis - Spontaneous:
Option 1:

Ampicillin: 1-2 gm IV q 4-6h (vancomycin 1 gm IV q12h if penicillin allergic) AND EITHER
Cefotaxime (Claforan): 1-2 gm IV q6h OR
Ceftizoxime (Cefizox): 1-2 gm IV q8h OR
Gentamicin or tobramycin: 1.5 mg/kg IV, then 1 mg/kg q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h.

Option 2:

Ticarcillin/clavulanate (Timentin): 3.1 gm IV q6h OR
Piperacillin/tazobactam (Zosyn): 3.375 gm IV q6h OR
Imipenem/cilastatin (Primaxin): 0.5-1.0 gm IV q6h OR
Meropenem (Merrem): 500-1000 mg IV q8h.

Secondary Bacterial Peritonitis – Abdominal Perforation or Rupture:

Option 1:

Ampicillin: 1-2 gm IV q4-6h AND
Gentamicin or tobramycin: as above AND
Metronidazole (Flagyl): 500 mg IV q8h OR
Cefoxitin (Mefoxin): 1-2 gm IV q6h OR
Cefotetan (Cefotan): 1-2 gm IV q12h.

Option 2:

Ticarcillin/clavulanate (Timentin): 3.1 gm IV q4-6h (200-300 mg/kg/d) with an aminoglycoside as above OR
Piperacillin/tazobactam (Zosyn): 3.375 gm IV q6h with an aminoglycoside as above OR
Ampicillin/sulbactam (Unasyn): 1.5-3.0 gm IV q6h with aminoglycoside as above OR
Imipenem/cilastatin (Primaxin): 0.5-1.0 gm IV q6-8h OR
Meropenem (Merrem): 500-1000 mg IV q8h.

Fungal Peritonitis:

Amphotericin B: peritoneal dialysis, 2 mg/L of dialysis fluid over the first 24 hours, then 1.5 mg in each liter OR
Fluconazole (Diflucan): 200 mg IV x 1, then 100 mg IV qd.
Caspofungin (Candidas): 70 mg IV x1, then 50 mg IV qd.

10. Symptomatic Medications:

Famotidine (Pepcid): 20 mg IV/PO q12h.
Acetaminophen (Tylenol): 325 mg PO/PR q4-6h prn temp >38.5EC.
Heparin: 5000 U SQ q12h.

11. Extras: Plain film, upright abdomen, lateral decubitus, CXR PA and LAT; surgery consult; ECG, abdominal ultrasound, CT scan.

12. Labs: CBC with differential, SMA 7&12, amylase, lactate, INR/PTT, UA with micro, C&S; drug levels peak and trough 3rd dose.

Paracentesis:

Tube 1: Cell count and differential (1-2mL, EDTA purple top tube).
Tube 2: Gram stain of sediment; inject 10-20 mL into anaerobic and aerobic culture bottle; AFB, fungal C&S (3-4 mL).
Tube 3: Glucose, protein, albumin, LDH, triglycerides, specific gravity, bilirubin, amylase (2-3 mL, red top tube).
Syringe: pH, lactate (3 mL).

DIVERTICULITIS

1. Admission: Medical Care Unit
2. Diagnosis: Diverticulitis
3. Condition:
4. Vital Signs: qid. Call physician if BP systolic >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC.
5. Activity: Up ad lib.
6. Nursing: Inputs and outputs.
7. Diet: NPO. Advance to clear liquids as tolerated.
8. IV Fluids: 0.5-2 L NS over 1-2 hr then, D5 ½ NS at 125 cc/hr. NG tube at low intermittent suction (if obstructed).
9. Special Medications:

Regimen 1:

Gentamicin or tobramycin: 100-120 mg IV (1.5-2 mg/kg), then 80 mg IV q8h (5 mg/kg/d) or 7 mg/kg in 50 mL of D5W over 60 min IV q24h AND EITHER
Cefoxitin (Mefoxin): 2 gm IV q6-8h OR
Clindamycin (Cleocin): 600-900 mg IV q8h.

Regimen 2:

Metronidazole (Flagyl): 500 mg q8h AND
Ciprofloxacin (Cipro): 250-500 mg PO bid or 200-300 mg IV q12h.

Outpatient Regimen:

Metronidazole (Flagyl):500 mg PO q6h AND EITHER
Ciprofloxacin (Cipro): 500 mg PO bid OR
Trimethoprim/SMX (Bactrim): 1 DS tab PO bid.

10. Symptomatic Medications:

Meperidine (Demerol): 50-100 mg IM or IV q3-4h prn pain.
Zolpidem (Ambien): 5-10 mg qhs PO prn insomnia.

11. Extras: Acute abdomen series, CXR PA and LAT, ECG, CT scan of abdomen, ultrasound, surgery and GI consults.

12. Labs: CBC with differential, SMA 7&12, amylase, lipase, blood cultures x 2, drug levels peak and trough 3rd dose. UA, C&S.

LOWER URINARY TRACT INFECTION

1. Admission: Dept. of infectious diseases
2. Diagnosis: UTI.
3. Condition:
4. Vital Signs: q shift. Call physician if BP <90/60; >160-/90; R >30, <10; P >120, <50; T >38.5EC.
5. Activity: Up ad lib
6. Nursing:
7. Diet: Regular
8. IV Fluids:
9. Special Medications:

Lower Urinary Tract Infection (treat for 3-7 days):

Trimethoprim-sulfamethoxazole (Septra): 1 double strength tab (160/800 mg) PO bid.
Norfloxacin (Noroxin): 400 mg PO bid.
Ciprofloxacin (Cipro): 250 mg PO bid.
Levofloxacin (Levaquin): 500 mg IV/PO q24h.
Lomefloxacin (Maxaquin): 400 mg PO qd.
Enoxacin (Penetrex): 200-400 mg PO q12h; 1h before or 2h after meals.
Cefpodoxime (Vantin): 100 mg PO bid.
Cephalexin (Keflex): 500 mg PO q6h.
Cefixime (Suprax): 200 mg PO q12h or 400 mg PO qd.
Cefazolin (Ancef): 1-2 gm IV q8h.

Complicated or Catheter-Associated Urinary Tract Infection:
Ceftizoxime (Cefizox): 1 gm IV q8h.
Gentamicin: 2 mg/kg, then 1.5/kg q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h.
Ticarcillin/clavulanate (Timentin): 3.1 gm IV q4-6h
Ciprofloxacin (Cipro): 500 mg PO bid.
Levofloxacin (Levaquin): 500 mg IV/PO q24h.

Prophylaxis ($3 episodes/yr):
Trimethoprim/SMX: single strength tab PO qhs.

Candida Cystitis
Fluconazole (Diflucan): 100 mg PO or IV x 1 dose, then 50 mg PO or IV qd for 5 days OR
Amphotericin B: continuous bladder irrigation, 50 mg/1000 mL sterile water via 3-way Foley catheter at 1 L/d for 5 days.

10. Symptomatic Medications:
Phenazopyridine (Pyridium): 100 mg PO tid.
Docusate sodium (Colace): 100 mg PO qhs.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn temp >39N C.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.

11. Extras: Renal ultrasound.

12. Labs: CBC, SMA 7. UA with micro, urine Gram stain, C&S.

PYELONEPHRITIS

1. Admission: Kidney care unite
2. Diagnosis: Pyelonephritis
3. Condition:
4. Vital Signs: tid. Call physician if BP <90/60; >160/90; R >30, <10; P >120, <50; T >38.5EC.
5. Activity:
6. Nursing: Inputs and outputs.
7. Diet: Regular
8. IV Fluids: D5 ½ NS at 125 cc/h.
9. Special Medications:
Trimethoprim-sulfamethoxazole: 160/800 mg (10 mL in 100 mL D5W IV over 2 hours) q12h or 1 double strength tab PO bid.
-Ciprofloxacin (Cipro) 500 mg PO bid or 400 mg IV q12h.
Norfloxacin (Noroxin): 400 mg PO bid.
Ofloxacin (Floxin): 400 mg PO or IV bid.
Levofloxacin (Levaquin): 500 mg PO/IV q24h.
In more severely ill patients, treatment with an IV third-generation cephalosporin, or ticarcillin/clavulanic acid, or piperacillin/tazobactam or imipenem is recommended with an aminoglycoside.
Ceftizoxime (Cefizox): 1 gm IV q8h.
Ceftazidime (Fortaz): 1 gm IV q8h.
Ticarcillin/clavulanate (Timentin): 3.1 gm IV q6h.
Piperacillin/tazobactam (Zosyn): 3.375 gm IV/PB q6h.
Imipenem/cilastatin (Primaxin): 0.5-1.0 gm IV q6-8h.
Gentamicin or tobramycin: 2 mg/kg IV, then 1.5 mg/kg q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h.
10. Symptomatic Medications:
Phenazopyridine (Pyridium): 100 mg PO tid.
Meperidine (Demerol): 50-100 mg IM q4-6h prn pain.
Docusate sodium (Colace): 100 mg PO qhs.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn temp >39N C.
Zolpidem (Ambien): 5-10 mg qhs prn insomnia.
11. Extras: Renal ultrasound, KUB.
12. Labs: CBC with differential, SMA 7. UA with micro, urine Gram stain, C&S; blood C&S x 2. Drug levels peak and trough third dose.

OSTEOMYELITIS

1. Admission: Dept. of Infectious Diseases
2. Diagnosis: Osteomyelitis
3. Condition:
4. Vital Signs: qid. Call physician if BP <90/60; T >38.5EC.
5. Activity: Bed rest with bathroom privileges.
6. Nursing: Keep involved extremity elevated. Range of motion exercises tid.
7. Diet: Regular, high fiber.
8. IV Fluids: Heparin lock with flush q shift.
9. Special Medications:

Adult Empiric Therapy:
Nafcillin or oxacillin: 2 gm IV q4h OR
Cefazolin (Ancef): 1-2 gm IV q8h OR
Vancomycin: 1 gm IV q12h (1 gm in 250 cc D5W over 1h). Add 3rd generation cephalosporin if gram negative bacilli on Gram stain. Treat for 4-6 weeks.

Post-Operative or Post-Trauma:
Vancomycin: 1 gm IV q12h **AND** ceftazidime (Fortaz) 1-2 gm IV q8h.
Imipenem/cilastatin (Primaxin)**:** (single-drug treatment) 0.5-1.0 gm IV q6-8h.
Ticarcillin/clavulanate (Timentin): (single-drug treatment) 3.1 gm IV q4-6h.

Ciprofloxacin (Cipro): 500-750 mg PO bid or 400 mgIV q12h ANDRifampin 600 mg PO qd.

Osteomyelitis with Decubitus Ulcer:

Cefoxitin (Mefoxin): 2 gm IV q6-8h.

Ciprofloxacin (Cipro) and metronidazole: 500 mg IV q8h.

Imipenem/cilastatin (Primaxin): 0.5-1.0 gm IV q6-8h.

Nafcillin, gentamicin and clindamycin: see dosage above.

10. Symptomatic Medications:

Meperidine (Demerol): 50-100 mg IM q3-4h prn pain.

Docusate (Colace): 100 mg PO qhs.

Heparin: 5000 U SQ bid.

11. Extras: Technetium/gallium bone scans, multiple Xray views, CT/MRI.

12. Labs: CBC with differential, SMA 7, blood C&S x 3, MIC, MBC, UA with micro, C&S. Needle biopsy of bone for C&S. Trough antibiotic levels.

ACTIVE PULMONARY TUBERCULOSIS

1. Admission: TB Hospital

2. Diagnosis: Active Pulmonary Tuberculosis

3. Condition:

4. Vital Signs: q shift

5. Activity: Up ad lib in room.

6. Nursing: Respiratory isolation.

7. Diet: Regular

8. Special Medications:

Isoniazid:300 mg PO qd (5 mg/kg/d, max 300 mg/d**) AND**

Rifampin:600 mg PO qd (10 mg/kg/d, 600 mg/d max)AND

Pyrazinamide:500 mg PO bid-tid (15-30 mg/kg/d,max 2.5 gm) AND

Ethambutol:400 mg PO bid-tid (15-25 mg/kg/d, 2.5 gm/d max).

Empiric treatment consists of a 4-drug combination of isoniazid (INH), rifampin, pyrazinamide (PZA), and either ethambutol or streptomycin. A modified regimen is recommended for patients known to have INH-resistant TB. Treat for 8 weeks with the four-drug regimen, followed by 18 weeks of INH and rifampin.

Pyridoxine:50 mg PO qd with INH.

Prophylaxis

Isoniazid:300 mg PO qd (5 mg/kg/d) x 6-9 months.

9. Extras: CXR PA, LAT, ECG.

10. Labs: CBC with differential, SMA7 and 12, LFTs, HIV serology. First AM sputum for AFB x 3 samples.

CELLULITIS

1. Admission: Dept. of Infectious Diseases

2. Diagnosis: Cellulitis

3. Condition:

4. Vital Signs: tid. Call physician if BP <90/60; T >38.5EC

5. Activity: Up ad lib.

6. Nursing: Keep affected extremity elevated; warm compresses prn.

7. Diet: Regular, encourage fluids.

8. IV Fluids: Heparin lock with flush q shift.

9. Special Medications:

Empiric Therapy Cellulitis

Nafcillin or oxacillin:1-2 gm IV q4-6h OR

Cefazolin (Ancef):1-2 gm IV q8h OR

Vancomycin:1 gm q12h (1 gm in 250 cc D5W over 1h) OR

Erythromycin:500 IV/PO q6h OR

Dicloxacillin:500 mg PO qid; may add penicillin VK, 500 mg PO qid, to increase coverage for streptococcus OR

Cephalexin (Keflex):500 mg PO qid.

Immunosuppressed, Diabetic Patients, or Ulcerated Lesions:

Nafcillin or cefazolin and gentamicin or aztreonam. Add clindamycin or metronidazole if septic.

Cefazolin (Ancef):1-2 gm IV q8h.

Cefoxitin (Mefoxin):1-2 gm IV q6-8h.

Gentamicin: 2 mg/kg, then 1.5 mg/kg IV q8h or 7 mg/kg in 50 mL of D5W over 60 min IV q24h OR aztreonam (Azactam) 1-2 gm IV q6h PLUS

Metronidazole (Flagyl): 500 mg IV q8h or clindamycin 900 mg IV q8h.

Ticarcillin/clavulanate (Timentin): (single- drug treatment) 3.1 gm IV q4-6h.

Ampicillin/Sulbactam (Unasyn): (single- drug therapy) 1.5-3.0 gm IV q6h.

Imipenem/cilastatin (Primaxin): **(**single- drug therapy) 0.5-1 mg IV q6-8h.

10. Symptomatic Medications:

Acetaminophen/codeine: 1-2 PO q4-6h prn pain.

-Docusate (Colace) 100 mg PO qhs.-Acetaminophen (Tylenol) 325-650 mg PO q4-6h prn temp >39N C.

Zolpidem (Ambien):5-10 mg qhs prn insomnia.

11. Extras: Technetium/Gallium scans.

12. Labs: CBC, SMA 7, blood C&S x 2. Leading edge aspirate for Gram stain, C&S; UA, antibiotic levels.

PELVIC INFLAMMATORY DISEASE

1. Admission: Medical Care Unit

2. Diagnosis: Pelvic Inflammatory Disease

3. Condition:

4. Vital Signs: q8h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC

5. Activity: Up ad lib.

6. Nursing: Inputs and outputs.

7. Diet: Regular
8. IV Fluids: D5 ½ NS at 100-125 cc/hr.
9. Special Medications:
Cefotetan (Cefotan): 2 g IV q12h, or cefoxitin (Mefoxin, 2 g IV q6h) plus doxycycline (100 mg IV or PO q12h) OR
Clindamycin (Cleocin):, 900 mg IV q8h, plus gentamicin (1-1.5 mg/kg IV q8h)
Ampicillin-sulbactam (Unasyn): 3 g IV Q6h plus doxycycline (100 mg IV or PO Q12h)
Parenteral administration: of antibiotics should be continued for 24 hours after clinical response, followed by doxycycline (100 mg PO BID) or clindamycin (Cleocin, 450 mg PO QID) for a total of 14 days.
Levofloxacin (Levaquin): 500 mg IV q24h, plus metronidazole (Flagyl, 500 mg IV q8h). With this regimen, azithromycin (Zithromax, 1 g PO once) should be given as soon as the patient is tolerating oral intake.
10. Symptomatic Medications:
Acetaminophen (Tylenol): 1-2 tabs PO q4-6h prn pain or temperature >38.5EC.
Meperidine (Demerol): 25-100 mg IM q4-6h prn pain.
Zolpidem (Ambien):10 mg PO qhs prn insomnia.
11. Labs: beta-HCG pregnancy test, CBC, SMA 7&12, ESR. GC culture, chlamydia direct fluorescent antibody stain. UA with micro, C&S, VDRL, HIV, blood cultures x 2. Pelvic ultrasound.

GASTROINTESTINAL DISORDERS

GASTROESOPHAGEAL REFLUX DISEASE (GERD)

1. Admission: Gastroentology
2. Diagnosis: Gastroesophageal reflux disease.
3. Condition:
4. Vital Signs: q4h. Call physician if BP >160/90, <90/60; P >120, <50; T >38.5EC.
5. Activity: Up ad lib. Elevate the head of the bed by 6 to 8 inches.
6. Nursing: Guaiac stools.
7. Diet: Low-fat diet; no cola, citrus juices, or tomato products; avoid the supine position after meals; no eating within 3 hours of bedtime.
8. IV Fluids: D5 ½ NS with 20 mEq KCL at TKO.
9. Special Medications:
Pantoprazole (Protonix): 40 mg PO/IV q24h OR
Nizatidine (Axid): 300 mg PO qhs OR
Omeprazole (Prilosec): 20 mg PO bid (30 minutes prior to meals) OR
Lansoprazole (Prevacid): 15-30 mg PO qd [15, 30 mg caps] OR
Esomeprazole (Nexium): 20 or 40 mg PO qd OR
Rabeprazole (Aciphex): 20 mg delayed-release tablet PO qd OR
Ranitidine (Zantac): 50 mg IV bolus, then continuous infusion at 12.5 mg/h (300 mg in 250 mL D5W at 11 mL/h over 24h) or 50 mg IV q8h OR
Cimetidine (Tagamet): 300 mg IV bolus, then continuous infusion at 50 mg/h (1200 mg in 250 mL D5W over 24h) or 300 mg IV q6-8h OR
Famotidine (Pepcid): 20 mg IV q12h.
10. Symptomatic Medications:
Mylanta Plus or Maalox Plus: 30 mg PO q2h prn.
Trimethobenzamide (Tigan): 100-250 mg PO or 100- 200 mg IM/PR q6h prn nausea OR
Prochlorperazine (Compazine): 5-10 mg IM/IV/PO q4- 6h or 25 mg PR q4-6h prn nausea.
11. Extras: Upright abdomen, KUB, CXR, ECG, endoscopy. GI consult, surgery consult.
12. Labs: CBC, SMA 7&12, amylase, lipase, LDH. UA.

PEPTIC ULCER DISEASE

1. Admission: Gastroentology
2. Diagnosis: Peptic ulcer disease.
3. Condition:
4. Vital Signs: q4h. Call physician if BP >160/90, <90/60; P >120, <50; T >38.5EC.
5. Activity: Up ad lib
6. Nursing: Guaiac stools.
7. Diet: NPO 48h, then regular diet, no caffeine.
8. IV Fluids: D5 ½ NS with 20 mEq KCL at 125 cc/h. NG tube at low intermittent suction (if obstructed).
9. Special Medications:
Ranitidine (Zantac): 50 mg IV bolus, then continuous infusion at 12.5 mg/h (300 mg in 250 mL D5W at 11 mL/h over 24h) or 50 mg IV q8h OR
Cimetidine (Tagamet): 300 mg IV bolus, then continuous infusion at 50 mg/h (1200 mg in 250 mL D5W over 24h) or 300 mg IV q6-8h OR
Famotidine (Pepcid): 20 mg IV q12h OR
Pantoprazole (Protonix): 40 mg PO/IV q24h OR
Nizatidine (Axid): 300 mg PO qhs OR
Omeprazole (Prilosec): 20 mg PO bid (30 minutes prior to meals) OR
Lansoprazole (Prevacid): 15-30 mg PO qd prior to breakfast [15, 30 mg caps].
Eradication of Helicobacter pylori
A. Bismuth, Metronidazole, Tetracycline, Ranitidine
1. 14 day therapy.
2. Bismuth (Pepto Bismol) 2 tablets PO qid.
3. Metronidazole (Flagyl) 250 mg PO qid (tid if cannot tolerate the qid dosing).
4. Tetracycline 500 mg PO qid.
5. Ranitidine (Zantac) 150 mg PO bid.
6. Efficacy is greater than 90%.

B. Amoxicillin, Omeprazole, Clarithromycin (AOC)
1. 10 days of therapy.
2. Amoxicillin 1 gm PO bid.
3. Omeprazole (Prilosec) 20 mg PO bid.
4. Clarithromycin (Biaxin) 500 mg PO bid.

C. Metronidazole, Omeprazole, Clarithromycin (MOC)
1. 10 days of therapy
2. Metronidazole 500 mg PO bid.
3. Omeprazole (Prilosec) 20 mg PO bid.
4. Clarithromycin (Biaxin) 500 mg PO bid.
5. Efficacy is >80%
6. Expensive, usually well tolerated.

D. Omeprazole, Clarithromycin (OC)
1. 14 days of therapy.
2. Omeprazole (Prilosec) 40 mg PO qd for 14 days, then 20 mg qd for an additional 14 days of therapy.
3. Clarithromycin (Biaxin) 500 mg PO tid.

E. Ranitidine-Bismuth-Citrate, Clarithromycin (RBC-C)
1. 28 days of therapy.
2. Ranitidine-bismuth-citrate (Tritec) 400 mg PO bid for 28 days.
3. Clarithromycin (Biaxin) 500 mg PO tid for 14days.
4. Efficacy is 70-80%; expensive

10. Symptomatic Medications:
Mylanta Plus or Maalox Plus: 30 mg PO q2h prn.
Trimethobenzamide (Tigan): 100-250 mg PO or 100-200 mg IM/PR q6h prn nausea OR
Prochlorperazine (Compazine): 5-10 mg IM/IV/PO q4- 6h or 25 mg PR q4-6h prn nausea.

11. Extras: Upright abdomen, KUB, CXR, ECG, endoscopy. GI consult, surgery consult.

12. Labs: CBC, SMA 7&12, amylase, lipase, LDH. UA, Helicobacter pylori serology. Fasting serum gastrin qAM for 3 days. Urea breath test for H pylori.

GASTROINTESTINAL BLEEDING

1. Admission: Gastroentology
2. Diagnosis: Upper/lower GI bleed
3. Condition:
4. Vital Signs: q30min. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; urine output <15 mL/hr for 4h.
5. Activity: Bed rest
6. Nursing: Place nasogastric tube, then lavage with 2 L of room temperature normal saline, then connect to low intermittent suction. Repeat lavage q1h. Record volume and character of lavage. Foley to closed drainage; inputs and outputs.
7. Diet: NPO
8. IV Fluids: Two 16 gauge IV lines. 1-2 L NS wide open; transfuse 2-6 units PRBC to run as fast as possible, then repeat CBC.
9. Special Medications:
Oxygen: 2 L by NC.
Pantoprazole (Protonix): 80 mg IV over 15min, then 8 mg/hr IV infusion OR
80 mg IV q12h.
Ranitidine (Zantac): 50 mg IV bolus, then continuous infusion at 12.5 mg/h [300 mg in 250 mL D5W over 24h (11 cc/h)], or 50 mg IV q6-8h OR
Famotidine (Pepcid): 20 mg IV q12h. -Vitamin K (Phytonadione) 10 mg IV/SQ qd for 3 days (if INR is elevated).

Esophageal Variceal Bleeds:
Somatostatin (Octreotide): 50 mcg IV bolus, followed by 50 mcg/h IV infusion (1200 mcg in 250 mL of D5W at 11 mL/h).

Vasopressin/Nitroglycerine Paste Therapy:
Vasopressin (Pitressin): 20 U IV over 20-30 minutes, then 0.2-0.3 U/min [100 U in 250 mL of D5W (0.4 U/mL)] for 30 min, followed by increases of 0.2 U/min until bleeding stops or max of 0.9 U/min. If bleeding stops, taper over24-48h AND
Nitroglycerine paste: 1 inch q6h OR nitroglycerin IV at 10-30 mcg/min continuous infusion (50 mg in 250 mL of D5W).

10. Extras: Portable CXR, upright abdomen, ECG. Surgery and GI consults.
Upper GI Bleeds: Esophagogastroduodenoscopy with coagulation or sclerotherapy; Linton-Nachlas tube for tamponade of esophageal varices.
Lower GI Bleeds: Sigmoidoscopy/colonoscopy (after a GoLytely purge 6-8 L over 4-6h), technetium 99m RBC scan, angiography with embolization.

11. Labs: Repeat hematocrit q2h; CBC with platelets q12-24h. Repeat INR in 6 hours. SMA 7&12, ALT, AST, alkaline phosphatase, INR/PTT, type and cross for 3-6 U PRBC and 2-4 U FFP.

CIRRHOTIC ASCITES AND EDEMA

1. Admission: Gastroentology
2. Diagnosis: Cirrhotic ascites and edema
3. Condition:
4. Vital Signs: Vitals q4-6 hours. Call physician if BP >160/90, <90/60; P >120, <50; T >38.5EC; urine output <25 cc/hr for 4h.
5. Activity: Bed rest with legs elevated.
6. Nursing: Inputs and outputs, daily weights, measure abdominal girth qd, guaiac all stools.
7. Diet: 2500 calories, 100 gm protein; 500 mg sodium restriction; fluid restriction to 1-1.5 L/d (if hyponatremia, Na <130).
8. IV Fluids: Heparin lock with flush q shift.
9. Special Medications:
Diurese: to reduce weight by 0.5-1 kg/d (if edema) or 0.25 kg/d (if no edema).
Spironolactone (Aldactone): 25-50 mg PO qid or 200 mg PO qAM, increase by 100 mg/d to max of 400 mg/d.

Furosemide (Lasix [refractory ascites]): 40-120 mg PO or IV qd-bid. Add KCL 20-40 mEq PO qAM if renal function is normal OR
Torsemide (Demadex): 20-40 mg PO/IV qd-bid.
Metolazone (Zaroxolyn): 5-10 mg PO qd (max 20 mg/d).
Captopril (Capoten): 6.75 mg PO q8h; increase to max 50 mg PO q8h for refractory ascites caused by hyperaldosteronism.
Famotidine (Pepcid): 20 mg IV/PO q12h.
-Vitamin K 10 mg SQ qd for 3 days.
Folic acid:1 mg PO qd.
Thiamine: 100 mg PO qd.
Multivitamin: PO qd.
Paracentesis: Remove up to 5 L of ascites if peripheral edema, tense ascites, or decreased diaphragmatic excursion. If large volume paracentesis without peripheral edema or with renal insufficiency, give salt-poor albumin, 12.5 gm for each 2 liters of fluid removed (50 mL of 25% solution); infuse 25 mL before paracentesis and 25 mL 6h after.
10. Symptomatic Medications:
Docusate (Colace): 100 mg PO qhs.
Lactulose: 30 mL PO bid-qid prn constipation.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
11. Extras: KUB, CXR, abdominal ultrasound, liverspleen scan, GI consult.
12. Labs: Ammonia, CBC, SMA 7&12, LFTs, albumin, amylase, lipase, INR/PTT. Urine creatinine, Na, K. HBsAg, anti-HBs, hepatitis C virus antibody, alpha-1-antitrypsin.
Paracentesis Ascitic Fluid
Tube 1: Protein, albumin, specific gravity, glucose, bilirubin, amylase, lipase, triglyceride, LDH (3-5 mL, red top tube).
Tube 2: Cell count and differential (3-5 mL, purple top tube).
Tube 3: C&S, Gram stain, AFB, fungal (5-20 mL); inject 20 mL into bottle of blood culture at bedside.
Tube 4: Cytology (>20 mL).
Syringe: pH (2 mL).

VIRAL HEPATITIS

1. Admission: Hepatic Care Unit
2. Diagnosis: Hepatitis
3. Condition:
4. Vital Signs: qid. Call physician if BP <90/60; T >38.5EC.
5. Activity:
6. Nursing: Stool isolation.
7. Diet: Clear liquid (if nausea), low fat (if diarrhea).
8. Special Medications:
Famotidine (Pepcid): 20 mg IV/PO q12h.
Vitamin K: 10 mg SQ qd for 3d.
Multivitamin: PO qd.
9. Symptomatic Medications:
Meperidine (Demerol): 50-100 mg IM q4-6h prn pain.
Trimethobenzamide (Tigan): 250 mg PO q6-8h prn pruritus or nausea q6-8h prn.
Hydroxyzine (Vistaril): 25 mg IM/PO q4-6h prn pruritus or nausea.
Diphenhydramine (Benadryl): 25-50 mg PO/IV q4-6h prn pruritus.
10. Extras: Ultrasound, GI consult.
11. Labs: CBC, SMA 7&12, GGT, LDH, amylase, lipase, INR/PTT, IgM anti-HAV, IgM anti-HBc, HBsAg, anti- HCV; alpha-1-antitrypsin, ANA, ferritin, ceruloplasmin, urine copper.

CHOLECYSTITIS AND CHOLANGITIS

1. Admission: Medicl Ward
2. Diagnosis: Bacterial cholangitis
3. Condition:
4. Vital Signs: q4h. Call physician if BP systolic >160, <90; diastolic. >90, <60; P >120, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest
6. Nursing: Inputs and outputs
7. Diet: NPO
8. IV Fluids: 0.5-1 L LR over 1h, then D5 ½ NS with 20 mEq KCL/L at 125 cc/h. NG tube at low constant suction. Foley to closed drainage.
9. Special Medications:
Ticarcillin or piperacillin: 3 gm IV q4-6h (single agent).
Ampicillin: 1-2 gm IV q4-6h and gentamicin 100 mg (1.5-2 mg/kg), then 80 mg IV q8h (3-5 mg/kg/d) and metronidazole 500 mg IV q8h.
-Imipenem/cilastatin (Primaxin) 1.0 gm IV q6h (single agent).
Ampicillin/sulbactam (Unasyn): 1.5-3.0 gm IV q6h (single agent).
10. Symptomatic Medications:
Meperidine (Demerol): 50-100 mg IV/IM q4-6h prn pain.
Hydroxyzine (Vistaril): 25-50 mg IV/IM q4-6h prn with meperidine.
Omeprazole (Prilosec): 20 mg PO bid.
Heparin: 5000 U SQ q12h.
Enoxaparin (Lovenox): 30 mg SQ q12h.
11. Extras: CXR, ECG, RUQ ultrasound, HIDA scan, acute abdomen series. GI consult, surgical consult.
12. Labs: CBC, SMA 7&12, GGT, amylase, lipase, blood C&S x 2. UA, INR/PTT.

ACUTE PANCREATITIS

1. Admission: Gastroentology
2. Diagnosis: Acute pancreatitis

3. Condition:
4. Vital Signs: q1-4h, call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; urine output < 25 cc/hr for more than 4 hours.
5. Activity: Bed rest with bedside commode.
6. Nursing: Inputs and outputs, fingerstick glucose qid, guaiac stools. Foley to closed drainage.
7. Diet: NPO
8. IV Fluids: 1-4 L NS over 1-3h, then D5 ½ NS with 20 mEq KCL/L at 125 cc/hr. NG tube at low constant suction (if obstruction).
9. Special Medications:
Ranitidine (Zantac): 6.25 mg/h (150 mg in 250 mL D5W at 11 mL/h) IV or 50 mg IV q6-8h **OR** Famotidine (Pepcid) 20 mg IV q12h.
Antibiotics: are indicated for infected pancreatic pseudocysts or for abscess. Uncomplicated pancreatitis does not require antibiotics.
Ticarcillin/clavulanate (Timentin): 3.1 gm IV, or ampicillin/sulbactam (Unasyn) 3.0 gm IV q6h or imipenem (Primaxin) 0.5-1.0 gm IV q6h.
Heparin: 5000 U SQ q12h.
Total parenteral nutrition: should be provided until the amylase and lipase are normal and symptoms have resolved.
10. Symptomatic Medications:
Meperidine: 50-100 mg IM/IV q3-4h prn pain.
11. Extras: Upright abdomen, portable CXR, ECG, ultrasound, CT with contrast. Surgery and GI consults.
12. Labs: CBC, platelets, SMA 7&12, calcium, triglycerides, amylase, lipase, LDH, AST, ALT; blood C&S x 2, hepatitis B surface antigen, INR/PTT, type and hold 4-6 U PRBC and 2-4 U FFP. UA.

ACUTE DIARRHEA

1. Admission: Gastroentology
2. Diagnosis: Acute Diarrhea
3. Condition:
4. Vital Signs: q6h; call physician if BP >160/90, <80/60; P >120; R>25; T >38.5EC.
5. Activity: Up ad lib
6. Nursing: Daily weights, inputs and outputs.
7. Diet: NPO except ice chips for 24h, then low residual elemental diet; no milk products.
8. IV Fluids: 1-2 L NS over 1-2 hours; then D5 ½ NS with 40 mEq KCL/L at 125 cc/h.
9. Special Medications:
Febrile or gross blood in stool or neutrophils on microscopic exam or prior travel:
Ciprofloxacin (Cipro): 500 mg PO bid OR
Levofloxacin (Levaquin): 500 mg PO qd OR
Trimethoprim/SMX (Bactrim DS): (160/800 mg) one DS tab PO bid.
11. Extras: Upright abdomen. GI consult.
12. Labs: SMA7 and 12, CBC with differential, UA, blood culture x 2.
Stool studies: Wright's stain for fecal leukocytes, ova and parasites x 3, clostridium difficile toxin, culture for enteric pathogens, E coli 0157:H7 culture.
Specific Treatment of Acute Diarrhea Shigella:
Trimethoprim/SMX, (Bactrim): one DS tab PO bid for 5 days OR
Ciprofloxacin (Cipro): 500 mg PO bid for 5 days OR
Azithromycin (Zithromax): 500 mg PO x 1, then 250 mg PO qd x 4.
Salmonella (bacteremia):
Ofloxacin (Floxin): 400 mg IV/PO q12h for 14 days
OR
Ciprofloxacin (Cipro): 400 mg IV q12h or 750 mg PO q12h for 14 days OR
Trimethoprim/SMX (Bactrim): one DS tab PO bid for 14 days OR
Ceftriaxone (Rocephin): 2 gm IV q12h for 14 days.
Campylobacter jejuni:
Erythromycin: 250 mg PO qid for 5-10 days OR
-Azithromycin (Zithromax) 500 mg PO x 1, then 250 mg PO qd x 4 OR
-Ciprofloxacin (Cipro) 500 mg PO bid for 5 days.
Enterotoxic/Enteroinvasive E coli (TravelersDiarrhea):
Ciprofloxacin (Cipro): 500 mg PO bid for 5-7 days OR
Trimethoprim/SMX (Bactrim): one DS tab PO bid for 5-7 days.
Antibiotic-Associated and Pseudomembranous Colitis (Clostridium difficile):
Metronidazole (Flagyl): 250 mg PO or IV qid for 10-14days OR
Vancomycin: 125 mg PO qid for 10 days (500 PO qid for 10-14 days, if recurrent).

Yersinia Enterocolitica (sepsis):
Trimethoprim/SMX (Bactrim): one DS tab PO bid for 5-7 days OR
Ciprofloxacin (Cipro): 500 mg PO bid for 5-7 days OR
Ofloxacin (Floxin): 400 mg PO bid OR
Ceftriaxone (Rocephin): 1 gm IV q12h.
Entamoeba Histolytica (Amebiasis):
Mild to Moderate Intestinal Disease:
Metronidazole (Flagyl):750 mg PO tid for 10 days OR
-Tinidazole 2 gm per day PO for 3 days **Followed By:**
Iodoquinol: 650 mg PO tid for 20 days **OR**
Paromomycin: 25-30 mg/kg/d PO tid for 7 days.
Severe Intestinal Disease:
Metronidazole (Flagyl):750 mg PO tid for 10 days OR
Tinidazole: 600 mg PO bid for 5 days Followed By:
Iodoquinol: 650 mg PO tid for 20 days OR
Paromomycin: 25-30 mg/kg/d PO tid for 7 days.
Giardia Lamblia:
Quinacrine: 100 mg PO tid for 5d OR
Metronidazole: 250 mg PO tid for 7 days OR

Nitazoxanide (Alinia): 200 mg PO q12h x 3 days.
Cryptosporidium:
Paromomycin: 500 mg PO qid for 7-10 days [250 mg]
OR
Nitazoxanide (Alinia): 200 mg PO q12h x 3 days.

CROHN'S DISEASE

1. Admission: Gastroentology
2. Diagnosis: Crohn's disease.
3. Condition:
4. Vital Signs: q8h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC
5. Activity: Up ad lib.
6. Nursing: Inputs and outputs. NG at low intermittent suction (if obstruction).
7. Diet: NPO except for ice chips and medications for 48h, then low residue or elemental diet, no milk products.
8. IV Fluids: 1-2 L NS over 1-3h, then D5 ½ NS with 40mEq KCL/L at 125 cc/hr.
9. Special Medications:
Mesalamine (Asacol): 400-800 mg PO tid or mesalamine (Pentasa) 1000 mg (four 250 mg tabs) PO qid OR
Sulfasalazine (Azulfidine): 0.5-1 gm PO bid; increase over 10 days to 0.5-1 gm PO qid OR
Olsalazine (Dipentum): 500 mg PO bid.
-Infliximab (Remicade) 5 mg/kg IV over 2 hours; may repeat at 2 and 6 weeks
Prednisone: 40-60 mg PO qd OR
Hydrocortisone: 50-100 mg IV q6h OR
Methylprednisolone (Solu-Medrol): 10-20 mg IV q6h.
Metronidazole (Flagyl): 250-500 mg PO q6h.
Vitamin B12: 100 mcg IM for 5d, then 100-200 mcg IM q month.
Multivitamin: PO qAM or 1 ampule IV qAM.
Folic acid:1 mg PO qd.
10. Extras: Abdominal x-ray series, CXR, colonoscopy. GI consult.
11. Labs: CBC, SMA 7&12, Mg, ionized calcium, blood C&S x 2; stool Wright's stain, stool culture, C difficile antigen assay, stool ova and parasites x 3.

ULCERATIVE COLITIS

1. Admission: Gastroentology
2. Diagnosis: Ulcerative colitis
3. Condition:
4. Vital Signs: q4-6h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC.
5. Activity: Up ad lib in room.
6. Nursing: Inputs and outputs.
7. Diet: NPO except for ice chips for 48h, then low residue or elemental diet, no milk products.
8. IV Fluids: 1-2 L NS over 1-2h, then D5 ½ NS with 40 mEq KCL/L at 125 cc/hr.
9. Special Medications:
Mesalamine (Asacol): 400-800 mg PO tid OR
5-aminosalicylate (Mesalamine):400-800 mg PO tid or 1 gm PO qid or enema 4 gm/60 mL PR qhs OR
Sulfasalazine (Azulfidine): 0.5-1 gm PO bid, increase over 10 days as tolerated to 0.5-1.0 gm PO qid OR
Olsalazine (Dipentum): 500 mg PO bid OR
Hydrocortisone retention enema: 100 mg in 120 mL saline bid.
Methylprednisolone (Solu-Medrol): 10-20 mg IV q6h
OR
Hydrocortisone: 100 mg IV q6h OR
Prednisone: 40-60 mg PO qd.
B12: 100 mcg IM for 5d then 100-200 mcg IM q month.
Multivitamin: PO qAM or 1 ampule IV qAM.
Folate: 1 mg PO qd.
10. Symptomatic Medications:
Loperamide (Imodium): 2-4 mg PO tid-qid prn, max 16 mg/d OR
Kaopectate: 60-90 mL PO qid prn.
11. Extras: Upright abdomen. CXR, colonoscopy, GI consult.
12. Labs: CBC, SMA 7&12, Mg, ionized calcium, liver panel, blood C&S x 2; stool Wright's stain, stool for ova and parasites x 3, culture for enteric pathogens; Clostridium difficile antigen assay, UA.

PARENTERAL NUTRITION

General Considerations: Daily weights, inputs and outputs. Finger stick glucose q6h.
Central Parenteral Nutrition:
Infuse: 40-50 mL/h of amino acid-dextrose solution in the first 24h; increase daily by 40 mL/hr increments until providing 1.3-2 x basal energy requirement and 1.2-1.7 gm protein/kg/d (see formula page 97).
Standard solution:
Amino acid solution (Aminosyn) 7-10% ..500 mL
Dextrose 40-70% . .. . 500 mL
Sodium . . . . 35 mEq
Potassium . . . . 36 mEq
Chloride . . . . . 35 mEq
Calcium . . . . . .4.5 mEq
Phosphate . . . . . 9 mmol
Magnesium . . . . . .8.0 mEq
Acetate . . . . 82-104 mEq
Multi-trace element formula . . . . . .1 mL/d
(zinc, copper, manganese, chromium)
Regular insulin (if indicated) . . . . . 10-60 U/L
Multivitamin(12)(2 amp) . . . . 10 mL/d
Vitamin K (in solution, SQ, IM) . . . . 10 mg/week

Vitamin B12 . . . . . 1000 mcg/week
Selenium (after 20 days of continuous TPN)80 mcg/d
Intralipid 20%, 500 mL/d IVPB; infuse in parallel with standard solution at 1 mL/min for 15 min; if no adverse reactions, increase to 100 mL/hr once daily or 20 mg/hr continuously. Obtain serum triglyceride 6h after end of infusion (maintain <250 mg/dL).

Cyclic Total Parenteral Nutrition:
12h night schedule; taper continuous infusion in morning by reducing rate to half of original rate for 1 hour. Further reduce rate by half for an additional hour, then discontinue. Finger stick glucose q4-6h; restart TPN in afternoon. Taperat beginning and end of cycle. Final rate of 185 mL/hr for 9-10 h and 2 hours of taper at eachend for total of 2000 mL.

Peripheral Parenteral Supplementation:
3% amino acid solution (ProCalamine) up to 3 L/d at 125 cc/h OR
Combine 500 mL amino acid solution 7% or 10% (Aminosyn) and 500 mL 20% dextrose and electrolyte additive. Infuse at up to 100 cc/hr in parallel with:
Intralipid 10% or 20% at 1 mL/min for 15 min (test dose); if no adverse reactions, infuse 500 mL/d at 21 mL/h over 24h, or up to 100 mL/h over 5 hours daily.
Draw triglyceride level 6h after end of Intralipid infusion.

7. Special Medications:
Famotidine (Pepcid): 20 mg IV q12h or 40 mg/day in TPN OR
Ranitidine (Zantac): 50 mg IV q8h or 150 mg/day in TPN.

8. Extras: Nutrition consult.

9. Labs:
Daily labs: SMA7, osmolality, CBC, cholesterol, triglyceride, urine glucose and specific gravity.
Twice weekly Labs: Calcium, phosphate, SMA-12, magnesium
Weekly Labs: Serum albumin and protein, prealbumin, ferritin, INR/PTT, zinc, copper, B12, folate, 24h urine nitrogen and creatinine.

Enteral Nutrition
General Considerations: Daily weights, inputs and outputs, nasoduodenal feeding tube. Head-of-bed at 30E while enteral feeding and 2 hours after completion.
Enteral Bolus Feeding: Give 50-100 mL of enteral solution (Pulmocare, Jevity, Vivonex, Osmolite, Vital HN) q3h. Increase amount in 50 mL steps to max of250-300 mL q3-4h; 30 kcal of nonprotein calories/ kg/d and 1.5 gm protein/kg/d. Before each feeding, measure residual volume, and delay feeding by 1h if >100 mL. Flush tube with 100 cc of water
after each bolus.
Continuous enteral infusion: Initial enteral solution (Pulmocare, Jevity, Vivonex, Osmolite) 30 mL/hr. Measure residual volume q1h for 12h then tid; hold feeding for 1h if >100 mL. Increase rate by 25-50 mL/hr at 24 hr intervals as tolerated until final rate of
50-100 mL/hr. Three tablespoonfuls of protein powder(Promix) may be added to each 500 cc of solution. Flush tube with 100 cc water q8h.

Special Medications:
Metoclopramide (Reglan): 10-20 mg IV/NG OR
Erythromycin: 125 mg IV or via nasogastric tube q8h.
Famotidine (Pepcid): 20 mg IV/PO q12h OR
Ranitidine (Zantac): 150 mg NG bid.

Symptomatic Medications:
Loperamide (Imodium): 2-4 mg NG/J-tube q6h prn, max 16 mg/d OR
Diphenoxylate/atropine (Lomotil): 1-2 tabs or 5-10 mL (2.5 mg/5 mL) PO/J-tube q4-6h prn, max 12
tabs/d OR
Kaopectate: 30 cc NG or in J-tube q8h.

Extras: CXR, plain abdominal x-ray for tube placement, nutrition consult.

Labs:
Daily labs: SMA7, osmolality, CBC, cholesterol, triglyceride. SMA-12
Weekly labs when indicated: Protein, Mg, INR/PTT, 24h urine nitrogen and creatinine. Pre-albumin, retinol-binding protein.

HEPATIC ENCEPHALOPATHY

1. Admission: Gastroentology
2. Diagnosis: Hepatic encephalopathy
3. Condition:
4. Vital Signs: q1-4h, neurochecks q4h. Call physician if BP >160/90,<90/60; P >120,<50; R>25,<10; T >38.5EC.
5. Allergies: Avoid sedatives, NSAIDS or hepatotoxic drugs.
6. Activity: Bed rest.
7. Nursing: Keep head-of-bed at 40 degrees, guaiac stools; turn patient q2h while awake, chart stools. Seizure precautions, egg crate mattress, softrestraints prn. Record inputs and outputs. Foley to closed drainage.
8. Diet: NPO for 8 hours, then low-protein nasogastricenteral feedings (Hepatic-Aid II) at 30 mL/hr. Increase rate by 25-50 mL/hr at 24 hr intervals as tolerated until final rate of 50-100 mL/hr as tolerated.
9. IV Fluids: D5W at TKO.
10.Special Medications:
Sorbitol 70% solution: 30-60 gm PO now.
Lactulose: 30-45 mL PO q1h for 3 doses, then 15-45 mL PO bid-qid, titrate to produce 3 soft stools/d OR
Lactulose enema: 300 mL added to 700 mL of tap water; instill 200-250 mL per rectal tube bid-qid AND
Neomycin: 1 gm PO q6h (4-12 g/d) OR
Metronidazole (Flagyl): 250 mg PO q6h.
Ranitidine (Zantac): 50 mg IV q8h or 150 mg PO bid
OR
Famotidine (Pepcid): 20 mg IV/PO q12h.

Flumazenil (Romazicon): 0.2 mg (2 mL) IV over 30 seconds q1min until a total dose of 3 mg; if a partial response occurs, continue 0.5 mg doses until a total of 5 mg. Flumazenil may help reverse hepatic encephalopathy, irrespective of benzodiazepine use.
Multivitamin: PO qAM or 1 ampule IV qAM.
Folic acid: 1 mg PO/IV qd.
Thiamine: 100 mg PO/IV qd.
Vitamin K: 10 mg SQ qd for 3 days if elevated INR.
11. Extras: CXR, ECG; GI and dietetics consults.
12. Labs: Ammonia, CBC, platelets, SMA 7&12, AST, ALT, GGT, LDH, alkaline phosphatase, protein, albumin, bilirubin, INR/PTT, ABG, blood C&S x 2, hepatitis B surface antibody. UA.

ALCOHOL WITHDRAWAL

1. Admission: Medicla Care Unite
2. Diagnosis: Alcohol withdrawals/delirium tremens.
3. Condition:
4. Vital Signs: q4-6h. Call physician if BP >160/90, <90-/60; P >130, <50; R>25, <10; T >38.5EC; or increase in agitation.
5. Activity:
6. Nursing: Seizure precautions. Soft restraints prn.
7. Diet: Regular, push fluids.
8. IV Fluids: Heparin lock or D5 ½ NS at 100-125 cc/h.
9. Special Medications:
Withdrawal syndrome:
Chlordiazepoxide (Librium): 50-100 mg PO/IV q6h for 3 days OR
Lorazepam (Ativan): 1 mg PO tid-qid.
Delirium tremens:
Chlordiazepoxide (Librium): 100 mg slow IV push or PO, repeat q4-6h prn agitation or tremor for 24h; max 500 mg/d. Then give 50-100 mg PO q6h prn agitation or tremor OR
Diazepam (Valium): 5 mg slow IV push, repeat q6h until calm, then 5-10 mg PO q4-6h.
Seizures:
Thiamine: 100 mg IV push AND
Dextrose water 50%: 50 mL IV push.
Lorazepam (Ativan): 0.1 mg/kg IV at 2 mg/min; may repeat x 1 if seizures continue.
Wernicke-Korsakoff Syndrome:
Thiamine: 100 mg IV stat, then 100 mg IV qd.
10. Symptomatic Medications:
Multivitamin: 1 amp IV, then 1 tab PO qd.
Folate: 1 mg PO qd.
Thiamine: 100 mg PO qd.
Acetaminophen: 1-2 PO q4-6h prn headache.
11. Extras: CXR, ECG. Alcohol rehabilitation and social work consult.
12. Labs: CBC, SMA 7&12, Mg, amylase, lipase, liver panel, urine drug screen. UA, INR/PTT.

TOXICOLOGY

POISONING AND DRUG OVERDOSE

DECONTAMINATION:
-Gastric Lavage: Place patient left side down, place nasogastric tube, and check position by injecting air and auscultating. Lavage with normal saline until clear fluid, then leave activated charcoal or other antidote. Gastric lavage is contraindicated for corrosives.
Cathartics:
Magnesium citrate 6% solution: 150-300 mL PO
Magnesium sulfate 10% solution: 150-300 mL PO.
Activated Charcoal: 50 gm PO (first dose should be given using product containing sorbitol). Repeat q2-6h for large ingestions.
HEMODIALYSIS:
Should be for isopropanol, methanol, ethylene glycol, severe salicylate intoxication (>100 mg/dL), lithium, or theophylline (if neurotoxicity, seizures, or coma).
ANTIDOTES:
Narcotic Overdose:
Naloxone (Narcan): 0.4 mg IV/ET/IM/SC, may repeat q2min.
Methanol Ingestion:
Ethanol (10% in D5W): 7.5 mL/kg load, then 1.4 mL/kg/hr IV infusion until methanol level <20 mg/dL. Maintain ethanol level of 100-150 mg/100 mL.
Ethylene Glycol Ingestion:
Fomepizole (Antizol): 15 mg/kg IV over 30 min, then 10 mg/kg IV q12h x 4 doses, then 15 mg/kg IV q12h until ethylene glycol level is less than 20 mg/dL AND
Pyridoxine: 100 mg IV q6h for 2 days and thiamine 100 mg IV q6h for 2 days.
Carbon Monoxide Intoxication:
Hyperbaric oxygen therapy: or 100% oxygen by mask if hyperbaric oxygen is not available.
Tricyclic Antidepressants Overdose:
Gastric lavage:
Magnesium citrate: 300 mg PO/NG x1.
Activated charcoal: premixed with sorbitol 50 gm NG round-the-clock until level is less than the toxic range.
Benzodiazepine Overdose:
Flumazenil (Romazicon): 0.2 mg (2 mL) IV over 30 seconds q1min until a total dose of 3 mg; if a partial response occurs, repeat 0.5 mg doses until a total of 5 mg. If sedation persists,

repeat the above regimen or start a continuous IV infusion of 0.1-0.5 mg/h.

Labs: Drug screen (serum, gastric, urine); blood levels, SMA 7, fingerstick glucose, CBC, LFTs, ECG.

ACETAMINOPHEN OVERDOSE

1. Admission: Medical intensive care unit.
2. Diagnosis: Acetaminophen overdose
3. Condition:
4. Vital Signs: q1h with neurochecks. Call physician if BP >160/90, <90/60; P >130, <50 <50; R>25, <10; urine output <20 cc/h for 3 hours.
5. Activity: Bed rest with bedside commode.
6. Nursing: Inputs and outputs, aspiration and seizure precautions. Place large bore (Ewald) NG tube, then lavage with 2 L of NS.
7. Diet: NPO
8. IV Fluids:
9. Special Medications:
Activated charcoal: 30-100 gm doses, remove via nasogastric suction prior to acetylcysteine.
Acetylcysteine (Mucomyst, NAC) 5% solution: loading dose 140 mg/kg via nasogastric tube, then 70 mg/kg via NG tube q4h x 17 doses OR acetylcysteine 150 mg/kg IV in 200 mL D5W over 15 min, followed by 50 mg/kg in 500 mL D5W, infused over 4h, followed by 100 mg/kg in 1000 mL of D5W over next 16h. Complete all NAC doses even if
acetaminophen levels fall below toxic range.
Phytonadione (Aquamephyton): 5 mg IV/IM/SQ (if INR increased).
Fresh frozen plasma: 2-4 U (if INR is unresponsive to Aquamephyton).
Trimethobenzamide (Tigan): 100-200 mg IM/PR q6h prn nausea.
10. Extras: ECG.
11. Labs: CBC, SMA 7&12, LFTs, INR/PTT, acetaminophen level now and in 4h. UA.

THEOPHYLLINE OVERDOSE

1. Admission: Medical intensive care unit.
2. Diagnosis: Theophylline overdose
3. Condition:
4. Vital Signs: Neurochecks q2h. Call physician if BP >160/90, <90/60; P >130; <50; R >25, <10.
5. Activity: Bed rest
6. Nursing: ECG monitoring until level <20 mcg/mL, aspiration and seizure precautions. Insert single lumen NG tube and lavage with normal saline if recent ingestion.
7. Diet: NPO
8. IV Fluids: D5 ½ NS at 125 cc/h
9. Special Medications:
-Activated charcoal 50 gm PO round-the-clock, with sorbitol cathartic, until theophylline level <20 mcg/ mL. Maintain head-of-bed at 30-45 degrees to prevent aspiration of charcoal.
-Charcoal hemoperfusion should be considered if the serum level is >60 mcg/mL or if signs of neurotoxicity, seizure, coma are present.
-**Seizure:** Lorazepam (Ativan) 0.1 mg/kg IV at 2 mg/min; may repeat x 1 if seizures continue.
10. Extras: ECG.
11. Labs: CBC, SMA 7&12, theophylline level now and in q6-8h; INR/PTT, liver panel. UA.

TRICYCLIC ANTIDEPRESSANT OVERDOSE

1. Admission: Medical intensive care unit.
2. Diagnosis: TCA Overdose
3. Condition:
4. Vital Signs: Neurochecks q1h.
5. Activity: Bedrest.
6. Nursing: Continuous suicide observation. ECG monitoring, measure QRS width hourly, inputs and outputs, aspiration and seizure precautions. Place single-lumen nasogastric tube and lavage with 2 liters of normal saline if recent ingestion.
7. Diet: NPO
8. IV Fluids: NS at 100-150 cc/hr.
9. Special Medications:
Activated charcoal: premixed with sorbitol, 50 gm via NG tube q4-6h round-the-clock until the TCA level decreases to therapeutic range. Maintain head-ofbed at 30-45 degree angle to prevent charcoal aspiration.
Magnesium citrate: 300 mL via nasogastric tube x 1 dose.
10. Protection Against Cardiac Toxicity:
If mechanical ventilation is necessary, hyperventilate to maintain pH 7.50-7.55.
Administer sodium bicarbonate 50-100 mEq (1-2 amps or 1-2 mEq/kg) IV over 5-10 min, followed by infusion of sodium bicarbonate (2 amps in D5W 1 L) at 100-150 cc/h. Adjust rate to maintain pH 7.50- 7.55.
11. Extras: ECG.
12. Labs: Urine toxicology screen, serum TCA levels, liver panel, CBC, SMA-7 and 12, UA.

NEUROLOGIC DISORDERS

ISCHEMIC STROKE

1. Admission: Neurology
2. Diagnosis: Ischemic stroke
3. Condition:
4. Vital Signs: Vital signs and neurochecks q30minutes for 6 hours, then q60 minutes for 12 hours. Call physician if BP >185/105, <110/60; P >120, <50; R>24, <10; T >38.5EC; or change in neurologic status.
5. Activity: Bedrest.
6. Nursing: Head-of-bed at 30 degrees, turn q2h when awake, range of motion exercises qid. Foley catheter, eggcrate mattress. Guaiac stools, inputs and outputs.
Bleeding precautions: check puncture sites for bleeding or hematomas. Apply digital pressure or pressure dressing to active compressible bleeding sites.
7. Diet: NPO except medications for 24 hours, then dysphagia ground diet with thickened liquids.
8. IV Fluids and Oxygen: 0.45% normal saline at 100 cc/h. Oxygen at 2 L per minute by nasal cannula.

9. Special Medications:
Ischemic Stroke <3 hours:
a. Tissue plasminogen activator (t-PA, Alteplase) is indicated if the patient presents within 3 hours of onset of symptoms and the stroke is nonhemorrhagic; 0.9 mg/kg (max 90 mg) over 60 min. Give 10% of the total dose as an initial bolus over 1 minute.
b. Repeat CT scan or MRI 24 hours after completion of tPA. Begin heparin if scan results are negative for hemorrhage.
c. Heparin 12 U/kg/h continuous IV infusion, without a bolus. Check aPTT q6h to maintain 1.2-1.5 x control.
Completed Ischemic Stroke >3 hours:
Aspirin enteric coated: 325 mg PO qd OR
Clopidogrel (Plavix): 75 mg PO qd OR
Aspirin: 25 mg/dipyridamole 200 mg (Aggrenox) 1 tab PO bid OR
Aspirin: 325 mg PO qd PLUS Clopidogrel (Plavix) 75 mg PO qd
10. Symptomatic Medications:
Famotidine (Pepcid): 20 mg IV/PO q12h.
Omeprazole (Prilosec): 20 mg PO bid or qhs.
Docusate sodium (Colace): 100 mg PO qhs
Bisacodyl (Dulcolax): 10-15 mg PO qhs or 10 mg PR prn.
Acetaminophen (Tylenol): 650 mg PO/PR q4-6h prn temp >38°C or headache.
11. Extras: CXR, ECG, CT without contrast or MRI with gadolinium contrast; carotid duplex scan; echocardiogram, 24-hour Holter monitor; swallowing studies. Physical therapy consult for range of motion exercises; neurology and rehabilitation medicine consults.
12. Labs: CBC, glucose, SMA 7&12, fasting lipid profile, VDRL, ESR; drug levels, INR/PTT, UA. Lupus anticoagulant, anticardiolipin antibody.

TRANSIENT ISCHEMIC ATTACK

1. Admission: Neurology
2. Diagnosis: Transient ischemic attack
3. Condition:
4. Vital Signs: q1-4h with neurochecks. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; or change in neurologic status.
5. Activity: Up as tolerated.
6. Nursing: Guaiac stools.
7. Diet: Dysphagia ground with thickened liquids or regular diet.
8. IV Fluids: Heparin lock with flush q shift.
9. Special Medications:
Aspirin: 325 mg PO qd **OR**
Clopidogrel (Plavix): 75 mg PO qd **OR**
Aspirin: 25 mg/dipyridamole 200 mg (Aggrenox) 1 tab PO bid.
Heparin: (only if recurrent TIAs or cardiogenic or vertebrobasilar source for emboli) 700-800 U/h (12 U/kg/h) IV infusion without a bolus (25,000 U in 500 mL D5W); adjust q6-12h until PTT 1.2-1.5 x control.
Warfarin (Coumadin): 5.0-7.5 mg PO qd for 3d, then 2-4 mg PO qd. Titrate to INR of 2.0-2.5.
10. Symptomatic Medications:
Famotidine (Pepcid): 20 mg IV/PO q12h.
Docusate sodium (Colace): 100 mg PO qhs.
Milk of magnesia: 30 mL PO qd prn constipation.
11. Extras: CXR, ECG, CT without contrast; carotid duplex scan, echocardiogram, 24-hour Holter monitor. Physical therapy, neurology consults.
12. Labs: CBC, glucose, SMA 7&12, fasting lipid profile, VDRL, drug levels, INR/PTT, UA.

SUBARACHNOID HEMORRHAGE

1. Admission: Neurology
2. Diagnosis: Subarachnoid hemorrhage
3. Condition:
4. Vital Signs: Vital signs and neurochecks q1-4h. Call physician if BP >185/105, <110/60; P >120, <50; R>24, <10; T >38.5EC; or change in neurologic status.
5. Activity: Bedrest.

6. Nursing: Head-of-bed at 30 degrees, turn q2h when awake. Foley catheter to closed drainage, eggcrate mattress. Guaiac stools, inputs and outputs.
7. Diet: NPO except medications.
8. IV Fluids and Oxygen: 0.45% normal saline at 100 cc/h. Oxygen at 2 L per minute by nasal cannula.
Keep room dark and quiet; strict bedrest. Neurologic checks q1h for 12 hours, then q2h for 12 hours, then q4h. Call physician if abrupt change in neurologic status.
Restrict total fluids to 1000 mL/day; diet as tolerated.
9. Special Medications:
Nimodipine (Nimotop): 60 mg PO or via NG tube q4h for 21d, must start within 96 hours.
Phenytoin (seizures): load 15 mg/kg IV in NS (infuse at max 50 mg/min), then 300 mg PO/IV qAM (4-6 mg/kg/d) OR
Valproic acid (Depakene): 500-1000 mg IV q6h.
Hypertension:
Nitroprusside sodium: 0.1-0.5 mcg/kg/min (50 mg in 250 mL NS), titrate to control blood pressure OR
Labetalol (Trandate): 10-20 mg IV q15min prn or 1-2 mg/min IV infusion.
10. Extras: CXR, ECG, CT without contrast; MRI angiogram; cerebral angiogram. Neurology, neurosurgery consults.
11. Labs: CBC, SMA 7&12, VDRL, UA.

SEIZURE AND STATUS EPILEPTICUS

1. Admission: Neurology
2. Diagnosis: Seizure
3. Condition:
4. Vital Signs: q6h with neurochecks. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; or any change in neurological status.
5. Activity: Bed rest
6. Nursing: Finger stick glucose. Seizure precautions with bed rails up; padded tongue blade at bedside. EEG monitoring.
7. Diet: NPO for 24h, then regular diet if alert.
8. IV Fluids: D5 ½ NS at 100 cc/hr; change to heparin lock when taking PO.
9. Special Medications:
Status Epilepticus:
1. Maintain airway.
2. Position the patient laterally with the head down. The head and extremities should be cushioned to prevent injury.
3. A bite block or other soft object may be inserted into the mouth to prevent injury to the tongue.
4. Give 100% O2 by mask. Obtain brief history and a fingerstick glucose.
5. Secure IV access and draw blood for glucose analysis. Give thiamine 100 mg IV push, then dextrose 50% 50 mL IV push.
6. Initial Control:
Lorazepam (Ativan) 6-8 mg (0.1 mg/kg; not to exceed 2 mg/min) IV at 1-2 mg/min. May repeat 6-8 mg q5-10min (max 80 mg/24h) **OR**
Diazepam (Valium), 5-10 mg slow IV at 1-2 mg/min. Repeat 5-10 mg q5-10 min prn (max
100 mg/24h).
Phenytoin (Dilantin) 15-20 mg/kg load in NS at 50 mg/min. Repeat 100-150 mg IV q30min, max 1.5 gm; monitor BP.
Fosphenytoin (Cerebyx) 20 mg/kg IV/IM (at 150 mg/min), then 4-6 mg/kg/day in 2 or 3 doses (150 mg IV/IM q8h). Fosphenytoin is metabolized to phenytoin; fosphenytoin may be given IM.
If seizures persist, administer phenobarbital 20 mg/kg IV at 50 mg/min, repeat 2 mg/kg q15min; additional phenobarbital may be given, up to max of 30-60 mg/kg.
7. If seizures persist, intubate the patient and give:
Midazolam (Versed): 0.2 mg/kg IV push, then 0.045 mg/kg/hr; titrate up to 0.6 mg/kg/hr **OR**
Propofol (Diprivan): 2 mg/kg IV push over 2-5 min, then 50 mcg/kg/min; titrate up to 165 mcg/kg/min **OR**
Phenobarbital: as above.
Induce coma with pentobarbital: 10-15 mg/kg IV over 1-2h, then 1-1.5 mg/kg/h continuous infusion. Initiate continuous EEG monitoring.
8. Consider Intubation and General Anesthesia Maintenance
Therapy for Epilepsy:
Primary Generalized Seizures – First-Line Therapy:
Carbamazepine (Tegretol): 200-400 mg PO tid [100, 200 mg]. Monitor CBC.
Phenytoin (Dilantin): loading dose of 400 mg PO, followed by 300 mg PO q4h for 2 doses (total of 1 g), then 300 mg PO qd or 100 mg tid or 200 mg bid [30, 50, 100 mg].
Divalproex (Depakote): 250-500 mg PO tid-qid with meals [125, 250, 500 mg].
Valproic acid (Depakene): 250-500 mg PO tid-qid with meals [250 mg].
Primary Generalized Seizures -- Second Line
Therapy:
Phenobarbital: 30-120 mg PO bid [8, 16, 32, 65, 100 mg].
Primidone (Mysoline): 250-500 mg PO tid [50, 250 mg]; metabolized to phenobarbital.
Felbamate (Felbatol): 1200-2400 mg PO qd in 3-4 divided doses, max 3600 mg/d [400, 600 mg; 600 mg/5 mL susp]; adjunct therapy; aplastic anemia, hepatotoxicity.
Gabapentin (Neurontin): 300-400 mg PO bid-tid; max 1800 mg/day [100, 300, 400 mg]; adjunct therapy.
Lamotrigine (Lamictal): 50 mg PO qd, then increase to 50-250 mg PO bid [25, 100, 150, 200 mg]; adjunct therapy.
Partial Seizure:
Carbamazepine (Tegretol): 200-400 mg PO tid [100, 200 mg].
Divalproex (Depakote): 250-500 mg PO tid with meals [125, 250, 500 mg].

Valproic acid (Depakene): 250-500 mg PO tid-qid with meals [250 mg].
Phenytoin (Dilantin): 300 mg PO qd or 200 mg PO bid [30, 50, 100].
Phenobarbital: 30-120 mg PO tid or qd [8, 16, 32, 65, 100 mg].
Primidone (Mysoline): 250-500 mg PO tid [50, 250 mg]; metabolized to phenobarbital.
Gabapentin (Neurontin): 300-400 mg PO bid-tid; max 1800 mg/day [100, 300, 400 mg]; adjunct therapy.
Lamotrigine (Lamictal): 50 mg PO qd, then increase to 50-250 mg PO bid [25, 100, 150, 200 mg]; adjunct therapy.
Topiramate (Topamax): 25 mg PO bid; titrate to max 200 mg PO bid [tab 25, 100, 200 mg]; adjunctive therapy.

Absence Seizure:

Divalproex (Depakote): 250-500 mg PO tid-qid [125, 250, 500 mg].
Clonazepam (Klonopin): 0.5-5 mg PO bid-qid [0.5, 1, 2 mg].
Lamotrigine (Lamictal): 50 mg PO qd, then increase to 50-250 mg PO bid [25, 100, 150, 200 mg]; adjunct therapy.

10. Extras: MRI with and without gadolinium or CT with contrast; EEG (with photic stimulation, hyperventilation, sleep deprivation, awake and asleep tracings); portable CXR, ECG.
11. Labs: CBC, SMA 7, glucose, Mg, calcium, phosphate, liver panel, VDRL, anticonvulsant levels. UA, drug screen.

ENDOCRINOLOGIC DISORDERS

DIABETIC KETOACIDOSIS

1. Admission: Endocrinillogy
2. Diagnosis: Diabetic ketoacidosis
3. Condition:
4. Vital Signs: q1-4h, postural BP and pulse. Call physician if BP >160/90, <90/60; P >140, <50; R >30, <10; T >38.5EC; or urine output <20 mL/hr for more than 2 hours.
5. Activity: Bed rest with bedside commode.
6. Nursing: Inputs and outputs. Foley to closed drainage. Record labs on flow sheet.
7. Diet: NPO for 12 hours, then clear liquids as tolerated.
8. IV Fluids:
1-2 L NS over 1-3h ($16 gauge), infuse at 400-1000 mL/h until hemodynamically stable, then change to 0.45% saline at 125-150 cc/hr; keep urine output >30-60 mL/h.
Add KCL when serum potassium is <5.0 mEq/L. Concentration.....20-40 mEq KCL/L
Use K phosphate, 20-40 mEq/L, in place of KCL if hypophosphatemic. Change to 5% dextrose in 0.45% saline with 20-40 mEq KCL/liter when blood glucose is 250-300 mg/dL.
9. Special Medications:
Oxygen: at 2 L/min by NC.
Insulin regular (Humulin): 7-10 units (0.1 U/kg) IV bolus, then 7-10 U/h IV infusion (0.1 U/kg/h); 50 U in 250 mL of 0.9% saline; flush IV tubing with 20 mL of insulin solution before starting infusion. Adjust insulin infusion to decrease serum glucose by 100 mg/dL or less per hour. When bicarbonate level is >16 mEq/L and the anion gap is <16 mEq/L, decrease insulin infusion rate by half.
When the glucose level reaches 250 mg/dL, 5% dextrose should be added to the replacement fluids with KCL 20-40 mEq/L.
-Use 10% glucose at 50-100 mL/h if anion gap persists and serum glucose has decreased to less than 100 mg/dL while on insulin infusion.
Change to subcutaneous insulin when the anion gap has cleared; discontinue insulin infusion 1-2h after subcutaneous dose.
10. Symptomatic Medications:
Famotidine (Pepcid): 20 mg IV q12h.
Docusate sodium (Colace): 100 mg PO qhs.
Acetaminophen (Tylenol): 325-650 mg PO q4-6h prn headache.
11. Extras: Portable CXR, ECG.
12. Labs: Fingerstick glucose q1-2h. SMA 7 q4-6h. SMA 12, pH, bicarbonate, phosphate, amylase, lipase, hemoglobin A1c; CBC. UA, serum pregnancy test.

NONKETOTIC HYPEROSMOLAR SYNDROME

1. Admission: Endocrinillogy
2. Diagnosis: Nonketotic hyperosmolar syndrome
3. Condition:
4. Vital Signs: q1h. Call physician if BP >160/90, <90/60; P >140, <50; R>25, <10; T >38.5E C; or urine output <20 cc/hr for more than 4 hours.
5. Activity: Bed rest with bedside commode.
6. Nursing: Input and output measurement. Foley to closed drainage. Record labs on flow sheet.
7. Diet: NPO.
8. IV Fluids: 1-2 L NS over 1h ($16 gauge IV catheter), then give 0.45% saline at 125 cc/hr. Maintain urine output $50 mL/h.
-Add 20-40 mEq/L KCL when urine output adequate.
9. Special Medications:
-Insulin regular 2-3 U/h IV infusion (50 U in 250 mL of 0.9% saline).
-Famotidine (Pepcid) 20 mg IV/PO q12h OR
-Lansoprazole (Prevacid) 30 mg PO qd.
-Heparin 5000 U SQ q12h.
10. Extras: Portable CXR, ECG.
11. Labs: Fingerstick glucose q1-2h x 6h, then q6h. SMA 7, osmolality. SMA 12, phosphate, ketones, hemoglobin A1C, CBC. UA.

THYROID STORM AND HYPERTHYROIDISM

1. Admission: Endocrinillogy
2. Diagnosis: Thyroid Storm
3. Condition:
4. Vital Signs: q1-4h. Call physician if BP >160/90, <90/60; P >130, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest
6. Nursing: Cooling blanket prn temp >39EC, inputs and outputs. Oxygen 2 L/min by nasal canula.
7. Diet: Regular
8. IV Fluids: D5 ½ NS at 125 mL/h.
9. Special Medications:
Thyroid Storm and Hyperthyroidism
Subtotal Thyroidectomy: Indicated in patients with large goiter that extends retrosternally, in pregnant patients, and children who have major adverse reaction to medications.
-Methimazole (Tapazole) 30-60 mg PO, then maintenance of 15 mg PO qd-bid OR
-Propylthiouracil (PTU) 1000 mg PO, then 50-250 mg PO q4-8h, up to 1200 mg/d; usual maintenance dose 50 mg PO tid AND
-Iodide solution (Lugol's solution), 3-6 drops tid; one hour after propylthiouracil AND
-Dexamethasone (Decadron) 2 mg IV q6h AND
-Propranolol 40-160 mg PO q6h or 5-10 mg/h, max 2- 5 mg IV q4h or propranolol-LA (Inderal-LA), 80-120 mg PO qd [60, 80, 120, 160 mg].
-Acetaminophen (Tylenol) 1-2 tabs PO q4-6h prn temp >38EC.
-Zolpidem (Ambien) 10 mg PO qhs prn insomnia OR
-Lorazepam (Ativan) 1-2 mg IV/IM/PO q4-8h prn anxiety.
10. Extras: CXR PA and LAT, ECG, endocrine consult.
11. Labs: CBC, SMA 7&12; sensitive TSH, free T4. UA.

MYXEDEMA COMA AND HYPOTHYROIDISM

1. Admission: Endocrinillogy
2. Diagnosis: Myxedema Coma
3. Condition:
4. Vital Signs: q1h. Call physician if BP systolic >160/90, <90/60; P >130, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest
6. Nursing: Triple blankets prn temp <36EC, inputs and outputs, aspiration precautions.
7. Diet: NPO
8. IV Fluids: IV D5 NS TKO.
9. Special Medications:
Myxedema Coma and Hypothyroidism:
-Volume replacement with NS 1 L rapid IV over 1 hour, then 125 mL/h.
-Levothyroxine (Synthroid, Levoxine) 300-500 mcg IV, then 100 mcg PO or IV qd.
-Hydrocortisone 100 mg IV loading dose, then 50-100 mg IV q8h.
Hypothyroidism in Medically Stable Patient:
-Levothyroxine (Synthroid, T4) 50-75 mcg PO qd, increase by 25 mcg PO qd at 2-4 week intervals to 75-150 mcg qd until TSH normalized.
11. Extras: ECG, endocrine consult.
12. Labs: CBC, SMA 7&12; sensitive TSH, free T4. UA, rheumatoid factor, ANA.

NEPHROLOGIC DISORDERS

RENAL FAILURE

1. Admission: Kidney Care Unit
2. Diagnosis: Renal failure
3. Condition:
4. Vital Signs: q8h. Call physician if QRS complex >0.14 sec; urine output <20 cc/hr; BP >160/90, <90/- 60; P >120, <50; R>25, <10; T >38.5EC.
5. Allergies: Avoid magnesium containing antacids, salt substitutes, NSAIDS. Discontinue phosphate or potassium supplements.
6. Activity: Bed rest.
7. Nursing: Daily weights, inputs and outputs, chart urine output. If no urine output for 4h, in-and-out catheterize. Guaiac stools.
8. Diet: Renal diet of high biologic value protein of 0.6- 0.8 g/kg, sodium 2 g, potassium 1 mEq/kg, and at least 35 kcal/kg of nonprotein calories. In oliguric patients, daily fluid intake should be restricted to less than 1 L after volume has been normalized.
9. IV Fluids: D5W at TKO.
10. Special Medications:
-Consider fluid challenge (to rule out pre-renal azotemia if not fluid overloaded) with 500-1000 mL NS IV over 30 min. In acute renal failure, in-and-out catheterize and check postvoid residual to rule out obstruction.
-Furosemide (Lasix) 80-320 mg IV bolus over 10-60 min, double the dose if no response after 2 hours to total max 1000 mg/24h, or furosemide 1000 mg in 250 mL D5W at 20-40 mg/hr continuous IV infusion OR
-Torsemide (Demadex) 20-40 mg IV bolus over 5-10 min, double the dose up to max 200 mg/day OR
-Bumetanide (Bumex) 1-2 mg IV bolus over 1-20 min; double the dose if no response in 1-2 h to total max 10 mg/day.
-Metolazone (Zaroxolyn) 5-10 mg PO (max 20 mg/24h) 30 min before a loop diuretic.
-Hyperkalemia is treated with sodium polystyrene sulfonate (Kayexalate), 15-30 gm PO/NG/PR q4-6h.
-Hyperphosphatemia is controlled with calcium acetate (PhosLo), 2-3 tabs with meals.
-Metabolic acidosis is treated with sodium bicarbonate to maintain the serum pH >7.2 and the bicarbonate level >20

mEq/L. 1-2 amps (50-100 mEq) IV push, followed by infusion of 2-3 amps in 1000 mL of D5W at 150 mL/hr.
-Adjust all medications to creatinine clearance, and remove potassium phosphate and magnesium from IV. Avoid NSAIDs and nephrotoxic drugs.
11. Extras: CXR, ECG, renal ultrasound, nephrology and dietetics consults.
12. Labs: CBC, platelets, SMA 7&12, creatinine, BUN, potassium, magnesium, phosphate, calcium, uric acid, osmolality, ESR, INR/PTT, ANA. Urine specific gravity, UA with micro, urine C&S; 1st AM spot urine electrolytes, eosinophils, creatinine, pH, osmolality; Wright's stain, urine electrophoresis. 24h urine protein, creatinine, sodium.

NEPHROLITHIASIS

1. Admission: Kidney Care Unit
2. Diagnosis: Nephrolithiasis
3. Condition:
4. Vital Signs: q8h. Call physician if urine output <30 cc/hr; BP >160/90, <90/60; T >38.5EC.
5. Activity: Up ad lib.
6. Nursing: Strain urine, measure inputs and outputs. Place Foley if no urine for 4 hours.
7. Diet: Regular, push oral fluids.
8. IV Fluids: IV D5 ½ NS at 100-125 cc/hr (maintain urine output of 80 mL/h).
9. Special Medications:
-Cefazolin (Ancef) 1-2 gm IV q8h
-Meperidine (Demerol) 75-100 mg and hydroxyzine 25 mg IM/IV q2-4h prn pain OR
-Butorphanol (Stadol) 0.5-2 mg IV q3-4h.
-Hydrocodone/acetaminophen (Vicodin), 1-2 tab q4- 6h PO prn pain OR
-Oxycodone/acetaminophen (Percocet) 1 tab q6h prn pain OR
-Acetaminophen with codeine (Tylenol 3) 1-2 tabs PO q3-4h prn pain.
-Ketorolac (Toradol) 10 mg PO q4-6h prn pain, or 30- 60 mg IV/IM then 15-30 mg IV/IM q6h (max 5 days).
-Zolpidem (Ambien) 10 mg PO qhs prn insomnia.
11. Extras: Intravenous pyelogram, KUB, CXR, ECG.
12. Labs: CBC, SMA 6 and 12, calcium, uric acid, phosphorous, UA with micro, urine C&S, urine pH, INR/PTT. Urine cystine (nitroprusside test), send stones for X-ray crystallography. 24 hour urine collection for uric acid, calcium, creatinine.

HYPERCALCEMIA

1. Admission: Kidney Care Unit
2. Diagnosis: Hypercalcemia
3. Condition:
4. Vital Signs: q4h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; or tetany or any abnormal mental status.
5. Activity: Encourage ambulation; up in chair at other times.
6. Nursing: Seizure precautions, measure inputs and outputs.
7. Diet: Restrict dietary calcium to 400 mg/d, push PO fluids.
8. Special Medications:
-1-2 L of 0.9% saline over 1-4 hours until no longer hypotensive, then saline diuresis with 0.9% saline infused at 125 cc/h AND
-Furosemide (Lasix) 20-80 mg IV q4-12h. Maintain urine output of 200 mL/h; monitor serum sodium, potassium, magnesium.
-Calcitonin (Calcimar) 4-8 IU/kg IM q12h or SQ q6- 12h.
-Etidronate (Didronel) 7.5 mg/kg/day in 250 mL of normal saline IV infusion over 2 hours. May repeat in 3 days.
-Pamidronate (Aredia) 60 mg in 500 mL of NS infused over 4 hours or 90 mg in 1 liter of NS infused over 24 hours x one dose.
9. Extras: CXR, ECG, mammogram.
10. Labs: Total and ionized calcium, parathyroid hormone, SMA 7&12, phosphate, Mg, alkaline phosphatase, prostate specific antigen and carcinoembryonic antigen. 24h urine calcium, phosphate.

HYPOCALCEMIA

1. Admission: Kidney Care Unit
2. Diagnosis: Hypocalcemia
3. Condition:
4. Vital Signs: q4h. Call physician if BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC; or any abnormal mental status.
5. Activity: Up ad lib
6. Nursing: I and O.
7. Diet: No added salt diet.
8. Special Medications:
Symptomatic Hypocalcemia:
-Calcium chloride, 10% (270 mg calcium/10 mL vial), give 5-10 mL slowly over 10 min or dilute in 50-100 mL of D5W and infuse over 20 min, repeat q20-30min if symptomatic, or hourly if asymptomatic. Correct hyperphosphatemia before hypocalcemia OR
-Calcium gluconate, 20 mL of 10% solution IV (2 vials)(90 mg elemental calcium/10 mL vial) infused over 10-15 min, followed by infusion of 60 mL ofcalcium gluconate in 500 cc of D5W (1 mg/mL) at 0.5-2.0 mg/kg/h.
Chronic Hypocalcemia:
-Calcium carbonate with vitamin D (Oscal-D) 1-2 tab PO tid OR
-Calcium carbonate (Oscal) 1-2 tab PO tid OR
-Calcium citrate (Citracal) 1 tab PO q8h or Extra strength Tums 1-2 tabs PO with meals.
-Vitamin D2 (Ergocalciferol) 1 tab PO qd.

-Calcitriol (Rocaltrol) 0.25 mcg PO qd, titrate up to 0.5-2.0 mcg qid.
-Docusate sodium (Colace) 1 tab PO bid.

9. Extras: CXR, ECG.
10. Labs: SMA 7&12, phosphate, Mg. 24h urine calcium, potassium, phosphate, magnesium.

HYPERKALEMIA

1. Admission: Urology
2. Diagnosis: Hyperkalemia
3. Condition:
4. Vital Signs: q4h. Call physician if QRS complex >0.14 sec or BP >160/90, <90/60; P >120, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest; up in chair as tolerated.
6. Nursing: Inputs and outputs. Chart QRS complex width q1h.
7. Diet: Regular, no salt substitutes.
8. IV Fluids: D5NS at 125 cc/h
9. Special Medications:
-Discontinue ACE inhibitors, angiotensin II receptor blockers, beta-blockers, potassium sparing diuretics.
-Calcium gluconate (10% solution) 10-30 mL IV over 2-5 min; second dose may be given in 5 min. Contraindicated if digoxin toxicity is suspected. Keep 10 mL vial of calcium gluconate at bedside for emergent use.
-Sodium bicarbonate 1 amp (50 mEq) IV over 5 min (give after calcium in separate IV).
-Regular insulin 10 units IV push with 1 ampule of 50% glucose IV push.
-Kayexalate 30-45 gm premixed in sorbitol solution PO/NG/PR now and q3-4h prn.
-Furosemide 40-80 mg IV, repeat prn.
-Consider emergent dialysis if cardiac complications or renal failure.
10. Extras: ECG.
11. Labs: CBC, platelets, SMA7, magnesium, calcium, SMA-12. UA, urine specific gravity, urine sodium, pH, 24h urine potassium, creatinine.

HYPOKALEMIA

1. Admission: Urology department
2. Diagnosis: Hypokalemia
3. Condition:
4. Vital Signs: Vitals, urine output q4h. Call physician if BP >160/90, <90/60; P>120, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest; up in chair as tolerated.
6. Nursing: Inputs and outputs
7. Diet: Regular
8. Special Medications:
Acute Therapy:
-KCL 20-40 mEq in 100 cc saline infused IVPB over 2 hours; or add 40-80 mEq to 1 liter of IV fluid and infuse over 4-8 hours. -KCL elixir 40 mEq PO tid (in addition to IV); max total dose 100-200 mEq/d (3 mEq/kg/d).
Chronic Therapy:
-Micro-K 10 mEq tabs 2-3 tabs PO tid after meals (40- 100 mEq/d) OR
-K-Dur 20 mEq tabs 1 PO bid-tid.
Hypokalemia with metabolic acidosis:
-Potassium citrate 15-30 mL in juice PO qid after meals (1 mEq/mL).
-Potassium gluconate 15 mL in juice PO qid after meals (20 mEq/15 mL).
9. Extras: ECG, dietetics consult.
10. Labs: CBC, magnesium, SMA 7&12. UA, urine Na, pH, 24h urine for K, creatinine.

HYPERMAGNESEMIA

1. Admission: Urology
2. Diagnosis: Hypermagnesemia
3. Condition:
4. Vital Signs: q6h. Call physician if QRS >0.14 sec.
5. Activity: Up ad lib
6. Nursing: Inputs and outputs, daily weights.
7. Diet: Regular
8. Special Medications:
-Saline diuresis 0.9% saline infused at 100-200 cc/h to replace urine loss AND
-Calcium chloride, 1-3 gm added to saline (10% solution; 1 gm per 10 mL amp) to run at 1 gm/hr AND
-Furosemide (Lasix) 20-40 mg IV q4-6h as needed.
-Magnesium of >9.0 mEq/L requires stat hemodialysis because of risk of respiratory failure.
9. Extras: ECG
10. Labs: Magnesium, calcium, SMA 7&12, creatinine. 24 hour urine magnesium, creatinine.

HYPOMAGNESEMIA

1. Admission: Urology
2. Diagnosis: Hypomagnesemia

3. Condition:
4. Vital Signs: q6h
5. Activity: Up ad lib
6. Diet: Regular
7. Special Medications:
-Magnesium sulfate 4-6 gm in 500 mL D5W IV at 1 gm/hr. Hold if no patellar reflex. (Estimation of Mg deficit = 0.2 x kg weight x desired increase in Mg concentration; give deficit over 2-3d) OR
-Magnesium sulfate (severe hypomagnesemia <1.0) 1-2 gm (2-4 mL of 50% solution) IV over 15 min, OR
-Magnesium chloride (Slow-Mag) 65-130 mg (1-2 tabs) PO tid-qid (64 mg or 5.3 mEq/tab) OR
-Milk of magnesia 5 mL PO qd-qid.
8. Extras: ECG
9. Labs: Magnesium, calcium, SMA 7&12. Urine Mg, electrolytes, 24h urine magnesium, creatinine.

HYPERNATREMIA

1. Admission: Urology
2. Diagnosis: Hypernatremia
3. Condition:
4. Vital Signs: q2-8h. Call physician if BP >160/90, <7-0/50; P >140, <50; R>25, <10; T >38.5EC.
5. Activity: Bed rest; up in chair as tolerated.
6. Nursing: Inputs and outputs, daily weights.
7. Diet: No added salt. Push oral fluids.
8. Special Medications:
Hypernatremia with Hypovolemia:
If volume depleted, give 1-2 L NS IV over 1-3 hours until not orthostatic, then give D5W IV to replace half of body water deficit over first 24hours (correct sodium at 1 mEq/L/h), then remaining deficit over next 1-2 days. Body water deficit (L) = 0.6(weight kg)([Na serum]-
140) 140
Hypernatremia with ECF Volume Excess:
-Furosemide 40-80 mg IV or PO qd-bid.
-Salt poor albumin (25%) 50-100 mL bid-tid x 48-72 h.
Hypernatremia with Diabetes Insipidus:
-D5W to correct body water deficit (see above).
-Pitressin 5-10 U IM/IV q6h or desmopressin (DDAVP) 4 mcg IV/SQ q12h; keep urine specific gravity >1.010.
9. Extras: CXR, ECG.
10. Labs: SMA 7&12, serum osmolality, liver panel, ADH, plasma renin activity. UA, urine specific gravity. Urine osmolality, Na, 24h urine K, creatinine.

HYPONATREMIA

1. Admission: Urology
2. Diagnosis: Hyponatremia
3. Condition:
4. Vital Signs: q4h. Call physician if BP >160/90, <7- 0/50; P >140, <50; R>25, <10; T >38.5EC.
5. Activity: Up in chair as tolerated.
6. Nursing: Inputs and outputs, daily weights.
7. Diet: Regular diet.
8. Special Medications:
Hyponatremia with Hypervolemia and Edema (low osmolality <280 mOsm/L, UNa <10 mmol/L: nephrosis, heart failure, cirrhosis):
-Water restrict to 0.5-1.0 L/d.
-Furosemide 40-80 mg IV or PO qd-bid.
Hyponatremia with Normal Volume Status (low osmolality <280 mOsm/L, UNa <10 mmol: water intoxication; UNa >20: SIADH, diuretic-induced):
-Water restrict to 0.5-1.5 L/d.
-Conivaptan (Vaprisol) 20 mg IV over 30 minutes once, followed by a continuous infusion of 20 mg over 24 hours. If the response is insufficient, increase dose to 40 mg/24 hours; max 4 days.
Hyponatremia with Hypovolemia (low osmolality <280 mOsm/L) UNa <10 mmol/L: vomiting, diarrhea, third space/respiratory/skin loss; UNa >20 mmol/L:diuretics, renal injury, RTA, adrenal insufficiency,partial obstruction, salt wasting:
-If volume depleted, give 0.5-2 L of 0.9% saline over 1-2 hours until no longer hypotensive, then 0.9% saline at 125 mL/h or 100-500 mL 3% hypertonic saline over 4h.
Severe Symptomatic Hyponatremia:
If volume depleted, give 1-2 L of 0.9% saline (154 mEq/L) over 1-2 hours until no longer orthostatic. Determine volume of 3% hypertonic saline (513 mEq/L) to be infused:
Na (mEq) deficit = 0.6 x (wt kg)x(desired [Na] – actual [Na])
Volume of solution (L) = Sodium to be infused (mEq)
Number of hrs (mEq/L in solution) x Number of hrs
-Correct half of sodium deficit intravenously over 24 hours until serum sodium is 120 mEq/L; increase sodium by 12-20 mEq/L over 24 hours (1 mEq/L/h).
-Alternative Method: 3% saline 100-300 mL over 4-6h, repeated as needed.
9. Extras: CXR, ECG, head/chest CT scan.
10. Labs: SMA 7&12, osmolality, triglyceride, liver panel. UA, urine specific gravity. Urine osmolality, Na.

HYPERPHOSPHATEMIA

1. Admission: Urology
2. Diagnosis: Hyperphosphatemia

3. Condition:
4. Vital Signs: qid
5. Activity: Up ad lib
6. Nursing: Inputs and outputs
7. Diet: Low phosphorus diet.
8. Special Medications:
Moderate Hyperphosphatemia:
-Restrict dietary phosphate to 0.7-1.0 gm/d.
-Calcium acetate (PhosLo) 1-3 tabs PO tid with meals OR
-Aluminum hydroxide (Amphojel) 5-10 mL or 1-2 tablets PO before meals tid.
Severe Hyperphosphatemia:
-Volume expansion with 0.9% saline 1-2 L over 1-2h.
-Acetazolamide (Diamox) 500 mg PO or IV q6h.
-Consider dialysis.
9. Extras: CXR PA and LAT, ECG.
10. Labs: Phosphate, SMA 7&12, magnesium, calcium. UA, parathyroid hormone.

HYPOPHOSPHATEMIA

1. Admission: Urology
2. Diagnosis: Hypophosphatemia
3. Condition:
4. Vital Signs: qid
5. Activity: Up ad lib
6. Nursing: Inputs and outputs.
7. Diet: Regular diet.
8. Special Medications:
Mild to Moderate Hypophosphatemia (1.0-2.2 mg/dL**):**
-Sodium or potassium phosphate 0.25 mMoles/kg in 150-250 mL of NS or D5W at 10 mMoles/h.
-Neutral phosphate (Nutra-Phos), 2 tab PO bid (250 mg elemental phosphorus/tab) OR
-Phospho-Soda 5 mL (129 mg phosphorus) PO bidtid.
Severe Hypophosphatemia (<1.0 mg/dL):
-Na or K phosphate 0.5 mMoles/kg in 250 mL D5W or NS, IV infusion at 10 mMoles/hr OR
-Add potassium phosphate to IV solution in place of maintenance KCL; max IV dose 7.5 mg phosphorus/kg/6h.
9. Extras: CXR PA and LAT, ECG.
10. Labs: Phosphate, SMA 7&12, Mg, calcium, UA.

RHEUMATOLOGIC DISORDERS

SYSTEMIC LUPUS ERYTHEMATOSUS

1. Admission: Medicl Ward
2. Diagnosis: Systemic Lupus Erythematosus
3. Condition:
4. Vital Signs: tid
5. Allergies:
6. Activity: Up as tolerated with bathroom privileges
7. Nursing:
8. Diet: No added salt, low psoralen diet.
9. Special Medications:
-Ibuprofen (Motrin) 400 mg PO qid (max 2.4 g/d) OR
-Indomethacin (Indocin) 25-50 mg tid-qid.
-Hydroxychloroquine (Plaquenil) 200-600 mg/d PO
-Prednisone 60-100 mg PO qd. Maintenance 10-20 mg PO qd or 20-40 mg PO qOD OR
-Methylprednisolone (pulse therapy) 500 mg IV over 30 min q12h for 3-5d, then prednisone 50 mg PO qd.
-Betamethasone dipropionate (Diprolene) 0.05%ointment applied bid.
10. Extras: CXR PA, LAT, ECG. Rheumatology consult.
11. Labs: CBC, platelets, SMA 7&12, INR/PTT, ESR, complement CH-50, C3, C4, C-reactive protein, LE prep, Coombs test, VDRL, rheumatoid factor, ANA,DNA binding, lupus anticoagulant, anticardiolipin, antinuclear cytoplasmic antibody. UA.

ACUTE GOUT ATTACK

1. Admission: Medicl Ward
2. Diagnosis: Acute gout attack
3. Condition:
4. Vital Signs: tid
5. Activity: Bed rest with bedside commode
6. Nursing: Keep foot elevated; support sheets over foot; guaiac stools.
7. Diet: Low purine diet.
8. Special Medications:
-Ibuprofen (Motrin) 800 mg, then 400-800 mg PO q4- 6h OR
-Diclofenac (Voltaren) 25-75 mg tid-qid with food OR
-Indomethacin (Indocin) 50 mg PO q6h for 2d, then 50 mg tid for 2 days, then 25 mg PO tid OR
-Ketorolac (Toradol) 30-60 mg IV/IM, then 15-30 mg IV/IM q6h or 10 mg PO tid-qid OR
-Naproxen sodium (Anaprox, Anaprox-DS) 550 mg PO bid OR
-Methylprednisolone (SoluMedrol) 125 mg IV x 1 dose
THEN
-Prednisone 60 mg PO qd for 5 days, followed by tapering.
-Colchicine 2 tablets (0.5 mg or 0.6 mg), followed by 1 tablet q1h until relief, max dose of 9.6 mg/24h. Maintenance colchicine: 0.5-0.6 mg PO qd-bid.
Hypouricemic Therapy:

-Probenecid (Benemid), 250 mg bid. Increase the dosage to 500 mg bid after 1 week, then increase by 500-mg increments every 4 weeks until the uric acid level is below 6.5 mg/dL. Max dose 2 g/d. Contraindicated during acute attack.
-Allopurinol (Zyloprim) 300 mg PO qd, may increase by 100-300 mg q2weeks. Usually initiated after the acute attack.

9. Symptomatic Medications:

-Famotidine (Pepcid) 20 mg IV/PO q12h. -Meperidine (Demerol) 50-100 mg IM/IV q4-6h prn pain OR
-Hydrocodone/acetaminophen (Vicodin), 1-2 tab q4- 6h PO prn pain.
-Docusate sodium (Colace) 100 mg PO qhs.
-Acetaminophen (Tylenol) 325-650 mg PO q4-6h prn headache.
-Zolpidem (Ambien) 5-10 mg qhs prn insomnia.

10. Labs: CBC, SMA 7, uric acid. UA with micro. Synovial fluid for light and polarizing micrography for crystals; C&S, Gram stain, glucose, protein, cell count. X-ray views of joint. 24-hour urine for uric acid.

Chapter 7.

DRUG INTERACTIONS

These drug interaction guidelines are offered as a general summary of Information for pharmacists, physicians, nurses and other health professionals. Inappropriate administration of interacting drugs to patients can result in severe injury or death. These guidelines cannot identify medical risks specific to an individual patient or recommend patient treatment. These guidelines are not to be used as a substitute for professional training. The absence of typographical errors is not guaranteed. These guidelines are not necessarily all-inclusive. Use of these guidelines indicates acknowledgement that neither Nephrology Pharmacy Associates, Inc. (NPA), Bone Care International, Inc. nor the authors will be responsible for any loss or injury, including death, sustained in connection with, or as a result of, the use of these guidelines. Readers should consult the complete information available in the package insert for each agent indicated before prescribing medications. Guides such as this one can only draw from information available at the time of publication. Nephrology Pharmacy Associates, Inc., Bone Care International, Inc. and the authors of these guidelines are under no obligation to update information obtained herein. Future medical advances or product information may affect or change the information provided. Health professionals using these guidelines are responsible for monitoring ongoing medical advances related to drug therapy.

Chapter 7.

DRUG INTERACTIONS

- Types of Drug Interactions
- Pharmacodynamic interactions
- Pharmacokinetic interactions
  - Interactions Resulting from Alterations in Gastrointestinal Absorption
  - Interactions Resulting from Alterations in Metabolizing Enzymes
    - Enzyme induction
    - Enzyme inhibition
  - Interactions Resulting from Alterations in Protein Binding
  - Interactions Resulting from Changes in Renal Excretion
- Risk Factors and Management of Drug Interactions
- Clinical Significance of Interactions
- Foods interacting with MAO inhibitors
- Cytochrome p450 enzyme inhibitors
- Commonly used drug levels
- Drugs that prolong the QT interval
- Some inportant relationship between drugs and cytochrom P-450 (CYP) Enzymes
- Major therapeutical interactions

DRUG INTERACTIONS

Many patients, especially the elderly, are treated continuously with one or more drugs for chronic diseases such as hypertension, heart failure, osteoarthritis and so on. Acute events (e.g. infections, myocardial infarction) are treated with additional drugs. The potential for drug interactions is therefore substantial. Drugs can also interact with other dietary constituents (e.g. grapefruit juice, which down-regulates expression of CYP3A4 in the gut) and herbal remedies (such as St John's wort). The administration of one drug (A) can alter the action of another (B) by one of two general mechanisms,

- Modification of the pharmacological effect of B without altering its concentration in the tissue fluid (pharmacodynamic interaction)
- Alteration of the concentration of B that reaches its site of action (pharmacokinetic interaction).

For such interactions to be important clinically, it is necessary that the therapeutic range of drug B is narrow (i.e. that a small reduction in effect will lead to loss of efficacy and/or a small increase in effect will lead to toxicity). For pharmacokinetic interactions to be clinically important, it is also necessary that the concentration-response curve of drug B is steep (so that a small change in plasma concentration leads to a substantial change in effect). For many drugs, these conditions are not met: even quite large changes in plasma concentrations of relatively non-toxic drugs such as penicillin are unlikely to give rise to clinical problems, because there is usually a comfortable safety margin between plasma concentrations produced by usual doses and those resulting in either loss of efficacy or toxicity.

Patients with acute renal failure, chronic kidney disease (CKD) or those treated with dialysis or kidney transplantation are frequently prescribed numerous medications. Drugs of many therapeutic classes are used to treat the underlying diseases leading to CKD, such as diabetes mellitus and hypertension, while others are used to control or treat the common complications of CKD, such as anemia, renal bone disease and lipid disorders. Dialysis patients often are prescribed 10 to 12 medications. With such a large number of medications, there is an increased risk for drug interactions. The accompanying table has been prepared as a reference regarding the most clinically significant drug interactions that might occur, together with an indication of the possible consequence. This table should be used as a general guideline. Sometimes information is known about one specific drug within a certain drug class, while additional information is not known about other agents within the same therapeutic category. Clinicians must be aware of this possibility and use their best judgement when prescribing or assessing drug therapy.

TYPES OF DRUG INTERACTIONS:

Drug interactions are often classified as either pharmacodynamic or pharmacokinetic interactions. Pharmacodynamic interactions include those that result in additive or antagonistic pharmacological effects. Pharmacokinetic interactions involve induction or inhibition of metabolizing enzymes in the liver or elsewhere, displacement of drug from plasma protein binding sites,

alterations in gastrointestinal absorption, or competition for active renal secretion. The frequency and prevalence of interactions is dependent upon the number of concomitant medications and the complexity of the regimens. The prevalence is also dependent upon other variables, such as patient adherence, hydration and nutritional status, degree of renal or hepatic impairment, smoking and alcohol use, genetics and drug dosing. Additionally, some patients may exhibit evidence of a particular drug interaction, while others with the same drug combination do not.

PHARMACODYNAMIC INTERACTIONS

Pharmacodynamic interaction can occur in many different ways. There are many mechanisms, and some examples of practical importance are probably more useful than attempts at classification.

This type of interaction will not be addressed in this reference, since these should be reasonably easy to predict, knowing the pharmacology of any given drug.

- β-Adrenoceptor antagonists diminish the effectiveness of β-adrenoceptor agonists such as **salbutamol**.
- Many diuretics lower plasma K^+ concentration, and thereby predispose to **digoxin** toxicity and to toxicity with *type III antidysrhythmic drugs*.
- **Sildenafil** inhibits the isoform of phosphodiesterase (type V) that inactivates cGMP; consequently, it potentiates organic nitrates, which activate guanylate cyclase, and can cause severe hypotension in patients taking these drugs.
- *Monoamine oxidase inhibitors* increase the amount of noradrenaline (norepinephrine) stored in noradrenergic nerve terminals and interact dangerously with drugs, such as **ephedrine** or **tyramine**, that release stored noradrenaline. This can also occur with tyramine-rich foods-particularly fermented cheeses such as Camembert.
- **Warfarin** competes with vitamin K, preventing hepatic synthesis of various coagulation factors. If vitamin K production in the intestine is inhibited (e.g. by antibiotics), the anticoagulant action of warfarin is increased.
- The risk of bleeding, especially from the stomach, caused by warfarin is increased by drugs that cause bleeding by different mechanisms (e.g. **aspirin** , which inhibits platelet thromboxane A_2 biosynthesis and which can damage the stomach.
- Sulfonamides prevent the synthesis of folic acid by bacteria and other micro-organisms; **trimethoprim** inhibits its reduction to tetrahydrofolate. Given together, the drugs have a synergistic action of value in treating *Pneumocystis carinii*.
- Non-steroidal anti-inflammatory drugs (NSAIDs), such as **ibuprofen** or **indometacin**, inhibit biosynthesis of prostaglandins, including renal vasodilator/natriuretic prostaglandins (prostaglandin E_2, prostaglandin I_2). If administered to patients receiving treatment for hypertension, they cause a variable but sometimes marked increase in blood pressure. If given to patients being treated with diuretics for chronic heart failure, they can cause salt and water retention and hence cardiac decompensation.
- Histamine H_1 receptor antagonists, such as **promethazine**, commonly cause drowsiness as an unwanted effect. This is more troublesome if such drugs are taken with alcohol, and it may lead to accidents at work or on the road.

PHARMACOKINETIC INTERACTIONS

All the four major processes that determine pharmacokinetics-absorption, distribution, metabolism and excretion-can be affected by drugs. Pharmacokinetic interactions have received a great deal of attention, and examples have sprouted in the literature like mushrooms. Some of the more important mechanisms are given here, with examples.

- Absorption:
  - gastric stasis (e.g. migraine)
  - malabsorption (e.g. steatorrhoea from pancreatic insufficiency)
  - oedema of ileal mucosa (e.g. heart failure, nephrotic syndrome).
- Distribution:
  - altered plasma protein binding (e.g. of phenytoin in chronic renal failure)
  - impaired blood-brain barrier (e.g. to penicillin in meningitis).
- Metabolism:
  - chronic liver disease
  - hypothermia.
- Excretion:
  - acute and/or chronic renal failure.
- Receptors (e.g. myasthenia gravis, familial hypercholesterolaemia).
- Signal transduction (e.g. pseudohypoparathyroidism, familial precocious puberty).
- Unknown mechanisms (e.g. increased sensitivity to pethidine in hypothyroidism)

Interactions Resulting from Alterations in Gastrointestinal Absorption

Gastrointestinal absorption is slowed by drugs that inhibit gastric emptying, such as **atropine** or opiates, or accelerated by drugs that hasten gastric emptying (e.g. **metoclopramide**). Alternatively, drug A may interact with drug B in the gut in such a way as to inhibit absorption of B (cf. pharmaceutical interactions). For example, Ca^{2+} (and also iron) forms an insoluble complex with **tetracycline** and retards its absorption; **colestyramine**, a bile acid-binding resin, binds several drugs (e.g. **warfarin**, **digoxin**), preventing their absorption if administered simultaneously. Another example is the addition of **adrenaline** (epinephrine) to local anaesthetic injections; the resulting

vasoconstriction slows the absorption of the anaesthetic, thus prolonging its local effect.

The rate and extent of drug absorption after oral administration may be grossly altered by other agents. Absorption of a drug is a function of the drug's ability to diffuse from the lumen of the gastrointestinal tract into the systemic circulation. Changes in intestinal pH may profoundly affect drug diffusion as well as dissolution of the dosage form. For example, the absorption of ketoconazole is reduced by the co-administration of antacids or H2-blockers (e.g. ranitidine, famotidine) that reduce the extent to which the ketoconazole tablet is dissolved. Formation of insoluble complexes by a process known as chelation is another mechanism by which a drug interaction may lead to reduced oral absorption. For example, fluoroquinolones (e.g. ciprofloxacin) and divalent metal ions (such as calcium and iron) form an insoluble complex that results in reduced absorption of both the antibiotic and the metal ion. Interactions that decrease the rate of drug absorption may be of little importance, since the overall extent of absorption may remain unaltered.

Interactions Resulting from Alterations in Drug Distribution

One drug may alter the distribution of another, but such interactions are seldom clinically important. Displacement of a drug from binding sites in plasma or tissues transiently increases the concentration of free (unbound) drug, but this is followed by increased elimination, so a new steady state results in which total drug concentration in plasma is reduced but the free drug concentration is similar to that before introduction of the second 'displacing' drug. There are several consequences of potential clinical importance:

- toxicity from the transient increase in concentration of free drug before the new steady state is reached
- if dose is being adjusted according to measurements of total plasma concentration, it must be appreciated that the target therapeutic concentration range will be altered by coadministration of a displacing drug
- When the displacing drug additionally reduces elimination of the first, so that the free concentration is increased not only acutely but also chronically at the new steady state, severe toxicity may ensue.

Interactions Resulting from Alterations in Metabolizing Enzymes

The liver is the major, though not exclusive, site for drug metabolism. Other sites include the kidney and the lining of the gastrointestinal tract. The two main types of hepatic drug metabolism are phase I and phase II reactions. Phase I oxidative reactions are the initial step in drug biotransformation, and are mediated by the cytochrome P-450 (CYP) system. This complex superfamily of enzymes has been subclassified into numerous enzymatic subfamilies. The most common CYP subfamilies include CYP1A2, CYP2C9, CYP2C19, CYP2D6, CYP2E1, and CYP3A4. These enzymes may be induced or inhibited by other agents, thereby leading to an increase or decrease in the metabolism of the primary drug. Phase II reactions occur following Phase I reactions. In this process, drug metabolites are converted into more water-soluble compounds that can be more easily eliminated by the kidneys.

Enzyme induction may result in increased CYP enzyme synthesis, faster drug metabolism, subtherapeutic drug concentrations and the risk for ineffective drug therapy. The rapidity of the enzyme induction is dependent upon the half-life of the inducing drug as well as the rate of synthesis of new enzymes. Examples of drugs that cause enzyme induction are the barbiturates, some anticonvulsants and rifampin.

Enzyme inhibition may result from noncompetitive or competitive inhibition of CYP enzymes by a second drug, an effect that may occur rapidly. Examples of hepatic enzyme inhibitors include cimetidine, fluconazole and erythromycin. The result of noncompetitive enzyme inhibition by addition of a second agent is slower metabolism of the first drug, higher plasma drug concentrations, and a risk for toxicity. In the case of competitive inhibition, the metabolism of both

drugs can be reduced, resulting in higher than expected concentrations of each drug.

A few drugs are metabolized by enzymes found in cells lining the gastrointestinal tract. One of these drugs is cyclosporine. Some foods and other preparations such as grapefruit juice contain certain substances that may inhibit those specific enzymes, resulting in elevated serum cyclosporine concentrations.

Interactions Resulting from Alterations in Protein Binding

Drugs may exist in plasma either reversibly bound to plasma proteins or in the free (unbound) state. The primary drug-binding plasma proteins are albumin and 1-acid glycoprotein. It is free drug that exerts the pharmacological effect. Drugs may compete with each other for plasma protein binding sites, and when this occurs, one drug may displace another that was previously bound to the protein. Displacement of a drug from its binding sites will therefore increase that agent's unbound concentrations, perhaps resulting in toxicity. Some drugs normally exist in a state of high protein binding, often exceeding 90%. Thus, even a small decrease in protein binding could significantly increase the free concentrations. Drugs which are normally highly protein bound, and which might participate in binding interactions, include anticonvulsants and warfarin.

Interactions Resulting from Changes in Renal Excretion

The majority of renally eliminated drugs are excreted via passive glomerular filtration. Some drugs are eliminated via active tubular secretion, such as penicillins, cephalosporins,

and most diuretics. The active secretion may be inhibited by secondary agents, such as cimetidine, nonsteroidal anti-inflammatory agents and probenecid, with resulting elevations in the serum drug

concentrations and reduced urinary drug concentrations. In some cases, the interaction is desirable, while others may lead to adverse therapeutic outcomes.

RISK FACTORS AND MANAGEMENT OF DRUG INTERACTIONS

In general, the more complex a patient's drug regimen, the higher the risk for interactions. CKD patients often take numerous medications. The average age of a dialysis patient is over 60 years and as a group, elderly patients are more prone to experience drug interactions because of reduced hepatic and renal function. Identification of the potential for interactions may enable the clinician to avoid its occurrence. Drugs that require careful dose titration to maintain efficacy and avoid toxicity must be monitored particularly carefully for drug interactions. Most drug interactions can be avoided or managed by substitution of one or more agents or more intense monitoring for the potential result. Other management strategies include separation of doses of interacting agents (e.g. ciprofloxacin and calcium) or prospective adjustment of doses.

CLINICAL SIGNIFICANCE OF INTERACTIONS

This guide lists only those interactions that have been previously rated as having a moderate or high level of clinical significance by the *Drug Interaction Facts* (see References). This rating scale requires that a potential interaction has a moderate to major severity. The effects of a *moderate* interaction may cause a deterioration in the patient's clinical status, resulting in additional treatment, hospitalization, and/or an extended hospital stay. The effects of a *major* interaction are potentially life-threatening or can lead to permanent damage. In addition to being clinically significant, the interaction must be reasonably documented in the literature (suspected, probable, or established). Therefore, the accompanying table is NOT an all-inclusive list of every possible drug interaction.

FOODS INTERACTING WITH MAO INHIBITORS

Food Containing Tyramine

Avocados: Particularly if overripe
Bananas: Reactions can occur if eaten in large amounts; tyramine levels high in peel.
Bean curd: Fermented bean curd, fermented soya bean, soya bean pastes, soy sauces and miso soup, prepared from fermented bean curd, all contain tyramine in large amounts; miso soup has caused reactions.
Beer and ale: Major domestic brands do not contain appreciable amounts; some imported brands and domestic tap lagers from local breweries have high levels.[6] Nonalcoholic beer may contain tyramine and should be avoided.
Caviar: Safe if vacuum-packed and eaten fresh or refrigerated only briefly.
Cheese: Reactions possible with most, except unfermented varieties such as cottage cheese and possibly some other cheeses.[5, 6] In others, tyramine concentration is higher near rind and close to fermentation holes.
Dietary supplements (weight loss products): May contain large amounts of yeast and/or yeast extracts, and cocoa.
Figs: Particularly if overripe.
Fish: Safe if fresh; dried products should not be eaten. Caution required in restaurants. Vacuum-packed products are safe if eaten promptly or refrigerated only briefly.
Liver: Safe if very fresh, but rapidly accumulates tyramine; caution required in restaurants.
Milk products:
Milk and yogurt appear to be safe.
Protein extracts: See also soups; avoid liquid and powdered protein dietary supplements.
Meat: Safe if known to be fresh; caution required in restaurants.
Sauerkraut: Contains large amounts of tyramine; no reaction has been reported.
Sausage: Fermented varieties such as bologna, pepperoni and salami have a high tyramine content.
Shrimp paste: Contains large amounts of tyramine.
Soups: May contain protein extracts and should be avoided.
Soy sauce: Contains large amounts of tyramine; reactions have occurred with teriyaki.
Wines: Generally do not contain tyramine, but many reactions have been reported with Chianti, champagne and other wines.
Yeast extracts: Dietary supplements, e.g. Marmite, contain large amounts. Yeast in baked goods, however, is safe.

FOOD NOT CONTAINING TYRAMINE

Caffeine: A weak pressor agent; large amounts may cause reactions.
Chocolate: Contains phenylethylamine, a pressor agent which can cause reactions in large amounts.
Fava beans (broad beans, "Italian" green beans):
Contain dopamine, a pressor amine, particularly when overripe.
Ginseng: Some preparations have caused headache, tremulousness and manic-like symptoms.
Liqueurs: Reactions reported with some, e.g. Chartreuse and Drambuie; cause unknown.
New Zealand prickly spinach: Single case report; patient ate large amounts.
Whiskey: Reactions have occurred; cause unknown.

CYTOCHROME P-450 ENZYME INHIBITING DRUGS

The cytochrome P450 enzymes are responsible for the metabolism of a number of pharmacological agents. The inhibition of these enzymes could result in elevation of serum levels of agents that are dependent on their activity of P450 enzymes for metabolism.

Amiodarone verapamil) Metronidazole

Azole antifungals (fluconazole, itraconazole, ketoconazole, miconazole)
Calcium channel blockers (nifedipine, nicardipine, diltiazem,
Cimetidine
Ciprofloxacin
Cyclophosphamide
Cyclosporine
Fluvoxamine
Grapefruit juice
Indinavir
Macrolide antibiotics (erythromycin > clarithromycin > azithromycin)
Mexiletine
Nefazodone
Quinidine
Ritonavir
SSRI antidepressants (paroxetine = fluoxetine > sertraline > fluvoxamine)
Zafirlukast
Zileuton

DRUGS THAT PROLONG THE QT INTERVAL

Amiodarone
Bepridil
Chlorpromazine
Desipramine
Disopyramide
Dofetilide
Droperidol
Erythromycin
Flecainide
Fluoxetine
Foscarnet
Fosphenytoin
Gatifolixin
Halofantrine
Haloperidol
Ibutilide
Isradipine
Mesoridazine
Moxifloxacin
Naratriptan
Nicardipine
Octreotide
Pentamidine
Pimozide
Probucol
Procainamide
Quetiapine
Quinidine
Risperidone
Salmetero
Sotalol
Sparfloxacin
Sumatriptan
Tamoxifen
Thioridazine
Venlafaxine
Zolmitriptan

COMMONLY USED DRUG LEVELS

Drug	Therapeutic Range*	Drug	Therapeutic Range*
Amikacin	Peak 25-30; trough <10 mcg/Ml	Imipramine	150-300 ng/mL
Amiodarone	1.0-3.0 mcg/mL	Lidocaine	2-5 mcg/mL
Amitriptyline	100-250 ng/mL	Lithium	0.5-1.4 mEq/L
Carbamazepine	4-10 mcg/mL	Nortriptyline	50-150 ng/mL
Chloramphenicol	Peak 10-15; trough <5 mcg/mL	Phenobarbital	10-30 mEq/mL
Desipramine	150-300 ng/mL	Phenytoin**	8-20 mcg/mL
Digoxin	0.8-2.0 ng/mL	Procainamide	4.0-8.0 mcg/mL
Disopyramide	2-5 mcg/mL	Quinidine	2.5-5.0 mcg/mL
Doxepin	75-200 ng/mL	Salicylate	15-25 mg/dL
Flecainide	0.2-1.0 mcg/mL	Theophylline	8-20 mcg/mL
Gentamicin <	Peak 6.0-8.0; trough 2.0 mcg/mL	Valproic acid	50-100 mcg/mL
		Vancomycin	Peak 30-40; trough <10 mcg/Ml

*The therapeutic range of some drugs may vary depending on the reference lab used.

** Therapeutic range of phenytoin is 4-10 mcg/mL in presence of significant azotemia and/or hypoalbuminemia.

SOME IMPORTANT RELATIONSHIP BETWEEN DRUGS AND CYTOCHROME P-450 (CYP) ENZYME

Cyp	Drug substrate	Inhibitors	Inducers
1A2	Cffien, clomipramine, clozapine, theophyline,	Cimitidine, Flouvoxamine, Ticlopidine, Flouroquinolone	Omeperazole, Tobacco
2C9	Diclofenace, ibuprofene, piroxicame, losartane, tolbutamide, warfarine.	Fluconazole, fluvastatine, zafirlukast,	Rifampin
2C19	Operazole, lanzprazole, diazepam, (S) mephenytoin, nelfinavir.	Cimitidine, fluvoxamine	Rifampin
2D6	**CNS active agents:** Amitriptyline, desipramine, amipramine, pyraxitine, haloperidol, theoridazine. **Anti-arrhythmic agent:** Maxiletine, propafenone. **Beta Blockers:** Proapranolol, metoprolol, timolol. **Norcotics:** Codien, dexomethomethorphane, hydrocodone.	Amiotarone, cimitidine, floxetine, piroxitine, pimozide, quinidine, ritonavir.	
3A4	**Calcium channel blockers:** Diltiazeme, flodipine, nimodipine, nefidipine, nisoldipine, niranidipine, virapamile. **Steroids:** Budesonide, cortisol, 17 Beta estradiol, progesterone, testosterone. **Macrolides:** Clarithromycin, erythromycin, troleandomycin **Chemotherapeutic agents:** Cyclophosphamide, tamoxifen, cincristine, vinblastine, ifosfamide. **Nonsedating antihistamines:** Astemizole, terfenadine, **Benzodiazepines:** Alprazolam, midazolam, triazolam, **Opoids:** Alfentanyl, fentanyl, suentanil **HMG-CoA reductase inhibitors:** Lovastatin, simvastatin, atorvastatin **HIV protease inhibitors:** Indinavir, nelfinavir, ritonavir, saquinovir, amprenavir **Others:** cisapride, nevirapine, pimozide, quinidine, rifabutin, sildenafil	Amiodarone Clarthromycin Delavirdine Efavirenz Erythromycin Fluconazole Grapefruit juice Indinavir Itraconazole Ketoconazole Nefazodone Rifabutin Ritonavir troleandomycin	Barbiturates Carbamazepine Efavirenz Phenytoin Rifampin

MAJOR THERAPEUTICAL INTERACTIONS

The given table of drug interaction contains four columns. First entitled "Drug," describe the primary drugs and its classes, by generic. The drugs are listed according to therapeutic classes. Second column entitled "Interacting Drug," describe the potential clinically significant interactions. Third column, "Potential Effect," gives a short description of the possible clinical outcome. The given outcomes are possible, not definite events. Clinicians must be aware that not all patients manifest these interactions. Forth column entitled "Management," indicates suggested strategies for prevention, monitoring, and managing any potential interactions. If combination therapy of interacting drugs cannot be avoided, the patient should be advised of any potential adverse effects. Always monitor the patient for any changes in clinical response when starting, stopping, or changing the dose of interacting drugs. Also monitor for any signs/symptoms of known toxicities. Appropriately the intervention of clinical pharmacist or physician required to design accuratre treatment protocols.

Drug	Interacting drug	Potential effect	Management
ANEMIA AGENTS			
ANDROGENS			
Nandrolone decanoate	Warfarin	See *Anticoagulants/ Thrombolytic Agents—Androgens*	
Methyltestosterone/ Testosterone	Cyclosporine,	see *Transplant Immunosuppressants—Androgens*	
	Warfarin	see *Anticoagulants/ Thrombolytic Agents—Androgens*	
Epoetin Alfa	No interactions noted.		
Iron PRODUCTS			
Iron Salts (IV) [iron dextran, ferric gluconate, iron sucrose]	Chloramphenicol	Increased concentrations of iron.	Use alternative antibiotic if possible. Otherwise, monitor iron stores and adjust iron replacement as needed.
Iron Salts (Oral) [ferrous fumarate, ferrous sulfate, ferrous gluconate, iron polysaccharide]	Chloramphenicol	Increased concentrations of iron.	Use alternative antibiotic if possible. Otherwise monitor iron stores and adjust iron replacement as needed.
	Levodopa,	see *Antiparkinson Agents*	
,	Levothyroxine	see *Miscellaneous Agents*	
	Mycophenolate mofetil,	see *Transplant Immunosuppressants*	
	Penicillamine	Decreased GI absorption of penicillamine.	Administer penicillamine on an empty stomach. Separate administration times.
	Phosphate Binders/Antacids [aluminum hydroxide, aluminum-magnesium hydroxide, calcium acetate, calcium carbonate, magnesium hydroxide]	Decreased GI absorption of iron.	Separate administration times.
	Quinolones,	see *Antimicrobial Agents (Antibacterial Antibiotics)*	
	Tetracyclines,	see *Antimicrobial Agents (Antibacterial Antibiotics)*	
ANTIHYPERTENSIVE AND CARDIOVASCULAR AGENTS			
ADRENERGIC MODIFIERS			
Clonidine	Beta-Blockers [acebutolol, atenolol, betaxolol, carteolol, esmolol, metoprolol, nadolol, penbutolol, pindolol, propranolol, timolol]	Increased blood pressure.	Monitor blood pressure when starting or stopping either drug. Discontinue either drug gradually.
	Tricyclic Antidepressants [amitriptyline, amoxapine, clomipramine, desipramine, doxepin, imipramine, nortriptyline, protriptyline, trimipramine]	Loss of blood pressure control. Increased risk of hypertensive crisis.	Avoid combination.
Methyldopa	Sympathomimetics [dobutamine,	Increased blood pressure.	Monitor blood pressure. Discontinue

	dopamine, ephedrine, epinephrine, mephentermine, metaraminol, methoxamine, norepinephrine, phenylephrine, pseudoephedrine]		sympathomimetic or administer phentolamine if necessary.
Prazosin	Beta-Blockers [acebutolol, atenolol, betaxolol, bisoprolol, carteolol, esmolol, metoprolol, nadolol, penbutolol, pindolol, propranolol, sotalol, timolol]	Increased postural hypotension.	Monitor for symptoms of postural hypotension.
	Verapamil	Increased postural hypotension.	Monitor for symptoms of postural hypotension.
ANGIOTENSIN CONVERTING ENZYME INHIBITORS (ACEIs)	Benazepril, Captopril, Enalapril, Fosinopril, Lisinopril, Moexipril, Perindopril, Quinapril, Trandolapril		
Angiotensin Converting Enzyme nhibitors-class.	Indomethacin	Decreased effects of angiotensin converting **l**enzyme inhibitor	Monitor blood pressure. Discontinue indomethacin or use alternative antihypertensive.
	Lithium,	see *Sedative/Hypnotics/Agents used in Psychiatry, Antidepressants (Miscellaneous Antidepressants)*	
	Potassium-Sparing Diuretics [amiloride, spironolactone, triamterene]	Elevated serum potassium.	Monitor serum potassium.
Captopril *(see also Angiotensin Converting Enzyme Inhibitors-class)*	Food	Decreased GI absorption of captopril.	Administer captopril 1 hour before meals.
ANGIOTENSIN II RECEPTOR BLOCKERS (ARBS)	Candesartan, Eprosartan, Irbesartan, Losartan, Olmesartan, Telmisartan, Valsartan		
Angiotensin II Receptor Blockers- class	Lithium,	see *Sedative/Hypnotics/Agents used in Psychiatry, Antidepressants (Miscellaneous Antidepressants)*	
BETA-BLOCKERS	Cardio-Selective [Acebutolol, Atenolol, Betaxolol, Bisoprolol, Esmolol, Metoprolol, Nadolol]; Noncardio-Selective [Carteolol, Carvedilol, Labetalol, Penbutolol, Pindolol, Propranolol, Sotalol, Timolol]		
Cardio-Selective and Noncardio-Selective Beta-Blockers-class	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Decreased bioavailability of beta-blocker.	Increase beta-blocker dose if necessary.
	Cimetidine	Increased concentrations of beta-blocker.	Monitor cardiovascular status. Decrease beta blocker dose if necessary.
	Clonidine,	see *Antihypertensive and Cardiovascular Agents (Adrenergic Modifiers)*	
	Hydralazine	Increased concentrations of both drugs (metoprolol, propranolol).	Decrease dose of one or both drugs if necessary.
	NSAIDs [ibuprofen, indomethacin, naproxen, piroxicam]	Decreased effects of beta-blocker.	Use noninteracting NSAID if possible (eg, sulindac). Monitor blood pressure and increase beta-blocker dose if necessary.
	Prazosin,	see *Antihypertensive and Cardiovascular Agents (Adrenergic Modifiers)*	
	Propafenone	Increased effects of beta-blocker (metoprolol, propanolol).	Monitor cardiovascular status. Decrease beta-blocker dose if necessary.
	Quinidine	Increased effects of beta- blocker (atenolol, propranolol, metoprolol, timolol).	Monitor cardiovascular status. Decrease beta blocker dose if necessary.
	Rifamycins [rifabutin, rifampin] (atenolol, bisoprolol, metoprolol, propranolol).	Decreased effects of beta- blocker.	Monitor cardiovascular status. Increase beta-blocker dose if necessary.
	Verapamil	Increased effects of both drugs.	Monitor cardiovascular status. Decrease dose of one or both drugs if necessary.
Noncardio-Selective s Beta-Blockers-class	Epinephrine,	see *Antihypertensive and Cardiovascular Agent (Miscellaneous Antihypertensive and Cardiovascular Agents)*	
	Ergot Alkaloids,	see *Miscellaneous Agents*	
	Insulin,	see *Hypoglycemic Agents*	
	Prazosin,	see *Antihypertensive and Cardiovascular Agents (Adrenergic Modifiers)*	
	Theophylline,	see *Bronchodilators*	
Atenolol *(see also Cardio-Selective and Noncardio- Selective Beta-Blockers-class)*	Ampicillin	Decreased effects of atenolol.	Separate administration times. Monitor blood pressure. Increase atenolol dose if necessary.

Carvedilol *(see also Cardio-Selective and Noncardio-Selective Beta-Blockers-class)*	Cyclosporine, see *Transplant Immunosuppressants*		
Labetalol *(see also Cardio-Selective and Noncardio-Selective Beta-Blockers-class)*]	Inhalation Anesthetics [desflurane, enflurane, halothane, isoflurane, sevoflurane	Excessive hypotension.	Monitor blood pressure. Use combination with caution. Halothane concentration should not exceed 3%.
Metoprolol *(see also Cardio-Selective and Noncardio-Selective Beta-Blockers-class)*	Lidocaine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Thioamines [methimazole, propylthiouracil]	Increased effects of metoprolol.	Monitor cardiovascular status. Decrease metoprolol dose if necessary as patient becomes euthyroid. Use alternative beta-blocker (eg, atenolol, nadolol).
Nadolol *(see also Cardio-Selective and Noncardio-Selective Beta-Blockers-class)*	Lidocaine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
Pindolol *(see also Cardio-Selective and Noncardio-Selective Beta-Blockers-class)*	Lidocaine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Phenothiazines [chlorpromazine, thioridazine]	Increased effects of one or both drugs.	Decrease dose of one or both drugs if necessary.
Propranolol *(see also Cardio-Selective andNoncardio-Selective Beta-Blockers-class)*	Lidocaine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Phenothiazines [chlorpromazine, thioridazine]	Increased effects of one or both drugs.	Decrease dose of one or both drugs if necessary.
	Thioamines [methimazole, propylthiouracil]	Increased effects of propranolol.	Monitor cardiovascular status. Decrease propranolol dose if necessary as patient becomes euthyroid. Use alternative beta-blocker (eg, atenolol, nadolol).
Sotalol *(see also Cardio-Selective and Noncardio-Selective Beta-Blockers-class)*	Quinolones [gatifloxacin, moxifloxacin, sparfloxacin]	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
CALCIUM-CHANNEL BLOCKERS (CCBs)	Amlodipine, Bepridil, Diltiazem, Felodipine, Isradipine, Nicardipine, Nifedipine, Nimodipine, Nisoldipine, Verapamil		
Bepridil	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
	Quinolones [gatifloxacin, moxifloxacin, sparfloxacin]	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
	Ritonavir	Increased concentrations of bepridil.	Avoid combination.
Diltiazem	Benzodiazepines,	see *Sedatives/Hypnotics/Agents used in Psychiatry (Sedatives)*	
	Carbamazepine	Increased concentrations of carbamazepine.	Monitor carbamazepine concentration. Adjust dose as needed when starting or stopping diltiazem.
	Cyclosporine,	see *Transplant Immunosuppressants*	
	HMG-CoA Reductase Inhibitors,	see *Hypolipidemic Agents*	
	Moricizine	Increased concentrations of moricizine. Decreased concentrations of diltiazem.	Adjust dose of one or both drugs as needed.
	Quinidine,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Sirolimus,	see *Transplant Immunosuppressants*	
	Tacrolimus,	see *Transplant Immunosuppressants*	
	Theophyllines [aminophylline, oxtriphylline, theophylline]	Increased concentrations theophylline.	Monitor of theophylline concentrations. Adjust theophylline dose as needed when starting or stopping diltiazem.
Felodipine	Barbiturates [amobarbital, aprobarbital, butabarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Decreased effects of felodipine.	Monitor cardiovascular status. Increase felodipine butalbital, mephobarbital, dose if necessary.

	Carbamazepine	Decreased effects of felodipine.	Monitor cardiovascular status. Increase felodipine dose if necessary.
	Erythromycin	Increased effects of felodipine.	Monitor cardiovascular status. Decrease felodipine dose if necessary.
	Grapefruit Juice	Increased effects of felodipine.	Avoid combination.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased effects of felodipine.	Monitor cardiovascular status Increase felodipine dose if necessary.
	Itraconazole	Increased effects of felodipine.	Monitor cardiovascular status Decrease felodipine dose if necessary.
	Nicardipine	Cyclosporine, see *Transplant Immunosuppressants*	
Nifedipine	Barbiturates [amobarbital, aprobarbital, butabarbital, pentobarbital, butalbital, mephobarbital, phenobarbital, primidone, secobarbital]	Decreased effects of nifedipine.	Monitor cardiovascular status. Increase nifedipine dose if necessary.
	Cimetidine	Increased effects of nifedipine.	Adjust nifedipine dose as needed when starting, stopping, or changing dose of cimetidine. Use alternative histamine H2-antagonist (eg, ranitidine).
	Rifampin	Decreased effects of nifedipine.	Monitor cardiovascular status. Adjust nifedipine dose as needed when starting or stopping rifampin.
	Tacrolimus,	see *Transplant Immunosuppressants*	
Nisoldipine	Grapefruit Juice	Increased effects of nisoldipine.	Avoid combination.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased effects of nisoldipine.	Monitor cardiovascular status. Adjust nisoldipine dose when starting, stopping, or changing dose of hydantoin.
Verapamil	Beta-Blockers,	see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers)*	
	Calcium Salts [calcium acetate, calcium carbonate, calcium chloride, calcium citrate, calcium glubionate, calcium gluconate, calcium glycerophosphate, calcium lactate, calcium levulinate, Calcium tricalcium phosphate]	Reverse clinical effects and toxicities of verapamil.	Monitor cardiovascular status. Calcium may be used to reverse verapamil toxicities.
	Carbamazepine,	see *Anticonvulsants*	
	Cyclosporine,	see *Transplant Immunosuppressants*	
	Digoxin	Increased concentrations of digoxin.	Monitor cardiovascular status and digoxin concentrations. Decrease digoxin dose if necessary.
	Ethanol,	see *Miscellaneous Agents*	
	HMG-CoA Reductase Inhibitors,	see *Hypolipidemic Agents*	
	Nondepolarizing Muscle Relaxants [atracurium, doxacurium, mivacurium, pancuronium, pipecuronium, tubocurarine, vecuronium]	Increased nondepolarizing muscle relaxant effects (prolonged respiratory depression).	Avoid combination if possible. Monitor respiratory function. Adjust nondepolarizing muscle relaxant dose as needed.
	Prazosin,	see *Antihypertensive and Cardiovascular Agents (Adrenergic Modifiers)*	
	Quinidine,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Rifampin	Decreased effects of oral verapamil.	Use intravenous verapamil or alternative drug. Adjust verapamil dose as needed when starting or stopping rifampin.

ANTIARRHYTHMIC AGENTS

Amiodarone	Cyclosporine,	see *Transplant Immunosuppressants*	
	Digoxin,	see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*	
	Fentanyl	Increased risk of profound bradycardia, sinus arrest, and hypotension.	Avoid combination if possible. Otherwise, monitor hemodynamic status and manage with supportive treatment as needed.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Increased concentrations of hydantoin. Decreased concentrations of amiodarone.	Monitor cardiovascular status and for signs/ symptoms of hydantoin toxicity. Adjust dose of one or both drugs as needed.
	Procainamide,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Protease Inhibitors [indinavir, ritonavir]	Increased concentrations of amiodarone.	Avoid combination.

	Quinidine,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Quinolones [gatifloxacin, moxifloxacin, sparfloxacin]	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
	Warfarin,	see *Anticoagulants/Thrombolytic Agents*	
Disopyramide	Hydantoins [ethotoin, fosphenytoin, mephenytoin, anticholinergic phenytoin]	Decreased concentrations of disopyramide. Increased risk of anticholinergic effects.	Monitor cardiovascular status and effects. Increase disopyramide dose if necessary.
	Quinolones [gatifloxacin, moxifloxacin, sparfloxacin]	Increased risk of cardiac arrhythmias, including torsades de pointes. (eg ciprofloxacin, levofloxacin).	Avoid combination. Use alternative quinolones.
	Rifampin	Decreased concentrations of disopyramide.	Monitor cardiovascular status. Increase disopyramide dose if necessary.
Flecainide	Ritonavir	Increased concentrations of flecainide.	Avoid combination.
Lidocaine	Beta-Blockers [atenolol, metoprolol, nadolol, pindolol, propranolol]	Increased concentrations of lidocaine.	Administer bolus lidocaine at a slow rate to avoid high peak concentrations and toxicity. Monitor lidocaine concentrations. Decrease lidocaine dose if necessary.
	Cimetidine	Increased concentrations of lidocaine.	Monitor lidocaine concentrations. Decrease lidocaine dose if necessary. Use alternative histamine H2- antagonist (eg, ranitidine).
Mexiletine	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased concentrations of mexiletine.	Monitor cardiovascular status. Increase mexiletine dose if necessary.
	Theophylline,	see *Bronchodilators*	
Moricizine	Cimetidine	Increased concentrations of moricizine.	Monitor ECG when starting, stopping, or changing dose of cimetidine. Decrease moricizine dose if necessary. Use alternative histamine H2- antagonist (eg, ranitidine).
Procainamide	Amiodarone	Increased concentrations of procainamide and N- acetylprocainamide.	Monitor serum procainamide and N-acetylprocainamide concentrations. Decrease procainamide dose if necessary.
	Cimetidine	Increased concentrations of procainamide and N-acetylprocainamide	Avoid combination if possible. Otherwise, decrease procainamide dose if necessary.
	Ofloxacin	Increased concentrations of procainamide.	Monitor serum procainamide concentrations. Decrease procainamide dose if necessary.
	Quinolones [gatifloxacin, moxifloxacin, sparfloxacin	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
	Trimethoprim]	Increased concentrations of procainamide and N-acetylprocainamide.	Monitor serum procainamide and N-acetylprocainamide concentrations. Decrease procainamide dose if necessary.
Propafenone	Quinidine	Increased concentrations of propafenone.	Monitor cardiovascular status. Decrease propafenone dose or extend dosing interval if necessary.
	Ritonavir	Increased concentrations of propafenone.	Avoid combination.
Quinidine	Amiloride	Increased risk of cardiac arrhythmias and reversal of quinidine effects.	Avoid combination if possible. Otherwise, closely monitor ECG.
	Amiodarone	Increased concentrations of quinidine. Increased risk of cardiac arrhythimas.	Avoid combination if possible. Otherwise, monitor quinidine concentrations and decrease quinidine dose if necessary.
	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Decreased concentrations of quinidine	Monitor quinidine concentrations. Adjust quinidine dose as needed when starting, stopping, or changing dose of barbiturate.
	Cimetidine	Increased concentrations of quinidine.	Avoid combination if possible. Otherwise, monitor quinidine concentrations and decrease quinidine dose if necessary.
	Codeine,	see *Pain Medications (Narcotic)*	
	Digoxin	see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*	
	Diltiazem	Increased concentrations of quinidine.	Monitor cardiovascular status and quinidine concentrations. Adjust quinidine dose as

			needed when starting or stopping diltiazem.
	Hydantoins [fosphenytoin, phenytoin]	Decreased concentrations of quinidine.	Monitor quinidine concentrations. Increase quinidine dose if necessary.
	Itraconazole	Increased concentrations of quinidine.	Monitor quinidine concentrations. Decrease quinidine dose if necessary.
	Phosphate Binders/ Antacids [aluminum hydroxide, aluminum-magnesium quinidine hydroxide, magnesium hydroxide, sodium bicarbonate]	Increased concentrations of quinidine.	Monitor quinidine concentrations. Decrease dose if necessary.
	Propafenone,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Quinolones [gatifloxacin, moxifloxacin, sparfloxacin]	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
	Rifamycins [rifabutin, rifampin]	Decreased concentrations of quinidine.	Monitor quinidine concentrations when starting, stopping, or changing dose of rifamycin. Adjust quinidine dose as needed
	Ritonavir	Increased concentrations of quinidine.	Avoid combination.
	Verapamil	Increased concentrations of quinidine. Increased risk of cardiac arrhythimas and hypotension.	Avoid combination if possible. Stop one or both drugs if interaction develops and treat symptomatically.
	Warfarin,	See *Anticoagulants/ Thrombolytic Agents*	
NITRATES	Amyl Nitrite, Isosorbide Dinitrate, Isosorbide Mononitrate, Nitroglycerin		
Nitrates-class	Ergot Alkaloids,	see *Miscellaneous Agents*	
	Phosphodiesterase-5 Enzyme Inhibitors [sildenafil, tradalafil, vardenafil]	Severe hypotension.	Avoid combination.
Nitroglycerin	Alteplase (tPA)	Decreased effects of tPA.	Avoid combination.

MISCELLANEOUS ANTIHYPERTENSIVE AND CARDIOVASCULAR AGENTS

Digoxin	Aminoglycosides [kanamycin, neomycin, paromomycin]	Decreased concentrations of digoxin.	Monitor digoxin concentrations. Increase digoxin dose if necessary.
	Amiodarone	Increased concentrations of digoxin.	Monitor digoxin concentrations and for signs/ symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Antineoplastic Agents [bleomycin, carmustine, cyclophosphamide, cytarabine, doxorubicin, methotrexate, vincristine]	Decreased concentrations of digoxin.	Monitor digoxin concentrations. Increase digoxin dose if necessary.
	Bepridil	Increased concentrations of digoxin. Increased negative chronotropic effects.	Monitor cardiovascular status. Decrease digoxin dose if necessary.
	Cholestyramine	Decreased concentrations of digoxin.	Separate administration times. Monitor for decreased digoxin effects. Increase digoxin dose if necessary.
	Cyclosporine	Increased concentrations of digoxin.	Monitor digoxin concentrations and for signs/ symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Indomethacin	Increased concentrations of digoxin in premature infants.	Monitor digoxin concentrations and for signs/symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Itraconazole	Increased concentrations of digoxin in premature infants.	Monitor digoxin concentrations and for signs/symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Loop Diuretics [bumetanide, ethacrynic acid furosemide]	Increased risk of arrhythmias.	Monitor serum potassium and, magnesium concentrations. Supplement electrolytes if necessary. Restrict dietary and sodium intake or use potassium-sparing diuretics.
	Macrolide Antibiotics [clarithromycin, erythromycin]	Increased concentrations of digoxin.	Monitor digoxin concentrations and for signs/symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Metoclopramide	Decreased concentrations of digoxin.	Monitor for decreased digoxin effects. Increase digoxin dose if necessary.
	Penicillamine	Decreased concentrations of digoxin.	Monitor digoxin concentrations and for signs/ symptoms of digoxin toxicity. Increase digoxin dose if necessary.
	Propafenone	Increased concentrations of digoxin.	Monitor digoxin concentrations and for signs/symptoms of digoxin toxicity. Decrease digoxin dose if necessary.

	Quinidine	Increased concentrations of digoxin.	Monitor digoxin concentrations and for signs/symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Spironolactone.	Decreased inotropic effects.	Monitor for decreased digoxin effects. Increase digoxin dose if necessary
	Tetracyclines [demeclocycline, doxycycline, minocycline, oxytetracycline, tetracycline]	Increased concentrations of digoxin.	Monitor digoxin concentrations and for signs/symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Thiazide Diuretics [bendroflumethiazide, chlorothiazide, chlorthalidone, hydrochlorothiazide, hydroflumethiazide, indapamide, methyclothiazide, metolazone, polythiazide, trichlormethiazide]	Increased risk of arrhythmias.	Monitor serum potassium and magnesium concentrations. Supplement electrolytes if necessary. Restrict dietary and sodium intake or use potassium-sparing diuretics.
	Thioamines [methimazole, propylthiouracil]	Increased concentrations of digoxin.	Monitor digoxin concentrations and for signs/ symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
	Thyroid Hormones [levothyroxine, liothyronine, liotrix, thyroid]	Decreased concentrations of digoxin	Increase digoxin dose if necessary in hypothyroid patients if they become euthyroid.
	Verapamil	Increased concentrations of digoxin	Monitor digoxin concentrations and for signs/ symptoms of digoxin toxicity. Decrease digoxin dose if necessary.
Epinephrine	Beta-Blockers [carteolol, nadolol, penbutolol, pindolol, propranolol, timolol]	Initial hypertensive episode, followed by reflex bradycardia.	Avoid combination if possible. Discontinue beta-blocker3 days prior to epinephrine use if possible. Otherwise, monitor vital signs and use IV chlorpromazine, IV hydralazine, IV aminophylline, and/or IV atropine if necessary.
Hydralazine	Beta-Blockers,	see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers)*	

ANTIMICROBIAL AGENTS

ANTIBACTERIAL ANTIBIOTICS

AMINOGLYCOSIDES	Amikacin, Gentamicin, Kanamycin, Neomycin, Streptomycin, Tobramycin		
Aminoglycosides-class	Cephalosporins [cefamandole, cefazolin, cefonicid, cefoperazone cefotaxime, cefotetan, cefoxitin, ceftazidime, ceftizoxime, ceftriaxone, cefuroxime, cephalothin, cephapirin, cephradine]	Increased risk of nephrotoxicity.	Monitor aminoglycoside concentrations and, kidney function.
	Digoxin,	see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*	
	Loop Diuretics [bumetanide, ethacrynic acid, furosemide, torsemide]	Increased risk of auditory toxicity.	Avoid excessive doses of either drug. Monitor aminoglycoside concentrations. Use alternative antibiotic if possible.
	NSAIDs [diclofenac, etodolac, fenoprofen, flubiprofen, ibuprofen, indomethacin, ketoprofen, ketorolac, meclofenamate, mefenamic acid, nabumetone, naproxen, oxaprozin, piroxicam, sulindac, tolmetin]	Increased concentrations of aminoglycoside in premature infants.	Avoid combination if possible. Otherwise, decrease aminoglycoside dose before starting NSAID. Monitor aminoglycoside concentrations and renal function.
	Penicillins [ampicillin, methicillin, mezlocillin,. nafcillin, oxacillin, penicillin G, piperacillin, ticarcillin]	Inactivation of Aminoglycoside.	Do not mix drugs in same solution. Separate administration times by at least 2 hours.
CEPHALOSPORINS	Cefamandole, Cefazolin, Cefonicid, Cefoperazone, Cefotaxime, Cefotetan, Cefoxitin, Ceftazidime, Ceftizoxime, Ceftriaxone, Cefuroxime, Cephalothin, Cephapirin, Cephradine		
Cephalosporins-class	Aminoglycosides,	see *Antimicrobial Agents (Antibacterial Antibiotics)*	

	Warfarin,	see *Anticoagulants/Thrombolytic Agents*	
Cefamandol *(see also Cephalosporins-class)*	Ethanol, see *Miscellaneous Agents*		
Cefonicid *(see also Cephalosporins-class)*	Ethanol, see *Miscellaneous Agents*		
Cefoperazone *(see also Cephalosporins-class)*	Ethanol, see *Miscellaneous Agents*		
Ceforanide *(see also Cephalosporins-class)*	Ethanol, see *Miscellaneous Agents*		
Cefotetan *(see also Cephalosporins-class)*	Ethanol, see *Miscellaneous Agents*		
Moxalactam *(see also Cephalosporins-class)*	Ethanol, see *Miscellaneous Agents*		
MACROLIDE	**Azithromycin, Clarithromycin, Erythromycin, Troleandomycin Antibiotics**		
Macrolide Antibiotics-class	Cyclosporine, see *Transplant Immunosuppressants*		
	HMG-CoA Reductase Inhibitors, Theophylline, see *Bronchodilators*	see *Hypolipidemic Agents*	
Clarithromycin	Buspirone,	see *Sedatives/Hypnotics/Agents used in Psychiatry(Miscellaneous Sedatives) (see also Macrolide Antibiotics-class)*	
	Carbamazepine,	see *Anticonvulsants*	
	Digoxin,	see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)—Macrolide Antibiotics*	
	Ergot Alkaloids,	see *Miscellaneous Agents— Macrolide Antibiotics*	
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased effects of clarithromycin. Increased adverse effects of rifamycin.	Monitor for increased rifamycin adverse effects and decreased response to macrolide antibiotic. Use alternative antibiotic (eg, azithromycin, dirithromycin).
	Tacrolimus,	see *Transplant Immunosuppressants— Macrolide Antibiotics*	
	Warfarin,	see *Anticoagulants/Thrombolytic Agents—Macrolide Antibiotics*	
Erythromycin *(see also Macrolide Antibiotics-class)*	Benzodiazepines, see *Sedatives/Hypnotics/Agents used in Psychiatry (Sedatives)*		
	Bromocriptine	Increased concentrations of bromocriptine.	Monitor for signs/symptoms of bromocriptine toxicity. Decrease bromocriptine dose if necessary.
	Buspirone,	see *Sedatives/Hypnotics/Agents used in Psychiatry (Miscellaneous Sedatives)—Macrolide Antibiotics*	
	Carbamazepine,	see *Anticonvulsants—Macrolide Antibiotics*	
	Digoxin,	see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)—Macrolide Antibiotics*	
	Ergot Alkaloids,	see *Miscellaneous Agents—Macrolide Antibiotics*	
	Felodipine,	see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers*)	
	Food	Decreased GI absorption of erythromycin.	Administer erythromycin stearate and non-enteric tablets at least 2 hours before or after a meal.
	Grapefruit Juice	Increased concentrations of erythromycin.	Avoid combination.
	Methylprednisolone,	see *Corticosteroids*	
	Quinolones [gatifloxacin, moxifloxacin, sparfloxacin]	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
	Rifamycins [rifabutin, rifampin]	Decreased effects of erythromycin Increased adverse effects of rifamycin.	Monitor for increased rifamycin adverse effects and decreased response to macrolide antibiotic. Use alternative antibiotic (eg, azithromycin, dirithromycin).
	Tacrolimus,	see *Transplant Immunosuppressants—Macrolide Antibiotics*	
	Warfarin,	see *Anticoagulants/Thrombolytic Agents—Macrolide Antibiotics*	
PENICILLINS	Amoxicillin, Ampicillin, Bacampicillin, Carbenicillin, Cloxacillin, Dicloxacillin, Methicillin, Mezlocillin, Penicillin G, Penicillin V, Piperacillin, Ticarcillin		
Penicillins-class	Aminoglycosides,	see *Antimicrobial Agents (Antibacterial Antibiotics)*	
	Food	Decreased or delayed GI absorption of oral penicillins	Administer penicillin at least. 2 hours before or after a meal.
	Methotrexate,	see *Antineoplastic Agents*	
	Tetracyclines [demeclocycline, doxycycline, minocycline, oxytetracycline, tetracycline]	Decreased effects of penicillins.	Avoid combination.
	Warfarin,	see *Anticoagulants/Thrombolytic Agents*	
Ampicillin *(see also Penicillins-*	Allopurinol	Increased rate of ampicillin- associated skin	Decrease allopurinol dose or use alternative

class)		rash.	drug if rash develops.
	Atenolol	Decreased effects of atenolol.	Separate administration times. Monitor blood pressure. Increase atenolol dose if necessary.
QUINOLONES	Ciprofloxacin, Gatifloxacin, Gemifloxacin, Levofloxacin, Lomefloxacin, Moxifloxacin, Nalidixic Acid, Norfloxacin, Ofloxacin, Sparfloxacin, Trovafloxacin		
Quinolones-class	Didanosine	Decreased GI absorption of quinolone.	Administer didanosine at least 6 hours before or 2 hours after quinolone.
	Iron Salts (Oral) [ferrous fumarate, ferrous gluconate, ferrous sulfate, iron polysaccharide]	Decreased GI absorption of quinolone.	Avoid combination.
	Phosphate Binders/ Antacids [aluminum hydroxide, aluminum-magnesium hydroxide, calcium acetate, calcium carbonate, magnesium hydroxide]	Decreased GI absorption of quinolone.	Separate administration times by at least 2 hours.
	Sucralfate	Decreased GI absorption of quinolone.	Administer sucralfate at least 6 hours after quinolone.
Ciprofloxacin *(see also Quinolones-class)*	Cyclosporine	see *Transplant Immunosuppressants—Quinolones*	
	Food [milk]	Decreased GI absorption of ciprofloxacin.	Avoid combination.
	Theophylline,	see *Bronchodilators—Quinolones*	
Norfloxacin *(see also Quinolones-class)*	Cyclosporine,	see *Transplant Immunosuppressants—Quinolones*	
	Food [milk]	Decreased GI absorption of norfloxacin.	Avoid combination.
	Theophylline,	see *Bronchodilators—Quinolones*	
Ofloxacin *(see also Quinolones-class)*	Procainamide,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
Sparfloxacin *(see also Quinolones-class)*	Amiodarone,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Bepridil	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination.
	Disopyramide,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Erythromycin,	see *Antimicrobial Agents, Antibacterial Antibiotics (Macrolide Antibiotics)*	
	Phenothiazines,	see *Sedatives/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*	
	Procainamide,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Quinidine,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Sotalol,	see *Antihypertensive and Cardiovascular Agents (Beta-Blockers)*	
	Tricyclic Antidepressants, see *(Tricyclic Antidepressants) Sedatives/Hypnotics/Agents used in Psychiatry*		
TETRACYCLINES	Demeclocycline, Doxycycline, Methacycline, Minocycline, Oxytetracycline, Tetracycline		
Tetracyclines-class	Bismuth Salts [bismuth subgallate bismuth subsalicylate]	Decreased GI absorption of tetracycline.	Separate administration, times by at least 2 hours.
	Iron Salts (Oral) [ferrous fumarate, ferrous gluconate, ferrous sulfate, iron polysaccharide]	Decreased GI absorption of tetracycline.	Separate administration times by at least 3-4 hours. Use enteric-coated or sustained-release formulation of iron salt.
	Phosphate Binders/ Antacids (aluminum carbonate, aluminum hydroxide, calcium acetate, calcium carbonate, calcium citrate, calcium glubionate, calcium gluconate, calcium lactate, tricalcium phosphate, magaldrate, magnesium carbonate, magnesium gluconate, magnesium hydroxide, magnesium oxide, magnesium sulfate, magnesium trisilicate)	Decreased GI absorption of tetracycline.	Separate administration times by at least 3-4 hours.
	Urinary Alkalinizers [potassium citrate, sodium acetate, sodium bicarbonate, sodium citrate, sodium lactate, tromethamine]	Decreased concentrations of tetracycline.	Separate administration times by at least 3-4 hours. Increase tetracycline dose if necessary.

	Zinc Salts [zinc gluconate, zinc sulfate]	Decreased GI absorption of tetracycline.	Separate administration times by at least 3-4 hours.
Doxycycline *(see also Tetracyclines-class)*	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, metharbital, pentobarbital, phenobarbital, primidone, secobarbital]	Decreased concentrations of doxycycline.	Increase doxycycline dose if necessary. Use alternative tetracycline.
	Carbamazepine	Decreased concentrations of doxycycline.	Increase doxycycline dose if necessary. Use alternative tetracycline.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, of. phenytoin]	Decreased doxycycline concentrations.	Increase doxycycline dose if necessary. Use alternative tetracycline.
	Penicillins,	see *Antimicrobial Agents (Antibacterial Antibiotics)—Tetracyclines*	
	Rifamycins [rifabutin, rifampin	Decreased concentrations of doxycycline.	Increase doxycycline dose if] necessary. Use alternative tetracycline.
Minocycline	Digoxin,	see *Antihypertensive and Cardiovascular Agents (see also (Miscellaneous Antihypertensive and Cardiovascular Agents)—Tetracyclines Tetracyclines-class)*	
	Penicillins,	see *Antimicrobial Agents (Antibacterial Antibiotics)—Tetracyclines*	
Tetracycline *(see also Tetracyclines-class)*	Penicillins, see *Antimicrobial Agents (Antibacterial Antibiotics)—Tetracyclines*		
MISCELLANEOUS ANTIBACTERIAL ANTIBIOTICS			
Chloramphenicol	Iron Products,	see *Anemia Agents*	
	Phenytoin,	see *Anticonvulsants (Hydantoins)*	
	Sulfonylureas,	see *Hypoglycemic Agents*	
	Warfarin,	see *Anticoagulants/Thrombolytic Agents*	
Clindamycin	Aluminum Salts aluminum salts [aluminum carbonate, aluminum hydroxide, aluminum phosphate, attapulgite, kaolin, magaldrate]	Delayed GI absorption of clindamycin.	Administer at least 2 hours before clindamycin.
Dapsone	Trimethoprim	Increased concentrations methemoglobinemia.	Monitor for of both drugs.
Imipenem/Cilastatin	Cyclosporine,	see *Transplant Immunosuppressants*	
Metronidazole	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Therapeutic failure of metronidazole.	Monitor for metronidazole treatment failure. Increase metronidazole dose if necessary. Use higher initial metronidazole dose.
	Disulfiram	Acute psychosis or confusion.	Avoid combination.
	Ethanol,	see *Miscellaneous Agents*	
	Warfarin,	see *Anticoagulants/Thrombolytic Agents*	
Trimethoprim/, Sulfamethoxazole	Cyclosporine	see *Transplant Immunosuppressants—Sulfonamides*	
	Dapsone,	see *Antimicrobial Agents (Miscellaneous Antibacterial Antibiotics)*	
	Methotrexate,	see *Antineoplastic Agents—Sulfonamides*	
	Phenytoin,	see *Anticonvulsants—Sulfonamides*	
	Procainamide,	see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*	
	Sulfonylureas,	see *Hypoglycemic Agents*	
	Warfarin,	see *Anticoagulants/Thrombolytic Agents—Sulfonamides*	
Vancomycin	Nondepolarizing Muscle Relaxants [atracurium, gallamine triethiodide, metocurine iodide, pancuronium, pipecuronium, tubocurarine, vecuronium]	Increased effects of nondepolarizing muscle relaxant (prolonged respiratory depression).	Avoid combination if possible. Otherwise, monitor respiratory function and adjust nondepolarizing muscle relaxant dose as needed.
AZOLE ANTIFUNGALS	Fluconazole, Itraconazole, Ketoconazole, Miconazole, Voriconazole		
Azole Antifungals-class	Benzodiazepines,	see *Sedatives/Hypnotics/Agents used in Psychiatry (Sedatives)*	
	Buspirone,	see *Sedatives/Hypnotics/Agents used in Psychiatry (Miscellaneous Sedatives)*	
	Cyclosporine,	see *Transplant Immunosuppressants*	
	Dexamethasone,	see *Corticosteroids*	
	Grapefruit Juice	Decreased GI absorption of azole antifungal.	Avoid combination.
	Haloperidol,	See *Sedatives/ Hypnotics/ Agents used in Psychiatry (Antipsychotic Agents)*	
	HMG-CoA Reductase Inhibitors,	see *Hypolipidemic Agents*	
	Indinavir,	see *Antimicrobial Agents (Antiviral Agents)*	
	Methylprednisolone,	see *Corticosteroids*	
	Nelfinavir,	see *Antimicrobial Agents (Antiviral Agents)*	

	Prednisolone and Prednisone,	see *Corticosteroids*	
	Rifamycins [rifabutin, rifampin]	Decreased concentrations of azole antifungal.	Avoid combination if possible. Otherwise, increase azole antifungal dose if necessary.
	Ritonavir,	see *Antimicrobial Agents (Antiviral Agents)*	
	Saquinavir,	see *Antimicrobial Agents (Antiviral Agents)*	
	Tacrolimus,	see *Transplant Immunosuppressants*	
	Warfarin,	see *Anticoagulants/Thrombolytic Agents*	
Fluconazole *(see also Azole Antifungals-class)*	Glimepride,	see *Hypoglycemic Agents (Sulfonylureas)*	
	Phenytoin,	see *Anticonvulsants*	
	Tolbutamide,	see *Hypoglycemic Agents (Sulfonylureas)*	
Itraconazole*(see also Azole Antifungals-class)*	Didanosine	Decreased GI absorption of itraconazole.	Separate administration by at least 2 hours.
	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
	Felodipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)*		
	Food/Cola	Increased GI absorption of itraconazole.	Administer drug immediately after meals.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased effects of itraconazole.	Avoid combination. Increased effects of hydantoin.
	Proton Pump Inhibitors [esomeprazole, lansoprazole, omeprazole, pantoprazole, itraconazole with an acidic rabeprazole]	Decreased GI absorption of itraconazole.	Avoid combination if possible. Otherwise, administer beverage (cola).
	Quinidine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmia Agents)*		
Ketoconazole	Didanosine *(see also Azole* of *Antifungals-class)*	Decreased GI absorption ketoconazole.	Separate administration by at least 2 hours.
	Histamine H2-Antagonists [cimetidine, famotidine, nizatidine, ranitidine]	Decreased GI absorption of ketoconazole.	Avoid combination if possible. Otherwise, administer glutamic acid hydrochloride 680 mg 15 minutes before ketoconazole.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased effects of ketoconazole.	Avoid combination.
	Indinavir, see *Antimicrobial Agents (Antiviral Agents)*		
	Proton Pump Inhibitors [esomeprazole, lansoprazole, omeprazole, pantoprazole, rabeprazole]	Decreased GI absorption of itraconazole (ketoconazole).	Avoid combination if possible. Otherwise, administer ketoconazole with an acidic beverage (cola).
Voriconazole *(see also Azole Antifungals-class)*	Barbiturates [mephobarbital, phenobarbital]	Decreased concentrations of voriconazole.	Avoid combination.
	Carbamazepine	Decreased concentrations of voriconazole.	Avoid combination.
	Ergot Alkaloids, see *Miscellaneous Agents*		
	Pimozide	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination.
	Quinidine	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination.
MISCELLANEOUS ANTIFUNGAL AGENTS			
Griseofulvin	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Decreased concentrations of griseofulvin	Separate administration times. Increase griseofulvin dose if necessary.
	Warfarin, see *Anticoagulants/Thrombolytic Agents*		
	Caspofungin Cyclosporine, see *Transplant Immunosuppressants*		
	Tacrolimus, see *Transplant Immunosuppressants*		

ANTIMYCOBACTERIAL AGENTS

Aminosalicylic acid (PAS)	Rifampin, see *Antimicrobial Agents (Rifamycins)—Rifampin*		
	Isoniazid Carbamazepine, see *Anticonvulsants*		
	Phenytoin, see *Anticonvulsants (Hydantoins)*		
	Rifampin	Increased risk of hepatotoxicity.	Monitor liver function tests. Discontinue one or both drugs if necessary.
RIFAMYCINS	Rifabutin, Rifampin, Rifapentine		
Rifamycins-class	Azole Antifungals, see *Antimicrobial Agents (Azole Antifungals)*		
	Bisoprolol	Decreased effects of bisoprolol.	Monitor cardiovascular status. Increase

			bisoprolol dose if necessary.
	Buspirone, see *Sedatives/Hypnotics/Agents used in Psychiatry (Miscellaneous Sedatives)*		
	Clarithromycin, see *Antimicrobial Agents, Antibacterial Antibiotics (Macrolide Antibiotics*)		
	Corticosteroids , see *Corticosteroids*		
	Cyclosporine, see *Transplant Immunosuppressants*		
	Delavirdine, see *Antimicrobial Agents (Antiviral Agents)*		
	Doxycycline, see *Antimicrobial Agents, Antibacterial Antibiotics (Tetracyclines)*		
	Erythromycin, see *Antimicrobial Agents, Antibacterial Antibiotics (Macrolide Antibiotics)*		
	Estrogens, see *Miscellaneous Agents*		
	Haloperidol, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*		
	HMG-CoA Reductase Inhibitors, see *Hypolipidemic Agents*		
	Indinavir, see *Antimicrobial Agents (Antiviral Agents)*		
	Methadone, see *Pain Medications (Narcotic)*		
	Metoprolol	Decreased effects of metoprolol.	Monitor cardiovascular status. Increase metoprolol dose if necessary.
	Morphine, see *Pain Medications (Narcotic)*		
	Nelfinavir, see *Antimicrobial Agents (Antiviral Agents)*		
	Phenytoin, see *Anticonvulsants (Hydantoins)*		
	Quinidine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Quinine, see *Miscellaneous Agents*		
	Ritonavir, see *Antimicrobial Agents (Antiviral Agents)*		
	Sulfonylureas, see *Hypoglycemic Agents*		
	Tacrolimus, see *Transplant Immunosuppressants*		
	Theophyllines, see *Bronchodilators*		
	Tricyclic Antidepressants, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antidepressants)*		
	Warfarin, see *Anticoagulants/Thrombolytic Agents*		
Rifampin *(see also Rifamycins-class)*	Disopyramide, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Isoniazid, see *Antimicrobial Agents (Antimycobacterial Agents)*		
	Nifedipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)*		
	Verapamil, *see Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)*		

ANTIVIRAL AGENTS

Acyclovir	Theophyllines, see *Bronchodilators*		
Delavirdine	Ergot Alkaloids, see *Miscellaneous Agents-NNRT Inhibitors*		
	Rifamycins [rifabutin, rifampin]	Decreased concentrations of delavirdine.	Avoid combination.
Didanosine	Food	Decreased GI absorption of didanosine.	Administer didanosine on an empty stomach.
	Indinavir, see *Antimicrobial Agents (Antiviral Agents)*		
	Itraconazole, see *Antimicrobial Agents (Azole Antifungals)*		
	Ketoconazole, see *Antimicrobial Agents (Azole Antifungals)*		
	Quinolones, see *Antimicrobial Agents (Antibacterial Antibiotics)*		
Foscarnet		Increased risk of renal failure.	Cyclosporine Avoid combination if possible. Otherwise, monitor renal function and discontinue foscarnet if necessary.
Ganciclovir	Zidovudine	Increased risk of life-threatening hematologic toxicity.	Avoid combination. Use foscarnet instead.
Indinavir	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased concentrations of protease inhibitor.	Decrease protease inhibitor dose if necessary.
	Benzodiazepines, see *Sedatives/Hypnotics/Agents used in Psychiatry (Sedatives)-Protease Inhibitor*		
	Didanosine	Decreased GI absorption of indinavir.	Separate administration times by at least 1 hour on an empty stomach.
	Ergot Alkaloids, see *Miscellaneous Agents-Protease Inhibitors*		
	Methadone, see *Pain Medications (Narcotic)-Protease Inhibitors*		
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased concentrations of in dinavir. Increased concentrations of rifamycin.	Avoid combination if possible. Otherwise, decrease rifabutin dose by 50%. Increase indinvair dose if necessary.
Nelfinavir	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased concentrations of protease inhibitor.	Decrease protease inhibitor dose if necessary.
	Ergot Alkaloids, see *Miscellaneous Agents-Protease Inhibitors*		
	Ethinyl Estradiol	Loss of contraceptive efficacy of ethinyl estradiol.	Use alternative nonhormonal or additional method of contraception. Use alternative protease inhibitor (eg, indinavir).
	Methadone,	see *Pain Medications (Narcotic)-Protease Inhibitors*	
	Rifamycins [rifabutin, rifampin]	Decreased concentrations of nelfinavir.	Avoid combination if possible. Otherwise, decrease rifabutin dose by 50%. Increase

			nelfinavir dose if necessary.
Ritonavir	Amiodarone, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased concentrations of protease inhibitor.	Decrease protease inhibitor dose if necessary.
	Benzodiazepines, see *Sedatives/Hypnotics/Agents used in Psychiatry (Sedatives)-Protease Inhibitor*		
	Buproprion, see *Sedatives/Hypnotics/Agents used in Psychiatry, Antidepressants (Miscellaneous Antidepressants)*		
	Clozapine, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*		
	Encainide	Increased concentrations of encainide.	Avoid combination.
	Ergot Alkaloids, see *Miscellaneous Agents-Protease Inhibitors*		
	Ethinyl Estradiol	Loss of contraceptive efficacy of ethinyl estradiol.	Use alternative nonhormonal or additional method of contraception. Use alternative protease inhibitor (eg, indinavir).
	Flecainide	Increased concentrations of flecainide.	Avoid combination.
	Meperidine, see *Pain Medications (Narcotic)*		
	Piroxicam, see *Arthritis and Gout Agents (NSAIDs)*		
	Propafenone	Increased concentrations of propafenone.	Avoid combination.
	Propoxyphene, see *Pain Medications (Narcotic)*		
	Quinidine	Increased concentrations of quinidine.	Avoid combination.
	Rifamycins	Decreased concentrations of ritonavir.	Avoid combination if possible. Otherwise, decrease rifabutin dose by 50%. Increase ritonavir dose if necessary.
	[rifabutin, rifampin]	Increased concentrations of rifabutin.	
Saquinavir	Benzodiazepines, see *Sedatives/Hypnotics/Agents used in Psychiatry (Sedatives)-Protease Inhibitor*		
	Ergot Alkaloids, see *Miscellaneous Agents-Protease Inhibitors*		
	Grapefruit Juice	Increased concentrations of saquinavir.	Avoid combination.
Zidovudine	Atovaquone	Increased concentrations of zidovuine.	Monitor for signs/symptoms of toxicity. Decrease zidovudine dose if necessary.
	Ganciclovir, see *Antimicrobial Agents (Antiviral Agents)*		
	Probenecid	Rash, malaise, myalgia, and fever.	Monitor for signs/symptoms of toxicity.

ANTICOAGULANTS/THROMBOLYTIC AGENTS

Alteplase	Nitroglycerin, see *Antihypertensive and Cardiovascular Agents (Nitrates)*		
Dipyridamole	Adenosine	Increased effects of adenosine (profound bradycardia).	No special precautions needed when using adenosine to terminate SVT due to its short half-life. Decrease initial infusion rate of adenosine when using it to simulate exercise during cardiac imaging.
Heparin	Salicylates [aspirin]	Increased risk of bleeding.	Monitor for signs/symptoms of bleeding. Treat symptomatically.
	Ticlopidine Phenytoin, see *Anticonvulsants*		
	Theophylline, see *Bronchodilators*		
Warfarin	Acetaminophen	Increased effects of warfarin.	Limit acetaminophen use. Monitor INR more frequently with chronic or high doses of acetaminophen.
	Aminoglutethimide	Decreased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed when starting or stopping aminoglutethimide.
	Amiodarone	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose empirically and adjust warfarin dose as needed.
	Androgens [danazol, fluoxymesterone, methyltestosterone, nandrolone decanoate oxandrolone, oxymetholone, stanozolol, testosterone]	Increased effects of warfarin.	Avoid combination if possible. Otherwise, monitor INR and decrease warfarin dose, if necessary.
	Azole Antifungals [fluconazole, itraconazole, ketoconazole, miconazole]	Increased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed when starting or stopping azole antifungal.
	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital,	Decreased effects of warfarin.	Adjust warfarin dose as needed when starting or stopping barbiturate. Monitor INR. Use benzodiazepine instead.
	Carbamazepine	Decreased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed when starting or stopping carbamazepine.
	Cephalosporins [cefamandole, cefazolin, cefoperazone, cefotetan,	Increased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed when starting or stopping cephalosporin.

cefoxitin, ceftriaxone]		
Chloramphenicol	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Cholestyramine	Decreased effects of warfarin.	Separate administration times by at least 3 hours. Monitor INR. Increase warfarin dose if necessary.
Cimetidine	Increased effects of warfarin.	Avoid combination if possible. Otherwise, monitor INR and decrease warfarin dose if necessary. Use alternative histamine H2-antagonist (eg, ranitidine).
Dextrothyroxine	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Disulfiram	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Ethchlorvynol	Decreased effects of warfarin.	Monitor INR. Increase warfarin dose if necessary. Use benzodiazepine instead.
Fibric Acids [clofibrate, fenofibrate, gemfibrozil]	Increased effects of warfarin.	Avoid combination.
Glucagon	Increased effects of warfarin	Monitor INR. Decrease with prolonged glucagon dosing. warfarin dose if necessary.
Glutethimide	Decreased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed when starting or stopping glutethimide. Use benzodiazepine instead.
Griseofulvin	Decreased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed when starting, stopping, or changing dose of griseofulvin.
HMG-CoA Reductase [fluvastatin, lovastatin, simvastatin]	Increased effects of warfarin.	Monitor INR. Adjust warfarin Inhibitors dose as needed when starting or stopping HMGCoA reductase inhibitor.
Levamisole	Increased effects of warfarin.	Monitor INR when starting or stopping levamisole. Adjust warfarin dose as needed.
Macrolide Antibiotics [azithromycin, clarithromycin, erythromycin]	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Metronidazole	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Nalidixic Acid	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
NSAIDs [diclofenac, etodolac, fenoprofen, flurbiprofen, ibuprofen, indomethacin, ketoprofen, ketorolac, meclofenamate, nabumetone, naproxen, oxaprozin, piroxicam, sulindac, tolmetin]	Increased effects of warfarin. Increased risk of bleeding.	Monitor INR and for signs/ symptoms of bleeding. Treat symptomatically.
Penicillins [ampicillin, dicloxacillin, methicillin, mezlocillin, nafcillin, oxacillin, penicillin G, piperacillin, ticarcillin]	Increased effects of warfarin with large doses of IV penicillin. Nafcillin and dicloxacillin can cause warfarin resistance.	Monitor INR. Decrease warfarin dose if necessary.
Quinine Derivatives [quinidine, quinine]	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Rifamycins [rifabutin, rifampin, rifapentine]	Decreased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed when starting or stopping rifamycin.
Salicylates [aspirin, methylsalicylate]	Increased effects of warfarin with large doses of salicylate. Increased risk of bleeding with any aspirin dose.	Avoid large doses of aspirin. Monitor INR and for signs/symptoms of bleeding. Treat symptomatically.
Sulfinpyrazone	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Sulfonamides [sulfamethizole, sulfamethoxazole, sulfasalazine, sulfisoxazole, trimethoprim/ sulfamethoxazole]	Increased effects of warfarin.	Monitor INR. Decrease warfarin dose if necessary.
Thioamines [methimazole, propylthiouracil]	Various effects on warfarin	Monitor INR. Adjustactivity. warfarin dose as needed.
Thyroid Hormones	Increased effects of warfarin.	Monitor INR. Adjust warfarin dose as needed

	[levothyroxine, liothyronine, liotrix, thyroid		when] starting, stopping, or changing dose of thyroid hormone.
	Vitamin E	Increased effects of warfarin.	Monitor INR. Decrease (Tocopherol) warfarin dose if necessary.
	Vitamin K (Phytonadione)	Decreased or reversed effects of warfarin.	Avoid or minimize intake of foods with high vitamin K. Monitor INR. Adjust warfarin dose as needed.

ANTICONVULSANTS

Carbamazepine	Bupropion, see *Sedatives/Hypnotics/Agents used in Psychiatry (Miscellaneous Sedatives)*		
	Cimetidine	Increased concentrations of carbamazepine.	Avoid combination if possible. Otherwise, monitor carbamazepine concentrations. Decrease dose if necessary. Usealternative histamine H2- antagonist (eg, ranitidine).
	Cyclosporine, see *Transplant Immunosuppressants*		
	Danazol	Increased concentrations of carbamazepine.	Avoid combination if possible. Otherwise, monitor carbamazepine concentrations. Decrease dose if necessary.
	Diltiazem	Increased concentrations of carbamazepine.	Monitor carbamazepine concentrations. Decrease carbamazepine dose if necessary.
	Doxycycline, see *Antimicrobial Agents, Antibacterial Antibiotics (Tetracyclines)*		
	Felodipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)*		
	Fluoxetine	Increased concentrations of carbamazepine.	Monitor carbamazepine concentrations. Decrease carbamazepine dose if necessary.
	Grapefruit Juice	Increased concentrations of carbamazepine.	Avoid combination.
	Haloperidol, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*		
	Isoniazid	Increased risk of carbamazepine toxicity and isoniazid hepatotoxicity.	Monitor liver function tests. Monitor carbamazepine concentrations. Decrease carbamazepine dose if necessary.
	Lamotrigine, see *Anticonvulsants*		
	Lithium, see *Sedative/Hypnotics/Agents used in Psychiatry, Antidepressants (Miscellaneous Antidepressants)*		
	Macrolide Antibiotics [clarithromycin, erythromycin, troleandomycin]	Increased concentrations of carbamazepine.	Avoid combination if possible. Otherwise, monitor carbamazepine concentrations and decrease dose if necessary.
	MAO Inhibitors [isocarboxazid, phenelzine, tranylcypromine]	Increased risk of severe adverse effects (hyperpyrexia, hyperexcitability, muscle rigidity, seizures).	Avoid combination. Discontinue MAO inhibitor at least 14 days prior to starting carbamazepine.
	Nefazodone	Increased concentrations of carbamazepine.	Avoid combination. Decreased concentrations of nefazodone.
	Phenytoin, see *Anticonvulsants (Hydantoins)*		
	Primidone	Decreased concentrations of carbamazepine, primidone, and phenobarbital (metabolite of primidone).	Monitor carbamazepine and primidone concentrations. Adjust dose of one or both drugs as needed.
	Propoxyphene	Increased concentrations of carbamazepine.	Avoid combination if possible. Otherwise, monitor carbamazepine concentrations and decrease dose if necessary.
	Tricyclic Antidepressants [amitriptyline, desipramine, doxepin, imipramine, nortriptyline	Increased concentrations of carbamazepine. Decreased concentrations of tricyclic antidepressant.	Monitor carbamazepine and tricyclic antidepressant concentrations. Adjust dose] of one or both drugs as needed.
	Valproic acid, see *Anticonvulsants*		
	Verapamil	Increased concentrations of carbamazepine.	Monitor carbamazepine concentrations. Decrease carbamazepine dose if necessary.
	Warfarin, see *Anticoagulants/Thrombolytic Agents*		
Lamotrigine	Carbamazepine	Decreased concentrations of lamotrigine. Increased risk of carbamazepine toxicity.	Adjust dose of lamotrigine as needed when starting, stopping, or changing dose of carbamazepine.
	Valproic Acid [divalproex sodium, valproic acid, valproate sodium]	Increased concentrations of lamotrigine.	Adjust dose of one or both drugs as needed. Decreased concentrations of valproic acid.
Phenobarbital	Beta-Blockers [metoprolol, propranolol]	Decreased bioavailability of beta-blocker.	Increase beta-blocker dose if necessary.
	Corticosteroids, see *Corticosteroids—Barbiturates*		
	Doxycycline, see *Antimicrobial Agents, Antibacterial Antibiotics (Tetracyclines)—Barbiturates*		
	Estrogens, see *Miscellaneous Agents—Barbiturates*		
	Ethanol, see *Miscellaneous Agents—Barbiturates*		
	Felodipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)—Barbiturates*		
	Griseofulvin, see *Antimicrobial Agents (Miscellaneous Antifungals)—Barbiturates*		

	Methadone, see *Pain Medications (Narcotic)—Barbiturates*		
	Metronidazole, see *Antimicrobial Agents (Miscellaneous Antibacterial Antibiotics)—Barbiturates*		
	Nifedipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)—Barbiturates*		
	Quinidine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)—Barbiturates*		
	Theophylline, see *Bronchodilators—Barbiturates*		
	Valproic Acid	Increased concentrations of phenobarbital.	Decrease phenobarbital dose if necessary.
	Voriconazole, see *Antimicrobial Agents (Azole Antifungals)—Barbiturates*		
	Warfarin, see *Anticoagulants/Thrombolytic Agents—Barbiturates*		
Hydantoins Monitor free (unbound) phenytoin concentrations in patients with renal insufficiency or failure.	Amiodarone [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Increased concentrations of phenytoin. Decreased concentrations of amiodarone.	Monitor phenytoin concentrations and signs/symptoms of phenytoin toxicity. Monitor for loss of amiodarone effect. Adjust doses of one or both drugs as needed.
	Anticoagulants [anisidione, dicumarol, warfarin	Increased concentrations of phenytoin. Increased INR and risk of bleeding.	Monitor for altered response] to phenytoin or anticoagulant. Monitor phenytoin concentrations and INR. Adjust dose of one or both drugs as needed.
	Antineoplastic Agents [bleomycin, carboplatin, carmustine, cisplatin, methotrexate, vinblastine]	Decreased concentrations of phenytoin.	Monitor phenytoin concentrations. Increase phenytoin dose if necessary.
	Carbamazepine	Decreased concentrations of carbamazepine. Variable effects on concentrations of phenytoin.	Monitor carbamazepine and phenytoin concentrations. Adjust dose of one or both drugs as needed.
	Chloramphenicol	Increased concentrations of phenytoin. Variable effects on concentrations of chloramphenicol.	Monitor phenytoin concentrations. Adjust dose of one or both drugs as needed.
	Cimetidine	Increased concentrations of phenytoin.	Avoid combination. Use alternative histamine H2-antagonist (eg, ranitidine).
	Corticosteroids, see *Corticosteroids—Hydantoins*		
	Cyclosporine, see *Transplant Immunosuppressants—Hydantoins*		
	Diazoxide	Decreased concentrations of phenytoin.	Monitor phenytoin concentrations. Increase phenytoin dose if necessary.
	Disopyramide, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)—Hydantoins*		
	Disulfiram	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Dopamine	Increased risk of profound hypotension and cardiac arrest.	Monitor blood pressure. Discontinue phenytoin if hypotension occurs.
	Doxycycline, see *Antimicrobial Agents, Antibacterial Antibiotics (Tetracyclines)—Hydantoins*		
	Estrogens, see *Miscellaneous Agents—Hydantoins*		
	Felbamate	Increased concentrations of phenytoin. Decreased concentrations of felbamate.	Monitor felbamate and phenytoin concentrations. Adjust dose of one or both drugs as needed.
	Felodipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)—Hydantoins*		
	Fluconazole	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Fluoxetine	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Folic acid	Decreased concentrations of phenytoin.	Monitor phenytoin concentrations. Increase phenytoin dose if necessary.
	Isoniazid	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Itraconazole, see *Antimicrobial Agents (Azole Antifungals)—Hydantoins*		
	Ketoconazole, see *Antimicrobial Agents (Azole Antifungals)—Hydantoins*		
	Levodopa, see *Antiparkinson Agents—Hydantoins*		
	Methadone, see *Pain Medications (Narcotic)—Hydantoins*		
	Metyrapone, see *Miscellaneous Agents—Hydantoins*		
	Mexiletine, see *Antihypertensive and Cardiovascular Agents, (Antiarrhythmic Agents)—Hydantoins*		
	Nisoldipine, *see Antihypertensive Agents and Cardiovascular Agents (Calcium-Channel Blockers)—Hydantoins*		
	Phenacemide	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Phenylbutazones [oxyphenbutazone, phenylbutazone]	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Primidone	Increased concentrations of primidone and primidone-metabolite.	Monitor primidone and primidone-metabolite concentrations. Decrease primidone dose if necessary.
	Quinidine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)—Hydantoins*		
	Rifamycins [rifabutin, rifampin]	Decreased concentrations of phenytoin.	Monitor phenytoin concentrations. Increase phenytoin dose if necessary.
	Sertraline	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease

			phenytoin dose if necessary.
	Sucralfate	Decreased GI absorption of phenytoin.	Monitor phenytoin concentrations. Increase phenytoin dose if necessary.
	Sulfonamides [sulfadiazine, sulfamethizole]	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Tacrolimus, see *Transplant Immunosuppressants*		
	Theophylline, see *Bronchodilators*		
	Ticlopidine	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Trimethoprim	Increased concentrations of phenytoin.	Monitor phenytoin concentrations. Decrease phenytoin dose if necessary.
	Valproic Acid [divalproex sodium, valproic acid]	Increased concentrations of phenytoin. Decreased concentrations of of valproic acid.	Monitor free phenytoin and valproic acid concentrations. Adjust dose one or both drugs as needed.
Valproic Acid [divalproex sodium, sodium valproate, valproic acid]	Barbiturates [phenobarbital, primidone]	Increased concentrations of barbiturate.	Increase barbiturate dose if necessary.
	Carbamazepine	Decreased concentrations of valproic acid.	Monitor valproic acid concentrations, seizure activity, and signs/symptoms of toxicity for at least a month after starting or stopping either drug. Increase valproic acid dose if necessary.
	Cholestyramine	Decreased GI absorption of valproic acid.	Separate administration times by at least 3 hours. Monitor valproic acid concentrations. Increase valproic acid dose if necessary.
	Felbamate	Increased concentrations of valproic acid.	Monitor valproic acid concentrations. Decrease valproic acid dose if necessary.
	Lamotrigine, see *Anticonvulsants*		
	Phenytoin, see *Anticonvulsants*		
	Salicylates [aspirin, bismuth subsalicylate, choline salicylate, magnesium salicylate, salsalate, sodium salicylate, sodium thiosalicylate]	Increased free (unbound) concentrations of valproic acid.	Monitor free valproic acid concentrations. Decrease valproic acid dose if necessary.
	Tricyclic Antidepressants, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antidepressants)*		

ANTINEOPLASTIC AGENTS

Azathioprine	Allopurinol, see *Arthritis and Gout Agents (Miscellaneous Arthritis and Gout Agents)—Thiopurines*		
Methotrexate	NSAIDs [diclofenac, etodolac, fenoprofen, flubiprofen, ibuprofen, indomethacin, ketoprofen, ketorolac, meclofenamate, mefenamic acid, nabumetone, naproxen, oxaprozin, piroxicam, sulindac, tolmetin]	Increased risk of methotrexate toxicity.	Monitor for renal impairment and signs/symptoms of toxicity. Monitor methotrexate Consider extended concentrations. leucovorin rescue therapy.
	Penicillins [amoxicillin, ampicillin, bacampicillin, carbenicillin, cloxacillin, dicloxacillin, methicillin, mezlocillin, penicillin G, penicillin V, piperacillin, ticarcillin]	Increased concentrations of methotrexate. Increased risk of methotrexate toxicity.	Monitor for signs/symptoms of toxicity. Monitor methotrexate concentrations. Consider extended leucovorin rescue therapy. Use alternative anbiotic if possible (eg, ceftazidime).
Probenecid	Methotrexate	Increased concentrations of methotrexate.	Decrease methotrexate dose. Monitor for signs/symptoms of toxicity. Increased risk of toxicity. Monitor methotrexate concentrations. Consider extended leucovorin rescue therapy.
	Salicylates [aspirin, bismuth subsalicylate, choline magnesium salicylate, choline salicylate, magnesium salicylate, salsalate, sodium salicylate, sodium thiosalicylate]	Increased risk of methotrexate toxicity.	Decrease methotrexate dose. Monitor for signs/symptoms of toxicity. Monitor methotrexate concentrations. Consider extended leucovorin rescue therapy.
	Sulfonamides [sulfadiazine, sulfamethizole, sulfamethoxazole,	Increased risk of bone marrow suppression and megaloblastic anemia.	Avoid combination if possible. Otherwise, monitor for signs/symptoms of hematologic toxicity. Administer leucovorin if necessary.

	sulfasalazine, ulfisoxazole, trimethoprim/ sulfamethoxazole]		

ANTIPARKINSON AGENTS

Levodopa	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased effects of levodopa.	Avoid combination.
	Iron Salts (Oral) [ferrous fumarate, ferrous gluconate, ferrous sulfate, l iron polysaccharide]	Decreased effects of levodopa.	Separate administration times. Monitor clincial response and increase evodopa dose if necessary.
	MAO Inhibitors [phenelzine, tranylcypromine]	Increased risk of hypertensive reactions.	Avoid combination. Use alternative MAOI (eg, selegiline).
	Pyridoxine	Decreased effects of levodopa.	Avoid combination if possible in patients treated with levodopa alone.

ARTHRITIS AND GOUT AGENTS

Allopurinol	Ampicillin, see *Antimicrobial Agents (Penicillins)*		
	Thiopurines [azathioprine, mercaptopurine	Increased effects of thiopurine.	Decrease thiopurine dose] by 25-33%. Monitor hematologic function (bone marrow suppression).
Colchicine	Cyclosporine, see *Transplant Immunosuppressants*		
NONSTEROIDAL ANTI-INFLAMMATORY DRUGS (NSAIDS)	Diclofenac, Diflunisal, Etodolac, Fenoprofen, Flubiprofen, Ibuprofen, Indomethacin, Ketoprofen, Ketorolac, Meclofenamate, Mefenamic Acid, Nabumetone, Naproxen, Piroxicam, Sulindac, Tolmetin		
Nonsteroidal Anti-Inflammatory Drugs (NSAIDs)-class	Aminoglycosides, see *Antimicrobial Agents (Antibacterial Antibiotics)*		
	Beta-Blockers, see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers)*		
	Lithium, see *Sedatives/Hypnotics/Agents used in Psychiatry, Antidepressants (Miscellaneous Antidepressants)*		
	Methotrexate, see *Antineoplastic Agents*		
	Warfarin, see *Anticoagulants/Thrombolytic Agents*		
Diflunisal*(see also Nonsteroidal Anti-Inflammatory Drugs-class)*	Probenecid	Increased effects of diflunisal.	Monitor for diflunisal toxicity.
Ibuprofen *(see also Nonsteroidal Anti-Inflammatory Drugs-class)*	Beta-Blockers, see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers) — NSAIDs*		
ndomethacin *(see also Nonsteroidal Anti-Inflammatory Drugs-class)*	**I**Beta-Blockers, see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers) — NSAIDs*		
	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
Ketorolac*(see also Nonsteroidal Anti-Inflammatory Drugs-class)*	Probenecid	Increased risk of ketorolac toxicity.	Avoid combination.
	Salicylates [aspirin]	Increased risk of ketorolac adverse effects.	Avoid combination.
Naproxen*(see also Nonsteroidal Anti-Inflammatory Drugs-class)*	Beta-Blockers, see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers) — NSAIDs*		
Piroxicam*(see also Nonsteroidal Anti-Inflammatory Drugs-class)*	Beta-Blockers, see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers) — NSAIDs*		
	Ritonavir	Increased risk of piroxicam toxicity.	Avoid combination.

BRONCHODILATORS

THEOPHYLLINES-CLASS	Theophyllines Aminophylline, Dyphylline, Oxtriphylline, Theophylline		
	Acyclovir	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Decreased concentrations of theophylline.	Monitor theophylline concentrations. Increase theophylline dose if necessary.
	Beta-Blockers,	Increased concentrations of theophylline.	Monitor theophylline concentrations. Use

	noncardio- selective [carteolol, penbutolol, pindolol, propranolol, timolol]	Pharmacologic antagonism may decrease effects of one or both drugs.	cardio- selective beta-blockers.
	Cimetidine	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose by 20-40% when starting cimetidine. Use alternative histamine H2-antagonist (eg, ranitidine).
	Contraceptives, Oral	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Diltiazem	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Disulfiram	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Food	Increased or decreased absorption or clearance of various theophylline products.	Refer to package insert for specific management.
	Halothane	Increased risk of arrhythmias.	Avoid combination. Use alternative anesthetic (eg, enflurane).
	Hydantoins [fosphenytoin, phenytoin]	Decreased concentrations of theophylline and phenytoin.	Monitor theophylline and phenytoin concentrations. Adjust dose of one or both drugs as needed.
	Macrolide Antibiotics [azithromycin, clarithromycin, dirithromycin, erythromycin, troleandomycin]	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary. Use alternative antibiotic.
	Mexiletine	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Quinolones [ciprofloxacin, enoxacin, norfloxacin]	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased concentrations of theophylline.	Monitor theophylline concentrations. Increase theophylline dose if necessary.
	Thiabendazole	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Thioamines [methimazole, propylthiouracil] .	Decreased theophylline concentrations in hyperthyroid patients; returns to normal once euthyroid state achieved.	Monitor theophylline concentrations. Adjust theophylline dose as needed. Achieve euthyroid state as soon as possible
	Thyroid Hormones [dextrothyroxine, levothyroxine, liothyronine, liotrix, thyroglobulin, thyroid]	Decreased theophylline concentrations in hyperthyroid patients; returns to normal once euthyroid state achieved.	Monitor theophylline concentrations. Adjust theophylline dose as needed. Achieve euthyroid state as soon as possible.
	Ticlopidine	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose if necessary.
	Zileuton	Increased concentrations of theophylline.	Monitor theophylline concentrations. Decrease theophylline dose by 50% when starting zileuton.
LEUKOTRIENE INHIBITORS			
Zileuton	Theophylline, see *Bronchodilators*		
CORTICOSTEROIDS	Corticosteroids Betamethasone, Corticotropin, Cortisone, Cosyntropin, Dexamethasone, Fludrocortisone, Hydrocortisone, Methylprednisolone, Prednisolone, Prednisone, Triamcinolone		
Corticosteroids-class	Anticholinesterases [ambenonium, edrophonium neostigmine, pyridostigmine]	Corticosteroids antagonize effect of anticholinesterases in myasthenia gravis.	Monitor clinical response.
	Aspirin, see *Pain Medications (Non-Narcotic)*		
	Barbiturates [amobarbital, aprobarbital, butabarbital butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Decreased effects of corticosteroid.	Avoid combination if possible. Otherwise, increase corticosteroid dose if necessary.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased effects of corticosteroid.	Increase corticosteroid dose if necessary.
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased effects of corticosteroid.	Avoid combination if possible. Otherwise, increase corticosteroid dose if necessary.
Dexamethasone*(see also Corticosteroids-class)*	Aminoglutethimide	Decreased effects of dexamethasone.	Increase dexamethasone dose if necessary. Use alternative corticosteroid (eg, hyrdrocortisone).
	Azole Antifungals	Increased effects of dexamethasone.	Decrease dexamethasone dose if necessary.

	[fluconazole, itraconazole, ketoconazole]		
Hydrocortisone *(see also Corticosteroids-class)*	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased effects of hydrocortisone.	Decrease hydrocortisone dose if necessary.
	Bile Acid Sequestrants [cholestyramine, colestipol]	Decreased GI absorption of hydrocortisone.	Separate administration times. Use alternative lipid-lowering drug.
	Estrogens [chlorotrianisene, conjugated estrogens, diethylstilbesterol, esterified estrogens, estradiol, estrone, estropipate, ethinyl estradiol, quinestrol]	Increased effects of hydrocortisone.	Decrease hydrocortisone dose if necessary.
Methylprednisolone*(see also Corticosteroids-class)*	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased effects of methylprednisolone.	Decrease methylprednisolone dose if necessary.
	Macrolide Antibiotics [erythromycin, troleandomycin]	Increased effects of methylprednisolone.	Decrease methylprednisolone doseif necessary.
Prednisolone and Prednisone *(see also Corticosteroids-class)*	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased effects of corticosteroid.	Decrease corticosteroid dose if necessary.
	Estrogens [chlorotrianisene, conjugated estrogens, diethylstilbesterol, esterified estrogens, estradiol, estrone, estropipate, ethinyl estradiol, quinestrol]	Increased effects of corticosteroid.	Decrease corticosteroid dose if necessary.
DIURETICS	Loop Diuretics Bumetanide, Ethacrynic Acid, Furosemide, Torsemide		
Loop Diuretics-class	Aminoglycosides, see *Antimicrobial Agents (Antibacterial Antibiotics)*		
	Cisplatin	Increased risk of ototoxicity.	Avoid combination if possible. Otherwise, monitor hearing function.
	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
	Thiazide Diuretics [bendroflumethiazide, benzthiazide, chlorothiazide, chlorthalidone, hydrochlorothiazide, hydroflumethiazide, indapamide, methyclothiazide, metolazone, polythiazide, quinethazone, trichlormethiazide]	Profound diuresis and electrolyte disturbances.	Adjust diuretic dose as needed. Monitor electrolyte abnormalities and hydration status when starting combination therapy.
	Furosemide *(see also Loop Diuretics-class)*	Decreased GI absorption of furosemide.	Administer cholestyramine at least 2 hours after furosemide.
	Cholestyramine		
	Colestipol	Decreased GI absorption of furosemide.	Administer colestipol at least 2 hours after furosemide.
THIAZIDE DIURETICS	Bendroflumethiazide, Benzthiazide, Chlorothiazide, Chlorthalidone, Hydrochlorothiazide, Hydroflumethiazide, Indapamide, Methyclothiazide, Metolazone, Polythiazide, Quinethazone, Trichlormethiazide		
Thiazide Diuretics-class	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
	Lithium, see *Sedative/Hypnotics/Agents used in Psychiatry, Antidepressants (Miscellaneous Antidepressants)*		
	Loop Diuretics, see *Diuretics*		
	Sulfonylureas, see *Hypoglycemic Agents*		

GASTROINTESTINAL AGENTS

HISTAMINE H2-ANTAGONISTS	Cimetidine, Famotidine, Nizatidine, Ranitidine		
Histamine H2-Antagonists-class	Ketoconazole, see *Antimicrobial Agents (Azole Antifungals)*		
Cimetidine*(see also Histamine H2-Antagonists-class)*	Beta-Blockers, see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers)*		
	Carbamazepine, see *Anticonvulsants*		
	Lidocaine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Metformin, see *Hypoglycemic Agents*		
	Moricizine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Nifedipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)*		

	Phenytoin, see *Anticonvulsants—Hydantoins*		
	Praziquantel	Increased concentrations of praziquantel.	Monitor for toxicity. Use alternative histamine H2-antagonist (eg, ranitidine).
	Procainamide, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Quinidine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Theophylline, see *Bronchodilators* Tricyclic Antidepressants, see *Sedatives/ Hypnotics/ Agents used in Psychiatry (Antidepressants)*		
	Warfarin, see *Anticoagulants/Thrombolytic Agents*		
PHOSPHATE BINDERS/ANTACIDS	Aluminum Salts (Aluminum Carbonate, Aluminum Hydroxide) Calcium Salts(Calcium Carbonate, Calcium Acetate), Magnesium Salts (Magnesium Carbonate, Magnesium Hydroxide)		
Phosphate Binders/ Antacids-class	Iron Salts, Oral, see *Anemia Agents (Iron Products)*		
	Ketoconazole, see *Antimicrobial Agents (Azole Antifungals)*		
	Quinidine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
	Quinolones, see *Antimicrobial Agents (Antibacterial Antibiotics)*		
	Sodium Polystyrene Sulfonate (Kayexalate), see *Gastrointestinal Agents (Miscellaneous Gastrointestinal Agents)*		
	Tetracyclines, see *Antimicrobial Agents (Antibacterial Antibiotics)*		
Calcium Carbonate *(see also Phosphate Binders/Antacids-class)*	Verapamil, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)—Calcium Salts*		
Calcium Acetate*(see also Phosphate Binders/Antacids-class)*	Verapamil, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)—Calcium Salts*		
Sevelamer	No drug-drug interaction studies were performed in humans. There is a possibility that sevelamer hydrochloride may bind concomitantly administered drugs and decrease their bioavailability.		
PROTON PUMP INHIBITORS (PPIs)	Esomeprazole, Lansoprazole, Omeprazole, Pantoprazole, Rabeprazole		
Proton Pump Inhibitors-class	Itraconazole, see *Antimicrobial Agents (Azole Antifungals)*		
	Ketoconazole, see *Antimicrobial Agents (Azole Antifungals)*		
MISCELLANEOUS GASTROINTESTINAL AGENTS			
Metoclopramide	Cyclosporine, see *Transplant Immunosuppressants*		
	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
Sodium Polystyrene Sulfonate (Kayexalate)	Phosphate Binders/ Antacids [aluminum-magnesium hydroxide, calcium carbonate]	Increased risk of metabolic alkalosis. Decreased potassium binding effects of resin.	Separate administration times.
Sucralfate	Quinolones, see *Antimicrobial Agents (Antibacterial Antibiotics)*		

HYPOGLYCEMIC AGENTS

Insulin	Beta-Blockers, Noncardio-Selective [carteolol, nadolol, penbutolol, pindolol, propranolol, timolol]	Prolonged hypoglycemia with masking of hypoglycemic signs/ symptoms (tachycardia)	Use cardio-selective beta-blocker.Monitor for signs/symptoms of hypoglycemia not affected by beta-blockers.
	Ethanol	Increased hypoglycemic effects of insulin.	Ingest ethanol in moderation and with meals.
	MAO Inhibitors [isocarboxazid, phenelzine, tranylcypromine].	Increased hypoglycemic effects of insulin.	Monitor blood glucose concentration. Decrease insulin dose if necessary.
	Salicylates [aspirin, bismuth subsalicylate, choline salicylate, magnesium salicylate, salsalate, sodium salicylate, sodium thiosalicylate]	Increased hypoglycemic effects of insulin.	Monitor blood glucose concentration. Decrease insulin dose if necessary.
Metformin	Cimetidine	Increased concentrations of metformin.	Monitor blood glucose concentration. Decrease metformin dose if necessary.
	Iodinated Contrast Materials, IV	Increased risk of lactic acidosis.	Avoid combination. Discontinue metformin for at least 48 hours prior to and subsequent to the use of IV iodinated contrast materials.
SULFONYLUREAS	Acetohexamide, Chlorpropamide, Glimepride, Glipizide, Glyburide, Tolazamide, Tolbutamide		
Sulfonylureas-class	Chloramphenicol	Increased hypoglycemic effects of sulfonylurea.	Monitor blood glucose concentration. Decrease sulfonylurea dose if necessary.
	Diazoxide	Decreased hypoglycemic effects of sulfonylurea.	Monitor blood glucose concentration. Increase sulfonylurea dose if necessary.
	Ethanol, see *Miscellaneous Agents*		
	MAO Inhibitors [isocarboxazid, phenelzine, tranylcypromine]	Increased hypoglycemic effects of sulfonylurea.	Monitor blood glucose concentration. Decrease sulfonylurea dose if necessary.
	Phenylbutazones [oxyphenbutazone, phenylbutazone]	Increased hypoglycemic effects of sulfonylurea.	Monitor blood glucose concentration. Decrease sulfonylurea dose if necessary. Use alternative NSAID.

	Rifamycins [rifabutin, rifampin, rifapentine].	Decreased concentrations of sulfonylurea.	Monitor blood glucose concentration. Increase sulfonylurea dose if necessary.
	Salicylates [aspirin, choline salicylate, magnesium salicylate, salsalate, sodium salicylate, sodium thiosalicylate]	Increased hypoglycemic effects of sulfonylurea.	Monitor blood glucose concentration. Decrease sulfonylurea dose if necessary.
	Sulfonamides [sulfacytine, sulfadiazine, sulfamethizole sulfamethoxazole, sulfasalazine, sulfisoxazole, multiple sulfonamides]	Increased concentrations of sulfonylurea. , [Exception: Glyburide]	Monitor blood glucose concentration. Decrease sulfonylurea dose if necessary. Use noninteracting sulfonylurea (eg, glyburide).
	Thiazide Diuretics [bendroflumethiazide, benzthiazide, chlorothiazide, chlorthalidone, hydrochlorothiazide, hydroflumethiazide, indapamide, methyclothiazide, metolazone, polythiazide, quinethazone, trichlormethiazide]	Increased concentrations of fasting blood glucose. Decreased hypoglycemic effects of sulfonylurea.	Monitor blood glucose concentration. Increase sulfonylurea dose if necessary.
Chlorpropamide *(see also Sulfonylureas-class)*	Dicumarol ic	Increased hypoglycem effects of chlorpropamide.	Monitor blood glucose concentration. Decrease chlorpropamide dose if necessary.
	Urinary Alkalinizers [potassium citrate, sodium acetate, sodium bicarbonate, sodium citrate, sodium lactate, tromethamine]	Increased elimination of chlorpropamide.	Monitor blood glucose concentration. Increase chlorpropamide dose if necessary.
Glimepride *(see also Sulfonylureas-class)*	Fluconazole	Increased hypoglycemic effects of tolbutamide.	Monitor blood glucose concentration. Decrease tolbutamide dose if necessary.
Tolbutamide *(see also Sulfonylureas-class)*	Dicumarol	Increased hypoglycemic effects of tolbutamide.	Monitor blood glucose concentration. Decrease tolbutamide dose if necessary.
	Fluconazole	Increased hypoglycemic effects of tolbutamide.	Monitor blood glucose concentration. Decrease tolbutamide dose if necessary.
	Sulfinpyrazone	Increased hypoglycemic effects of tolbutamide.	Monitor blood glucose concentration. Decrease tolbutamide dose if necessary.

HYPOLIPIDEMIC AGENTS

Cholestyramine	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)* HMG-CoA Reductase Inhibitors, see *Hypolipidemic Agents (Bile Acid Sequestrants)* Hydrocortisone, see *Corticosteroids— Bile Acid Sequestrants* Furosemide, see *Diuretics (Loop Diuretics)—Bile Acid Sequestrants* Levothyroxine, see *Miscellaneous Agents* Valproic Acid, see *Anticonvulsants* Warfarin, see *Anticoagulants/Thrombolytic Agents*
Clofibrate	Warfarin, see *Anticoagulants/Thrombolytic Agents*
Colestipol	HMG-CoA Reductase Inhibitors, see *Hypolipidemic Agents—Bile Acid Sequestrants* Hydrocortisone, see *Corticosteroids—Bile Acid Sequestrants* Loop Diuretics, see *Diuretics—Bile Acid Sequestrants*
Gemfibrozil	HMG-CoA Reductase Inhibitors, see *Hypolipidemic Agents*
Probucol	Cyclosporine, *see Transplant Immunosuppressants*

HMG-CoA REDUCTASE INHIBITORS (STATINS)	Atorvastatin, Fluvastatin, Lovastatin, Pravastatin, Rosuvastatin, Simvastatin		
HMG-CoA Reductase Inhibitors-class	Azole Antifungals [fluconazole, itraconazole, ketoconazole, miconazole, voriconazole]	Increased risk of rhabdomyolysis.	Avoid combination if possible. Otherwise, monitor for signs/symptoms of statin toxicity. Decrease statin dose if necessary. Pravastatin is least affected by the interaction.
	Bile Acid Sequestrants [cholestyramine, colestipol]	Decreased GI absorption of HMG-CoA reductase inhibitor.	Separate administration times by at least 4 hours.
	Cyclosporine	Increased risk of rhabdomyolysis.	Avoid combination if possible. Otherwise, monitor for signs/ symptoms of statin toxicity. Decrease statin dose if necessary.
	Diltiazem [Exceptions: fluvastatin, pravastatin]	Increased risk of rhabdomyolysis.	Avoid combination if possible. Otherwise, monitor for signs/symptoms of statin toxicity. Use noninteracting statin (eg, fluvastatin, pravastatin).

	Gemfibrozil	Increased risk of severe myopathy and rhabdomyolysis.	Avoid combination.
	Grapefruit Juice	Increased risk of rhabdomyolysis. [Exceptions: fluvastatin, pravastatin]	Avoid combination. Use noninteracting statin (eg, fluvastatin, pravastatin).
	Macrolide Antibiotics [azithromycin, clarithromycin, erythromycin]	Increased risk of severe myopathy and rhabdomyolysis. [Exceptions: fluvastatin, pravastatin]	Avoid combination. Use alternative antibiotic or noninteracting statin (eg, fluvastatin, pravastatin).
	Nefazodone	Increased risk of rhabdomyolysis. [Exceptions: fluvastatin, pravastatin]	Avoid combination. Use noninteracting statin (eg, fluvastatin, pravastatin).
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased effects of statin. [Exception: pravastatin]	Monitor clinical response. Use noninteracting statin (eg, pravastatin).
	Verapamil	Increased risk of rhabdomyolysis. [Exceptions: fluvastatin, pravastatin]	Avoid combination. Use noninteracting statin (eg, fluvastatin, pravastatin).
Lovastatin *(see also HMG-CoA Reductase Inhibitors-class)*	Cyclosporine	Increased risk of rhabdomyolysis.	Avoid combination. Report unexplained muscle pain, tenderness, or weakness.

PAIN MEDICATIONS

NON-NARCOTIC			
Acetaminophen	Ethanol	Increased risk of acetaminophen-induced hepatotoxicity.	Avoid combination. Advise chronic ethanol consumers to avoid excessive or prolonged use of acetaminophen.
	Hydantoins [ethotoin, fosphenytoin, acetaminophen-induced, phenytoin] regular hydantoin therapy.	Increased risk of hepatotoxicity.	Avoid chronic and excessive use of acetaminophen with mephenytoin.
	Sulfinpyrazone	Increased risk of acetaminophen-induced hepatotoxicity.	Avoid chronic and excessive use of acetaminophen with regular sulfinpyrazone therapy.
	Warfarin, see *Anticoagulants/Thrombolytic Agents*		
Aspirin	Carbonic Anhydrase Inhibitors [acetazolamide, dichlorphenamide, methazolamide]	Increased risk of carbonic anhydrase inhibitor toxicity (CNS depression, metabolic acidosis).	Avoid combination.
	Corticosteroids [betamethasone, cortisone, desoxycorticosterone, dexamethasone, fludrocortisone, hydrocortisone, methylprednisolone, paramethasone, prednisolone, prednisone, triamcinolone]	Decreased effects of salicylate.	Monitor aspirin concentrations. Increase salicylate dose if necessary.
	Heparin, see *Anticoagulants/Thrombolytic Agents— Salicylates*		
	Insulin, see *Hypoglycemic Agents—Salicylates*		
	Ketorolac, see *Arthritis and Gout Agents (NSAIDs)—Salicylates*		
	Methotrexate, see *Antineoplastic Agents—Salicylates*		
	Probenecid	Decreased uricosuric action of one or both drugs.	Avoid combination. Use non-antiinflammatory doses of aspirin.
	Sulfonylureas, see *Hypoglycemic Agents—Salicylates*		
	Valproic acid, see *Anticonvulsants—Salicylates*		
	Warfarin, see *Anticoagulants/Thrombolytic Agents—Salicylates*		
NARCOTIC			
Alfentanil	Ethanol, see *Miscellaneous Agents*		
Codeine	Quinidine	Decreased effects of codeine.	Use alternative analgesic.
Fentanyl	Amiodarone, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)*		
Meperidine	MAO Inhibitors [isocarboxazid, phenelzine, selegiline, tranylcypromine]	Agitation, seizures, diaphoresis and fever.	Avoid combination. May progress to coma, apnea, and death.
	Phenothiazines [chlorpromazine]	Excessive sedation and hypotension.	Avoid combination.
	Ritonavir	Decreased efficacy of meperidine and increased risk of neurologic toxicity.	Avoid combination.
Methadone	Barbiturates [amobarbital, aprobarbital, butabarbital, butalbital, mephobarbital, pentobarbital,	Decreased effects of methadone. Possible withdrawal symptoms in patients on chronic methadone therapy.	Increase methadone dose if necessary.

	phenobarbital, primidone, secobarbital]		
	Fluvoxamine	Increased concentrations of methadone.	Monitor clinical response when starting and stopping fluvoxamine in patients on chronic methadone therapy.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased effects of methadone. Possible withdrawal symptoms in patients on chronic methadone therapy.	Increase methadone dose if necessary.
	Protease Inhibitors [nelfinavir, ritonavir]	Decreased effects of methadone. Possible withdrawal symptoms in patients on chronic methadone therapy.	Increased methadone dose if necessary.
	Rifampin	Decreased effects of methadone. Possible withdrawal symptoms in patients on chronic methadone therapy.	Increase methadone dose if necessary.
Morphine	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased analgesic effects of morphine.	Monitor analgesic response. Use alternative analgesic.
Propoxyphene	Carbamazepine, see *Anticonvulsants*		
	Ritonavir	Increased risk of propoxyphene toxicity (seizures, respiratory depression, apnea, cardiac arrhythmias, pulmonary edema).	Avoid combination.

SEDATIVES/HYPNOTICS/AGENTS USED IN PSYCHIATRY

ANTIDEPRESSANTS			
MONOAMINE OXIDASE INHIBITORS (MAOIs)	Isocarboxazid, Phenelzine, Selegiline, Tranylcypromine		
Monoamine Oxidase (MAO) Inhibitors-class	Buproprion, *see Sedatives/Hypnotics/Agents used in Psychiatry, Antidepressants (Miscellaneous Antidepressants)*		
	Carbamazepine, see *Anticonvulsants*		
	Insulin, see *Hypoglycemic Agents*		
	Levodopa, see *Antiparkinson Agents*		
	Meperidine, see *Pain Medications (Narcotic)—MAO Inhibitors*		
	Serotonin Reuptake Inhibitors, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antidepressants)*		
	Sibutramine, see *Miscellaneous Agents*		
	Sulfonylureas, see *Hypoglycemic Agents*		
	Tricyclic Antidepressants, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antidepressants)*		
SEROTONIN REUPTAKE INHIBITORS	Citolapram, Escitalopram, Fluoxetine, Fluvoxamine, Nefazodone, Paroxetine, Sertraline, Venlafaxine		
Serotonin Reuptake Inhibitors-class	Clozapine, see *Sedative/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*— Serotonin Reuptake Inhibitors		
	Cyclosporine	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations. Decrease cyclosporine dose if necessary.
	Cyproheptadine	Decreased antidepressant effects of serotonin reuptake inhibitor.	Discontinue cyproheptadine if necessary.
	MAO Inhibitors [isocarboxazid, phenelzine, selegiline, ranylcypromine]	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination. Allow at least 2 weeks after stopping MAO inhibitor before starting serotonin reuptake inhibitor, and vice versa. Allow at least 5 weeks after stopping fluoxetine before starting MAO inhibitor.
	Sibutramine, see *Miscellaneous Agents*		
	Sympathomimetics [amphetamine, benzphetamine, dextroamphetamine, dexfenfluramine, diethylpropion, fenfluramine, mazindol, methamphetamine, phendimetrazine, phenmetrazine, phentermine]	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, monitor for signs/symptoms of CNS toxicity and adjust dose of one or both drugs as needed.
Tricyclic Antidepressants, Fluoxetine *(see also Serotonin Reuptake Inhibitors-class)*	see *Sedatives/Hypnotics/Agents used in Psychiatry (Antidepressants)- Serotonin Reuptake Inhibitors*		
	Carbamazepine, see *Anticonvulsants*		
	Phenytoin, see *Anticonvulsants (Hydantoins)*		
	Thioridazine, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*		
Fluvoxamine *(see also Serotonin Reuptake Inhibitors-class)*	Methadone, see *Pain Medications (Narcotic)-Protease Inhibitors*		
	Tacrine	Increased concentrations of tacrine.	Avoid combination if possible. Otherwise,

			monitor liver function tests. Use alternative serotonin reuptake inhibitor (eg, fluoxetine).
	Thioridazine, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*		
Paroxetine *(see also Serotonin Reuptake Inhibitors-class)*	Desipramine, see *Sedatives/Hypnotics/Agents used in Psychiatry, Antidepressants(Tricyclic Antidepressants)*		
	Imipramine, see *Sedatives/Hypnotics/Agents used in Psychiatry, Antidepressants (Tricyclic Antidepressants)*		
TRICYCLIC ANTIDEPRESSANTS (TCAs)		Amitriptyline, Amoxapine, Clomipramine, Desipramine, Doxepin, Imipramine, Nortriptyline, Protriptyline, Trimipramine	
Tricyclic Antidepressants-class	Carbamazepine, see *Anticonvulsants*		
	Cimetidine	Increased concentrations of tricyclic antidepressant.	Monitor tricyclic antidpressant concentrations. Adjust tricyclic antidepressant dose as needed when starting or stopping cimetidine. Use alternative histamine H2- antagonist (eg, ranitidine).
	Clonidine, see *Antihypertensive and Cardiovascular Agents, Adrenergic Modifiers*		
	Serotonin Reuptake Inhibitors [fluoxetine, fluvoxamine, paroxetine, sertraline]	Increased concentrations of tricyclic antidepressant. Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Monitor tricyclic antidepressant concentrations and for signs/symptoms of toxicity. Decrease tricyclic antidepressant dose if necessary.
	MAO Inhibitors [phenelzine, tranylcypromine]	Hyperpyretic crisis, seizures. May progress to death.	Avoid combination. Do not administer tricyclic antidepressant within 2 weeks of MAO inhibitor therapy.
	Rifamycins [rifabutin, rifampin]	Decreased concentrations of tricyclic antidepressant.	Monitor tricyclic antidepressant concentrations. Increase tricyclic antidepressant dose if necessary.
	Sparfloxacin	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
	Sympathomimetics [dobutamine, dopamine,. ephedrine, epinephrine, sympathomimetic mephentermine, metaraminol, methoxamine, norepinephrine, phenylephrine]	Increased pressor effects of direct-acting sympathomimetics. Decreased pressor effects of indirect-acting sympathomimetics.	Monitor for hypertension and dysrrhythmias. Adjust dose as needed.
	Valproic Acid [divalproex, valproate sodium, valproic acid] altered consciousness).	Increased concentrations of tricyclic antidepressant. Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus,	Monitor tricyclic antidepressant concentrations and for signs/symptoms of toxicity. Decrease tricyclic antidepressant dose if necessary.
MISCELLANEOUS ANTIDEPRESSANTS			
Bupropion	Carbamazepine	Decreased effects of bupropion.	Increase bupropion dose if necessary.
	MAO Inhibitors [phenelzine, tranylcypromine]	Increased risk of acute bupropion toxicity (seizures).	Avoid combination. Allow at least 2 weeks after stopping MAO inhibitor before starting bupropion.
	Ritonavir	Increased risk of bupropion toxicity.	Avoid combination.
Lithium	Angiotensing Converting Enzyme Inhibitors [benazepril captopril, enalapril, fosinopril, lisinopril, moexipril, quinapril, ramipril, trandolapril]	Increased concentrations of lithium.	Monitor lithium, concentrations and for signs/symptoms of toxicity.
	Angiotensin II Receptor Blockers [candesartan, eprosartan, irbesartan, losartan, olmesartan, telmisartan, valsartan]	Increased concentrations of lithium.	Monitor lithium concentrations and for signs/symptoms of toxicity.
	Carbamazepine	Increased risk of neurotoxicity(lethargy, ataxia, tremor, hyperreflexia). muscular weakness,	Monitor for signs/symptoms of toxicity. Discontine one or both drugs if necessary.
	Haloperidol, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antipsychotic Agents)*		
	Iodide Salts [calcium iodide, hydrogen iodide, iodide, iodinated glycerol, iodine, potassium iodide, sodium iodide]	Increased risk of hypothyroidism.	Avoid combination if possible. Otherwise, adminsiter thyroid hormone if necessary
	NSAIDs [diclofenac, ibuprofen, indomethacin, ketorolac,	Increased concentrations of lithium.	Monitor lithium concentrations. Adjust lithium dose as needed when starting or stopping NSAID.

	meloxicam, naproxen, piroxicam, sulindac]		
	Sibutramine, see *Miscellaneous Agents*		
	Thiazide Diuretics [bendroflumethiazide, benzthiazide, chlorothiazide, chlorthalidone, hydrochlorothiazide, hydroflumethiazide, indapamide, meloxicam, methyclothiazide, metolazone, polythiazide, quinethazone, sulindac, trichlormethiazide]	Increased concentrations of lithium.	Monitor lithium concentrations. Decrease lithium dose if necessary.
	Urinary Alkalinizers [potassium citrate, sodium acetate, sodium bicarbonate, sodium citrate, sodium lactate, tromethamine]	Decreased concentrations of lithium.	Avoid combination.

ANTIPSYCHOTIC AGENTS

Clozapine	Ritonavir	Increased concentrations of clozapine.	Avoid combination.
	Serotonin Reuptake Inhibitors [fluoxetine, fluvoxamine, sertraline]	Increased concentrations of clozapine.	Monitor clozapine concentrations. Decrease clozapine dose if necessary.
Haloperidol	Anticholinergics [atropine, belladonna, haloperidol benztropine, biperiden, clidinium, dicyclomine, glycopyrrolate, hyoscyamine, mepenzolate, methscopolamine, orphenadrine, oxybutynin, procyclidine, propantheline, scopolamine, trihexyphenidyl]	Decreased concentrations of haloperidol. Worsening of schizophrenic symptoms. Development of tardive dyskinesia.	Discontinue anticholinergic or increase dose if necessary.
	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased concentrations of haloperidol.	Adjust haloperidol dose as needed when starting or stopping azole antifungal.
	Carbamazepine	Decreased effects of haloperidol. Increased effects of carbamazepine.	Adjust dose of one or both drugs as needed.
	Lithium	Alterations in consciousness, encephalopathy, extrapyramidal effects, fever, leukocytosis, and increased serum enzymes.	Avoid combination if possible. Otherwise, discontinue one or both drugs andprovide supportive treatment if necessary.
	Rifamycins [rifabutin, rifampin]	Decreased effects of haloperidol.	Adjust haloperidol dose as needed when starting or stopping rifamycin.
PHENOTHIAZINES		Acetophenazine, Chlorpromazine, Fluphenazine, Mesoridazine, Methotrimeprazine, Perphenazine, Prochlorperazine, Promazine, Promethazine, Propiomazine, Thiethylperazine, Thioridazine, Trifluoperazine, Triflupromazine	
Phenothiazines-class	Anticholinergics [atropine, belladonna, benztropine, biperiden, clidinium, dicyclomine, glycopyrrolate, hyoscyamine, isopropamide, mepenzolate, orphenadrine, oxybutynin, oxyphencyclimine, procyclidine, ropantheline, scopolamine, trihexyphenidyl]	Decreased effects of phenothiazine.	Increase phenothiazine dose if necessary.
	Ethanol, see *Miscellaneous Agents*		
	Paroxetine	Increased effects of phenothiazine. Increased risk of life-threatening cardiac arrhythmias with thioridazine.	Avoid combination if possible (thioridazine is contraindicated). Adjust phenothiazine dose as needed.
	Propranolol, see *Antihypertensive and Cardiovascular Agents (Beta-Blockers)*		
	Sparfloxacin	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination. Use alternative quinolones (eg, ciprofloxacin, levofloxacin).
Chlorpromazine *(see also Phenothiazines-class)*	Meperidine, *see Pain Medications (Narcotic)—Phenothiazines*		

Propiomazine *(see also Phenothiazines-class)*	Meperidine, *see Pain Medications (Narcotic)—Phenothiazines*		
Thioridazine *(see also Phenothiazines-class)*	Antiarrhythmic Agents [amiodarone, bretylium, disopyramide, procainamide, quinidine, sotalol]	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination.
	Fluoxetine	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination.
	Fluvoxamine	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination.
	Pimozide	Increased risk of cardiac arrhythmias, including torsades de pointes.	Avoid combination.

SEDATIVES

BARBITURATES		Amobarbital, Aprobarbital, Butabarbital, Butalbital, Mephobarbital, Pentobarbital, Phenobarbital, Primidone, Secobarbital	
Barbiturates-class	Beta-Blockers, see *Antihypertensive and Cardiovascular Agents (Cardio-Selective and Noncardio-Selective Beta-Blockers)* Corticosteroids, see *Corticosteroids* Doxycycline, see *Antimicrobial Agents (Antibacterial Antibiotics - Tetracyclines)* Estrogens, see *Miscellaneous Agents* Ethanol, see *Miscellaneous Agents* Felodipine, see *Antihypertensive and Cardiovascular Agents (Calcium Channel-Blockers)* Griseofulvin, see *Antimicrobial Agents (Miscellaneous Antifungals)—Barbiturates* Methadone, see *Pain Medications (Narcotic)* Metronidazole, see *Antimicrobial Agents (Miscellaneous Antibacterial Antibiotics)* Nifedipine, see *Antihypertensive and Cardiovascular Agents (Calcium-Channel Blockers)* Quinidine, see *Antihypertensive and Cardiovascular Agents (Antiarrhythmic Agents)* Rifamycins [rifabutin, rifampin], see *Antimicrobial Agents (Antimycobacterial Agents)* Theophyllines, see *Bronchodilators* Voriconazole, see *Antimicrobial Agents (Azole Antifungals)—Barbiturates* Warfarin, see *Anticoagulants/Thrombolytics*		
BENZODIAZEPINES		Alprazolam, Chlordiazepoxide, Clonazepam, Clorazepate, Diazepam, Estazolam, Flurazepam, Halazepam, Lorazepam, Midazolam, Oxazepam, Quazepam, Temazepam, Triazolam	
Benzodiazepines, Oxidative Metabolism-class [alprazolam, chlordiazepoxide, clonazepam, clorazepate, diazepam, estazolam, flurazepam, halazepam, midazolam, quazepam, triazolam]	Azole Antifungals [fluconazole, itraconazole, ketoconazole, miconazole, voriconazole]	Increased concentrations of benzodiazepine. Prolonged CNS depression and psychomotor impairment.	Avoid combination if possible(alprazolam and triazolam are contraindicated with itraconazole and ketoconazole). Otherwise, decrease benzodiazepine dose.
	Diltiazem	Increased effects of benzodiazepine (diazepam, midazolam, triazolam). Prolonged sedation and respiratory depression.	Decrease benzodiazepine dose.
	Ethanol, see *Miscellaneous Agents*		
	Grapefruit Juice	Increased effects of benzodiazepine. Delayed onset of benzodiazepine effects.	Avoid combination.
	Macrolide Antibiotics [clarithromycin, erythromycin, troleandomycin] oxazepam,	Increased concentrations of benzodiazepine. Prolonged sedation and respiratory depression.	Decrease benzodiazepine dose if necessary. Use alternative benzodiazepine (eg, lorazepam, temazepam). Use alternative macrolide antibiotic (eg, azithromycin).
	Protease Inhibitors [indinavir, ritonavir, saquinavir]	Increased concentrations of benzodiazepine. Prolonged sedation and respiratory depression.	Avoid combination. Use alternative benzodiazepine (eg, lorazepam, oxazepam, temazepam).
	Ritonavir	Prolonged sedation and respiratory depression.	Substitute lorazepam, oxazepam, or temazepam.
Miscellaneous Sedatives			
Buspirone	Azole Antifungals [fluconazole, itraconazole, ketoconazole, miconazole, voriconazole]	Increased effects of buspirone.	Adjust buspirone dose as needed when starting, stopping, or changing dose of azole antifungal.
	Macrolide Antibiotics [clarithromycin, erythromycin, troleandomycin]	Increased effects of buspirone.	Adjust buspirone dose as needed when starting, stopping, or changing dose of macrolide antibiotic. Use alternative antibiotic if possible.
	Rifamycins [rifabutin, rifampin]	Decreased effects of buspirone.	Adjust buspirone dose as needed when starting, stopping, or changing dose of rifamycin.

Zolpidem	Ritonavir	Severe sedation and respiratory depression.	Avoid combination.

TRANSPLANT IMMUNOSUPPRESSANTS

Cyclosporine	Amiodarone	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
	Androgens [danazol, methyltestosterone]	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
	Azole Antifungals [fluconazole, itraconazole, ketoconazole]	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Adjust cyclosporine dose as needed when starting or stopping azole antifungal.
	Carbamazepine	Decreased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of organ rejection. Increase cyclosporine dose if necessary.
	Carvedilol	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
	Caspofungin	Increased concentrations of caspofungin. Elevated liver function test results.	Avoid combination if possible. Otherwise, monitor for signs/symptoms of hepatotoxicty. Discontinue caspofungin if necessary.
	Colchicine	Increased risk of cyclosporine toxicity (GI, hepatic, renal, neuromuscular).	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
	Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
	Diltiazem	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
	Etoposide	Increased concentrations of etoposide.	Monitor complete blood count for increased bone marrow suppression. Decrease etoposide dose if necessary.
	Foscarnet, see *Antimicrobial Agents (Antiviral Agents)*		
	Grapefruit Juice	Increased concentrations	Avoid combination unless of cyclosporine. specifically indicated.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of organ rejection. Increase cyclosporine dose if necessary.
	Imipenem/Cilastatin	Increased CNS adverse effects of both drugs (confusion, agitation, tremor).	Use alternative antibiotic if interaction develops.
	Lovastatin, see *Hypolipidemic Agents (HMG-CoA Reductase Inhibitors)*		
	Macrolide Antibiotics [azithromycin, clarithromycin, erythromycin, troleandomycin].	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Adjust cyclosporine dose as needed when starting or stopping macrolide antibiotic.
	Metoclopramide	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Adjust cyclosporine dose as needed when starting, stopping, or changing dose of metoclopramide.
	Nefazodone	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
	Nicardipine	Increased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
	Orlistat	Increased concentrations of cyclosporine.	Avoid combination.
	Probucol	Decreased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/ symptoms of organ rejection. Increase cyclosporine dose if necessary.
	Quinolones [ciprofloxacin, norfloxacin]	Increased risk of nephrotoxicity.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Use alternative quinolone (eg, levofloxacin).
	Rifamycins [rifabutin, rifampin]	Decreased concentrations of cyclosporine.	Avoid combination if possible. Otherwise, monitor cyclosporine concentrations and for

			signs/symptoms of organ rejection. Adjust cyclosporine dose as needed when starting, stopping, or changing dose of rifamycin.
	Serotonin Reuptake Inhibitors, see *Sedatives/Hypnotics/Agents used in Psychiatry (Antidepressants)*		
	Sirolimus, see *Transplant Immunosuppressants*		
	Sulfonamides [sulfadiazine, cyclosporine. trimethoprim/ sulfamethoxazole]	Decreased effects of sulfamethoxazole, Increased risk of nephrotoxicity with oral sulfonamides.	Avoid combination if possible. Otherwise, monitor cyclosporine concentrations and for signs/symptoms of organ rejection. Adjust cyclosporine dose as needed when starting, stopping, or changing dose of sulfonamide.
	Terbinafine	Decreased concentrations of cyclosporine.	Monitor cyclosporine concentrations and for signs/ symptoms of organ rejection. Adjust cyclosporine dose as needed when starting or stopping terbinafine.
	Verapamil .	Increased concentrations of cyclosporine. Possible nephroprotective effect if verapamil is adminstered before cyclosporine.	Monitor cyclosporine concentrations and for signs/symptoms of toxicity. Decrease cyclosporine dose if necessary.
Mycophenolate mofetil	Iron Salts, Oral [ferrous fumarate, ferrous gluconate, ferrous sulfate, iron polysaccharide]	Decreased effects of mycophenolate.	Separate administration times. Monitor clinical response and increase mycophenolate dose if necessary.
	Tacrolimus	Increased concentrations of mycophenolate.	Monitor mycophenolic acid levels. Adjust mycophenolate doses as needed when starting or stopping tacrolimus.
Sirolimus	Azole Antifungals [fluconazole, itraconazole, ketoconazole, voriconazole]	Increased concentrations of sirolimus.	Monitor sirolimus concentrations and for signs/symptoms of toxicity. Adjust sirolimus dose as needed when starting or stopping azole antifungal.
	Cyclosporine	Increased concentrations of sirolimus.	Administer sirolimus 4 hours after cyclosporine to prevent changes in sirolimus concentrations.
	Diltiazem	Increased concentrations of sirolimus.	Monitor sirolimus concentrations and for signs/symptoms of toxicity. Adjust sirolimus dose as needed when starting or stopping diltiazem.
Tacrolimus	Azole Antifungals [fluconazole, itraconazole, ketoconazole, miconazole, voriconazole]	Increased concentrations of tacrolimus.	Monitor tacrolimus concentrations and for signs/symptoms of toxicity. Adjust tacrolimus dose as needed when starting or stopping azole antifungal.
	Caspofungin	Decreased concentrations of tacrolimus.	Monitor tacrolimus concentrations. Adjust tacrolimus dose as needed when starting or stopping caspofungin.
	Diltiazem	Increased concentrations of tacrolimus.	Monitor tacrolimus concentrations and for signs/symptoms of toxicity. Decrease tacrolimus dose if necessary.
	Hydantoins [fosphenytoin, phenytoin]	Decreased concentrations of tacrolimus.	Monitor tacrolimus and phenytoin concentrations. Increased concentrations Adjust doses of one or both of phenytoin. drugs as needed.
	Macrolide Antibiotics [clarithromycin, erythromycin, troleandomycin]	Increased concentrations of tacrolimus.	Monitor tacrolimus concentrations and for signs/symptoms of toxicity. Adjust tacrolimus dose as needed when starting or stopping azole antifungal. Use alternative antibiotic.
	Mycophenolate mofetil, see *Transplant Immunosuppressants*		
	Nifedipine	Increased concentrations of tacrolimus.	Monitor tacrolimus concentrations and for signs/symptoms of toxicity. Decrease tacrolimus dose if necessary.
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased concentrations of tacrolimus.	Monitor tacrolimus concentrations. Adjust tacrolimus dose as needed when starting or stopping rifamycin.

VITAMINS

Folic acid	Phenytoin, see *Anticonvulsants*
Vitamin E (Tocopherol)	Warfarin, see *Anticoagulants/Thrombolytic Agents*
Vitamin K	Warfarin, see *Anticoagulants/Thrombolytic Agents* (Phytonadione)

MISCELLANEOUS AGENTS

Ergot Alkaloids [dihydroergotamine, ergotamine, methysergide}	Beta-Blockers [carteolol, nadolol, penbutolol, pindolol, propranolol, timolol]	Increased risk of ergot toxicity (peripheral ischemia, gangrene).	Discontinue beta-blocker or decrease ergot alkaloid dose if necessary.
	Macrolide Antibiotics [clarithromycin erythromycin, troleandomycin]	Acute ergotism (peripheral ischemia).	Avoid combination if possible. , Use alternative antibiotic. Discontinue one or both drugs if ergotism develops. Administer sodium nitroprusside to decrease macrolide-ergot induced vasopasm if necessary.
	Nitrates [amyl nitrite, isosorbide dinitrate, nitroglycerin]	Increased standing systolic blood pressure. Pharmacologic antagonism between dihydroergotamine and nitroglycerin may decrease antianginal effects of nitroglycerin	Decrease dihydroergotamine dose if necessary.
	NNRT Inhibitors [delavirdine, efavirenz] (peripheral ischemia, peripheral vasospasm).	Increased risk of ergot toxicity	Avoid combination.
	Protease Inhibitors [amprenavir, indinavir, nelfinavir, ritonavir, saquinavir]	Increased risk of ergot toxicity (peripheral ischemia, peripheral vasospasm).	Avoid combination.
	Sibutramine, see *Miscellaneous Agents*		
	Voriconazole	Increased risk of ergot toxicity (peripheral ischemia, peripheral vasospasm).	Avoid combination.
Estrogens [chlorotrianisene, conjugated estrogens, diethylstilbesterol, esterified estrogens, estradiol, estriol estrogenic substance, estrone, estropipate, ethinyl estradiol, mestranol, quinestrol]	Barbiturates [amobarbital, aprobarbital, phenobarbital, primidone, butabarbital, butalbital,mephobarbital, pentobarbital, secobarbital, thiamylal]	Decreased concentrations of estrogen.	Use alternative nonhormonal or additional method of contraception. Increase estrogen dose if necessary.
	Hydrocortisone, see *Corticosteroids*		
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased concentrations of estrogen. Possible loss of seizure control.	Use alternative nonhormonal or additional method of contraception. Increase estrogen dose if necessary.
	Methylprednisolone, see *Corticosteroids*		
	Prednisolone and Prednisone, see *Corticosteroids*		
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased concentrations of estrogen.	Use alternative nonhormonal or additional method of contraception. Increase estrogen dose if necessary.
Ethanol	Acetaminophen, see *Pain Medications (Non-Narcotic)*		
	Alfentanil	Increased tolerance to alfentanil with chronic ethanol ingestion.	Increase alfentanil dose if necessary.
	Barbiturates [amobarbital, butabarbital, butalbital, mephobarbital, pentobarbital, phenobarbital, primidone, secobarbital]	Additive CNS effects with acute ethanol ingestion (potentially fatal).	Avoid combination.
	Benzodiazepines [alprazolam, chlordiazepoxide, clorazepate, diazepam, estazolam, flurazepam, halazepam, lorazepam, midazolam, oxazepam, prazepam, quazepam, temazepam, triazolam]	Additive CNS effects with acute ethanol ingestion.	Avoid combination.
	Cephalosporins [cefamandole, cefoperazone, ceforanide, cefonicid, cefotetan moxalactam]	Disulfuram-like reaction.	Avoid combination.
	Chloral Hydrate	Additive CNS depression. Disulfiram-like reaction.	Avoid combination.

	Chlorpropamide, see *Hypoglycemic Agents (Sulfonylureas)*		
	Disulfiram	Flushing, tachycardia, bronchospasm, sweating, nausea, and vomiting. May progress to death.	Avoid combination.
	Furazolindone	Disulfiram-like reaction.	Avoid combination.
	Glutethimide	Additive CNS depression.	Avoid combination.
	Insulin, *see Hypoglycemic Agents*		
	Levothyroxine, see *Miscellaneous Agents*		
	Meprobamate	Increased CNS depression.	Avoid combination.
	Metronidazole	Disulfiram-like reaction.	Avoid combination.
	Phenothiazines [acetophenazine, chlorpromazine, fluphenazine, mesoridazine, perphenazine, prochlorperazine, promazine, promethazine, thioridazine, trifluoperazine, triflupromazine, trimeprazine]	Increased CNS depression and psychomotor impairment.	Avoid combination.
	Sulfonylureas [acetohexamide, chlorpropamide, glipizide, glyburide, tolazamide, tolbutamide]	Prolonged hypoglycemia. Disulfiram-like reaction when taken with chlorpropamide.	Avoid combination.
	Verapamil	Increased and prolonged CNS depression and psychomotor impairment.	Limit ethanol ingestion.
Levothyroxine	Cholestyramine	Decreased GI absorption of levothyroxine.	Separate administration times by at least 6 hours. Monitor thyroid function. Increase levothyroxine dose if necessary.
	Estrogens [conjugated estrogens, esterified estrogens, estradiol, estrone, estropipate, esthinyl estradiol, mestranol]	Decreased serum concentrations of free thyroxine. Increased serum concentrations of thyrotropin.	Monitor serum thyrotropin concentrations approximately12 weeks after starting estrogen. Adjust levothyroxine dose as needed.
	Iron Salts (Oral) [ferrous fumarate, ferrous gluconate, ferrous sulfate, iron polysaccharide]	Decreased GI absorption of levothyroxine.	Separate administration times. Monitor thyroid function. Increase levothyroxine dose if necessary.
	Sucralfate	Decreased GI absorption of levothyroxine.	Separate administration times by at least 8 hours. Monitor thyroid function. Increase levothyroxine dose if necessary.
	Theophylline, see *Bronchodilators (Theophyllines)—Thyroid Hormones*		
	Warfarin, see *Anticoagulants/Thrombolytic Agents—Thyroid Hormones*		
Metyrapone	Cyproheptadine	Decreased pituitary-adrenal to metyrapone.	Discontinue cyproheptadine response before testing pituitaryadrenal axis with metyrapone.
	Hydantoins [ethotoin, fosphenytoin, mephenytoin, phenytoin]	Decreased pituitary-adrenal response to metyrapone.	Consider doubling metyrapone dose when testing pituitary-adrenal axis function in patients on chronic hydantoin therapy.
	Quinine Digoxin, see *Antihypertensive and Cardiovascular Agents (Miscellaneous Antihypertensive and Cardiovascular Agents)*		
	Rifamycins [rifabutin, rifampin, rifapentine]	Decreased concentrations of quinine.	Monitor ECG and quinine concentrations. Increase quinine dose if necessary.
	Warfarin, see *Anticoagulants/Thrombolytic Agents*		
Sibutramine	Dextromethorphan	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, obtain medical treatment if serotonin syndrome develops.
	Ergot Alkaloids	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, obtain medical treatment if serotonin syndrome develops.
	Lithium	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, obtain medical treatment if serotonin syndrome develops.
	MAO Inhibitors [isocarboxazid, phenelzine, tranylcypromine]	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination. Allow at least 2 weeks after stopping MAO inhibitor before starting sibutramine, and vice versa.
	Meperidine	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, obtain medical treatment if serotonin syndrome develops.

Selective 5HT-1 Receptor Antagonists [almotriptan, naratriptan, rizatriptan, sumatriptan, zolmitriptan]	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, obtain medical treatment if serotonin syndrome develops.
Serotonin Reuptake Inhibitors [fluoxetine, fluvoxamine, nefazodone, paroxetine, sertraline, venlafaxine]	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, obtain medical treatment if serotonin syndrome develops.
Tryptophan	Increased risk of serotonin syndrome (CNS irritability, shivering, myoclonus, altered consciousness).	Avoid combination if possible. Otherwise, obtain medical treatment if serotonin syndrome develops.

Chapter 8.

INDIVIDUAL THERAPEUTICAL AGENTS

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Drug	Category	Dosage Forms	Dosage, Side Effects, Interactions, and Comments
Abacavir	Antiretroviral	Tab: 300 mg Oral soln: 20 mg/mL	300 mg bid in combination with other antiretroviral agents. Fatalhypersensitivity reactions, lactic acidosis.
Abciximab	Antiplatelet	Inj: 5 mg/10 mL	0.25mg/kg IVP, then 0.125 mcg/kg/min (max 10 mcg/min) for 12 hrs. Thrombocytopenia; possible anaphylaxis on re-exposure in 1 year.
Acarbose	Hypoglycemic	Tab: 50, 100 mg	Initially 25 mg (½ tab) tid, then 50-100 mg tid with first bite of each meal. Delays carbohydrate absorption modestly reduces glucose. Flatulence, bloating, diarrhea common.
Acebutolol	Antiarrhythmic Antihypertensive	Cap: 200, 400 mg	200 mg bid, increase up to 600 mg bid; cardioselective, intrinsic betaactivity; less bradycardia at rest.
Acetaminophen	Analgesic Antipyretic	Tab, cap: 160, 325, 500, 650mg Elixir: 325 mg/5 mL, 160 mg/5 mL, 120mg/5 mL Suppository: 120, 125, 325, 650 mg	325-650 mg (1-2 tab) tid-qid; overdose causes hepatotoxicity, renal failure.
Acetylcysteine	Antidote	Soln: 10, 20%	**Acetaminophen overdose:** Initially 140 mg/kg, then 70 mg/kg q4h orally x 17 doses. All 17 doses must be given, even if acetaminophen levels have declined to non-toxic range.
Acitretin	Antipsoriatic	Cap: 10, 25 mg	25-50 mg qd, full benefit in 2-3 months. Mandatory contraception, teratogenic, avoid alcohol and UV light exposure
Acyclovir	Antiviral	Tab: 400, 800 mg Cap: 200 mg Vial: 500, 1000 mg Susp: 200 mg/5 mL Oint: 5% (3, 5 gm)	**Herpes Simplex:** **Initial infection:** 200 mg five times a day or 400 mg tid for 10 days or **Recurrent infection:** 400 mg tid or 800 mg bid for 5 days **Severe infections or immunosuppressed:** 5 mg/kg IV q8h for 5-7 days **Suppressive therapy:** 400 mg bid. Gastrointestinal upset. **Herpes varicella/zoster:** **Immunocompetent patients**0 mg q4h (5 times a day) for 7 days **Severely immunosuppressed or ophthalmic zoster:** 10 mg/kg IV over 1 hour q8h; keep patient well-hydrated; lethargy, confusion, tremor. May cause meperidine toxicity. **Encephalitis:** 10 mg/kg IV over 1 hour, q8h x 14 days Adjust dose in renal failure, headache, rash. Apply to lesion 6 times daily x 7 days
Adalimumab	Immunomodulator (Rheumatoid Arthritis)	Inj: 40 mg/0.8 mL	40 mg SC every 14 days. Infection, injection site pain, erythenma.
Adapalene	Anti-acne	Topical gel: 0.1% [15, 45 gm]	Apply qhs after washing; photosensitizing; contraception mandatory; teratogenic
Adefovir	Antiviral	Tab: 10 mg	**Chronic Hepatitis B:** 10 mg qd. Nephrotoxic, rebound hepatitis upon discontinuation.
Adenosine (Adenocard)	Antiarrhythmic	Vial: 2 mL	6 mg IV push, then 12 mg x 2 doses; max 30 mg; theophylline and methylxanthines antagonize its effect.

Albumin (Albuminar)	Plasma expander	Soln: 25% [50, 100 mL] 5% [250, 500 mL]	50-100 mL of 25% soln IV, increases plasma oncotic pressure. 250-500 mL of 5% soln IV; contains 130-160 mEq sodium per liter
Albuterol (Proventil, Ventolin, Volmax)	Bronchodilator	Inhaler: [17 gm] Soln: 0.5% Repetabs: 4 mg Tab: 2, 4 mg Tab ER: 4, 8 mg	1-2 puffs bid-qid prn 0.5 mL in 2.5 mL NS q4-8h prn by nebulizer 4-8 mg sustained release tab bid 2-4 mg tid-qid; cardiac side effects, insomnia, anxiety. 1-2 tab bid.
Alefacept (Amevive)	Antipsoriatics	Inj: 7.5, 15 mg 15 mg IM (or 7.5 mg IV)	once weekly x 12; may repeat prn after 12 weeks of drug free period. Lymphopenia, serious infections, malignancies. Monitor CD 4+ T lymphocyte count before each dose.
Alendronate (Fosamax)	Anti- osteoporotic Bone stabilizer	Tab: 5, 10, 35, 40, 70 Mg	**Osteoporosis in post-menopausal women:** Treatment: 10 mg qd, or 70 mg weekly Prevention: 5 mg qd, or 35 mg weekly. Patients should not lie down for at least 30 minutes after taking the dose **Osteoporosis in men:** 10 mg qd **Paget's disease:** 40 mg qd x 6 months
Alfuzosin (UroXatral)	Prostatic relaxant	Tab: 10 mg 10 mg	PO qhs. Avoid concurrent use with P3A4 inhibitors.
Allopurinol (Zyloprim)	Antigout	Tab: 100, 300 mg Inj: 500 mg/vial	100-300 mg PO/IV qd; max 600 mg PO/IV qd. Rash, GI upset, hepatitis, marrow suppression.
Alprazolam (Xanax, Xanax XR)	Anxiolytic Panic disorders Mood stabilizer	Tab: 0.25, 0.5, 1, 2 mg Soln: 0.5, 1 mg/mL Tab XR: 0.5, 1, 2, 3 mg	0.25-0.5 mg tid; max 4 mg/day; decrease dosage in elderly; short acting, addictive. 0.5-1 mg qAm; max 6 mg qAm. Not for treatment of acute anxiety.
Aluminum acetate (PhosLo)	Phosphate binder	Tab: 667	1-3 tabs prior to meals. Binds to intestinal phosphate
Aluminum carbonate (Basaljel)	Antacid Phosphate binder	Tab and cap: 500 mg Susp: 400 mg/mL	1-2 tab or cap or 5-10 mL tid-qid
Aluminum hydroxide (Amphojel, Alucap, Alu-tab)	Antacid Phosphate binder	Tab: 300, 600 mg Cap: 475 mg Tab: 600 mg Susp: 320 mg/5 mL	1 tab tid-qid; may cause constipation 3 caps tid prior to meals 3 tabs tid 15-30 mL tid-qid prn
Amantadine (Symmetrel)	Antiparkinsonian Antiviral	Cap: 100 mg Syr: 50 mg/5 mL	200 mg qd or 100 mg bid; 100 mg qd in elderly; reduce in renal insufficiency. Confusion, anorexia, peripheral edema. Effective against influenza A.
Amcinonide (Cyclocort)	Topical corticosteroid	Cr: 0.1% [15, 30, 60 g] Lotion, oint: 0.1%	Apply to affected area(s) bid-tid
Amikacin (Amikin)	Antibiotic	Inj: 100, 500 mg/2 mL	7.5 mg/kg IV loading dose; then 5 mg/kg IV q8h; monitor serum levels. Nephrotoxic, ototoxic.
Aminophylline	Bronchodilator	Tab: 100, 200 mg Inj: 25 mg/mL	100-200 qid IV loading dose: 5.6 mg/kg (total weight) IV over 20-30 min, then 0.3- 0.9 mg/kg/h (ideal weight) IV infusion
Amiodarone (Cordarone)	Antiarrhythmic Class III	Tab: 200 mg Inj: 150 mg/3 mL amp	PO loading dose: 400 mg tid x 15-30 days, then 200-400 mg qd (5-10 mg/kg); pneumonitis when dose >400 mg/d; elevation of digoxin level, prolongation of prothrombin time (70-100%) with warfarin; pulmonary fibrosis, hepatitis, ocular opacities; proarrhythmic; monitor thyroid function, liver function tests 150 mg IV over 10 min, then 1 mg/min for 6 hrs, then 0.5 mg/min IV infusion(900 mg in 500 mL D5W).
Amitriptyline (Elavil, Endep)	Antidepressant	Tab: 10, 25, 50, 75, 100, 150 mg Inj: 10 mg/mL	50 mg qhs-bid, increase dose to 300 mg/d; may be given in single bedtime dose. Elderly: 10 mg tid; strong anticholinergic; urinary retention, sedation; serum levels may be monitored. 20-30 mg IM q6-8h
Amlodipine (Norvasc)	Calcium-blocker	Tab: 2.5, 5, 10 mg	2.5-10 mg qd
Amoxapine (Asendin)	Antidepressant	Tab: 25, 50, 100, 150 mg	50-100 mg bid-tid; max 400 mg/day; reduce dosage in elderly
Amoxicillin (Amoxil)	Antibiotic	Tab: 500, 875 mg Cap: 250, 500 mg	500-875 mg bid 250-500 mg q8h

Amphotericin B (Fungizone)	Antifungal	Inj powd:: 50 mg Susp: 100 mg/mL (24 mL) Cream: 3% [20 gm] Lotion: 3% [30 mL] Oint: 3% [20 gm]	Test dose of 1 mg over 60 min, gradually increase to 0.7 to 1 mg/kg/d in 500 mL of D5W over 4h for immunocompromised patients; 0.6-0.7 mg/kg/d for immunocompetent patients; monitor renal function, serum K and Mg. 100 mg po qid. Oral candidiasis; no systemic effect. Apply liberally to affected area bid-qid.
Amphotericin B, lipid-based (Abelcet, Amphotec, AmBisome)	Antifungal	Inj: 100 mg/20 mL Inj: 50 mg/vial Inj: 50 mg/vial	**Systemic**: 5 mg/Kg/day infuse over 2 hours. Lipid-based amphotericin B is less nephrotoxic. **Systemic**: 3-4 mg/Kg/day infuse over 3-4 hours. **Systemic**: 3-5 mg/Kg/day infuse over 2 hours. **Cryptococcal meningitis**: 6 mg/Kg/day infuse over 2 hours.
Amphotericin B liposomal (Abelcet)	Antifungal	Susp for inj: 5 mg/mL [20 mL/vial]	Dosage: 5 mg/kg IV qd over 2 hours; use in patients who are refractory to or intolerant to conventional amphotericin B. Less nephrotoxic; more expensive than amphotericin B.
Ampicillin (Omnipen, Principen)	Antibiotic	Inj: 125, 250, 500 mg Cap: 250, 500 mg	0.5-2 gm IV q4-6h 125-500 mg qid
Amprenavir (Agenerase)	Antiretroviral	Cap: 50, 150 mg Soln: 15 mg/mL	1200 mg bid. Diarrhea, rash, paraesthesias. Use with cisapride, diltiazem, amiodarone, or quinidine is contraindicated.
Anakinra (Kineret)	Antirheumatic	Inj: 100 mg	100 mg SC qd. Injection site reaction common.
Anistreplase (Eminase)	Thrombolytic	Vial: 30 U	**Myocardial Infarction:** 30 U IV over 2 min; pre-hospital use.
Ardeparin (Normiflo)	Anticoagulant LMW Heparin		Inj: 5000, 10,000 U **Prophylaxis:** 50 U/kg SC q12h
Aripiprazole (Abilify)	Antisychotic	Tab: 10, 15, 20, 30 mg	10-15 mg once daily, then max 30 mg qd. Reduce dose by half when used with quinidine, fluoxetine, or paroxetine.
Argatroban (Acova)	Anticoagulant	Inj: 250 mg/2.5mL	2 mcg/kg/min IV infusion (250 mg in 250 mL NS or D5W). Direct thrombin inhibitor for use in venous thrombosis. Hypotension, fever. No antidote available.
Aspirin (Bayer, Ecotrin, Easprin, Halfprin)	NSAID	Tab: 325 mg, 975 mg Tab SR: 800 mg Tab: 81, 165 mg	**Analgesia:** 325-650 mg qd-qid; max 12 tab day; may cause GI upset, peptic ulcer, bleeding **Antiplatelet:** One tab qd
Atazanavir (Reyataz)	Antiretroviral	Cap: 100, 150, 200 mg 400mg	PO once daily, **OR** atazanavir 300 mg plus ritonavir 100 mg plus efavirenz 600 mg once daily. Paresthesia, rash, nausea.
Atenolol (Tenormin)	Beta-blocker Antianginal	Tab: 25, 50, 100 mg Amps: 5 mg/10 mL	25-100 mg qd; contraindicated in heart failure, asthma, diabetes. Supraventricular tachycardia: 5-10 mg IV.
Atomoxetine (Strattera)	Psychotherapeutic	Cap: 10,18, 25, 40, 80 mg	**Attention Deficit Hyperactivity Disorder (ADHD):** 40-80 mg PO once daily. Hypertension, tachycardia, urinary retention. Atorvastatin (Lipitor) Antihyperlipidemic Tab: 10, 20, 40 mg 10 mg qhs then up to 80 mg qd. Lowers LDL and triglycerides.
Atovaquone (Mepron)	Antiprotozoal	Susp: 750 mg/5 mL	**Pneumocystis carinii pneumonia prevention:** 1500 mg po qd with food. **Pneumocystis carinii pneumonia treatment:** 750 mg po bid with food x 21 days.
Atracurium (Tracrium)	Neuromuscular blocker	Inj: 10 mg/mL	0.4-0.5 mg/kg IV push, then 0.08-0.1 mg/kg/hr.
Atropine	Anticholinergic	Inj: 1 mg/mL, 1 mg/10 mL	**Bradycardia or asystole**: 0.5 mg IV, repeat q5min, max 3mg
Auranofin (Ridaura)	Antirheumatic	Cap: 3 mg 6 mg	qd or 3 mg bid
Azatadine (Optimine) Azathioprine (Imuran)	Antihistamine Immunosuppressive	Tab: 1 mg Tab: 50 mg Inj: 100 mg	1-2 mg bid 1-2 mg/kg/d PO/IM in divided doses; max 2.5 mg/kg/d; GI intolerance, monitor blood count
Azelaic acid (Azelex)	Anti-acne	Cream: 20% [30 gm]	Apply to affected areas bid. Less irritating than tretinoin; equal efficacy, but more expensive.

Azelastine (Astelin)	Antihistamine, Antiallergic	Nasal spray: 17 mg/bottle [2 bottle pack]	2 sprays per nostril bid. Bitter taste.
Azithromycin (Zithromax)	Antibiotic	Cap: 250 mg [6 pack] Tab: 600 mg Susp: 100, 200 mg/5 mL Inj: 500 mg	500 mg x 1, then 250 mg qd x 4 days; increases theophylline levels. Prolongation of QT if taken with astemizole. **Mycoplasma avium complex prophylaxis:** 1200 mg once weekly **Chlamydia**: 1 gm PO once 500 mg IV q24h x 10-14 days; monotherapy for community-acquired pneumonia and pelvic inflammatory disease.
Aztreonam (Azactam)	Antibiotic	Vial: 0.5, 1, 2 gm	1-2 gm IV q6-8h; max 8 g/day; Gram negative bacilli only
Bacitracin (Bacitracin)	Antibiotic	Ophth oint: 500 U/g [1, 3.5 gm] Oint topical: 500 U/gm [1, 15, 30 gm]	Apply to affected area(s) qd-qid Apply to affected area(s) qd-qid prn
Baclofen (Lioresal)	Muscle relaxant	Tab: 10, 20 mg	10 mg tid, increase to a max of 80 mg/day.
Balsalazide (Colazal)	Ulcerative colitis	Cap: 750 mg	3 caps tid x 8 weeks. Headache, abdominal pain.
Beclomethasone Dipropionate (Beclovent, Beconase, Beconase AQ)	Corticosteroid	Aerosol: [16.8 gm] Nasal aerosol: [16.8 gm] Aqueous nasal spray: 0.042% [25 gm]	Two puffs tid-qid; oral thrush. One spray in each nostril bid-qid One spray in each nostril bid-qid
Benazepril (Lotensin)	ACE-inhibitor	Tab: 5, 10, 20, 40 mg	10-20 mg qd-bid; increase to 20-40 mg qd; max 80 mg/day; orthostatic hypotension, cough; hyperkalemia in renal failure.
Benzonatate (Tessalon)	Antitussive	Cap: 100, 200 mg	100-200 mg tid. Headache, dizziness, confusion.
Benzoyl peroxide	Anti-acne	Lotion: 5, 10% Liq: 5, 10% Gel: 2.5, 5, 10%	Apply to affected area(s) qd-bid; 10% is more irritating, but not more effective than 5%.
Benztropine (Cogentin)	Anticholinergic	Tab: 0.5, 1, 2 mg; inj: 1 mg/mL	**Extrapyramidal symptoms**: 1-2 mg IV/PO bid prn Bepridil (Vascor) Antianginal Tab: 200, 300, 400 mg Initially: 200 mg qd, max 400 mg qd; for unstable angina only; proarrhythmic, agranulocytosis.
Betamethasone (Celestone)	Corticosteroid	Tab: 0.6 mg	0.6-7.2 mg qd.
Betamethasone dipropionate augmented (Diprolene, Diprolene AF)	Corticosteroid	Gel, oint: 0.05% [15, 45 gm] Lotion: 0.05% [30, 60 mL] Cr: 0.05%	Apply to affected area(s) bid-qid
Betamethasone dipropionate (Diprolene, Diprosone, Maxivate)	Corticosteroid	Oint, Cr, lotion: 0.05% [15, 45 gm] Oint, lotion, aerosol: 0.1% [15, 45 gm]	Apply to affected area(s) qd-bid Apply to affected area(s) qd-tid
Betamethasone valerate (Valisone)	Corticosteroid	Cr, oint : 0.1% [15, 45 gm] Lotion: 0.1% [60 mL]	Apply to affected area(s) qd-tid
Betaxolol (Kerlone, Betoptic, Betoptic S)	Beta-blocker Antiglaucoma	Tab: 10, 20 mg Ophth soln: 0.5, 0.25% [2.5, 5, 10, 15 mL]	Initially: 10-20 mg qd, increase prn to a max of 40 mg qd. Elderly: Start with 5 mg qd. 1 drop in each eye bid; may cause bradycardia.
Bethanechol (Urecholine)	GI stimulant	Tab: 5, 10, 25, 50 mg	10-20 mg PO tid-qid, 1-2 hrs after meals. Abdominal cramps, diarrhea, urinary urgency, vasomotor responses, bronchial constriction.
Biperiden (Akineton)	Antiparkinsonian	Tab: 2 mg	2 mg tid-qid, max 8 tab/day
Bisacodyl (Dulcolax)	Laxative, irritant	Tab: 5 mg Suppository: 10 mg	10-15 mg qhs prn 10 mg PR prn
Bismuth subsalicylate (Pepto-Bismol)	Antidiarrheal	Tab: 162 mg Liq: 120, 240, 360, 480 mL	2 tab or 30 mL prn; max 8 doses per day.
Bisoprolol (Zebeta)	Antihypertensive	Tab: 5, 10 mg	2.5-10 mg qd; max 20 mg qd; cardioselective beta-blocker.
Bitolterol (Tornalate)	Bronchodilator	Aerosol: [15 mL]	2-3 puffs tid-qid prn
Bivalirudin (Angiomax)	Anticoagulant	Inj: 250 mg/vial	**PCI**: 1 mg/kg IVP, then 2.5 mg/Kg/hr cont inf x 4 hours. A dosage reduction may be required if used with a GP 2b/3a receptor blocker.
Bosentan (Tracleer)	Vasodilator	Tab: 62.5, 125 mg	**Pulmonary arterial hypertension:** 62.5-125 mg PO bid. Hepatotoxic,

			teratogenic. Lowers effectiveness of cyclosporin, glyburide, statins, and hormonal contraceptives.
Bretylium (Bretylol)	Antiarrhythmic	Class III Inj: 500 mg/10 mL	5-10 mg/kg IV over 5-10 min, then maintenance of 1-4 mg/min IV infusion.
Brinzolamide (Azopt)	Antiglaucoma	Ophth susp: 1% (10, 15 mL)	One drop tid. Bitter or sour taste, blurred vision.
Bromocriptine (Parlodel)	Parkinsonian agent	Tab: 2.5 mg Cap: 5 mg	**Parkinson's disease:** 1.25-2.5 mg bid with meals, increase prn to a max of 100 mg/day **Lactation suppression:** 2.5 mg bid x 14-21 days Nausea, vertigo, confusion, abnormal involuntary movements, hallucinations, depression; prevent pregnancy.
Budesonide (Rhinocort, Pulmicort Turbuhaler)	Glucocorticoid	Nasal spray: 32 mcg/spray Resp inh: 200mcg/spray	Two sprays in each nostril bid. 1-2 inhalations bid; max 4 inhalations bid.
Bumetanide (Bumex)	Diuretic	Tab: 0.5, 1, 2 mg Inj: 0.25 mg/mL	0.5-2.0 mg qAM 0.5-1 mg IV q2-3h until response; then 0.5-1.0 mg IV q8-24h.
Bupropion (Zyban, Wellbutrin, Wellbutrin SR)	Smoking deterrent Antidepressant	Tab: 150 mg Tab: 75, 100 mg Tabs SR: 100, 150, 200mg	150 mg qd x 3, then 150 mg bid x 7-12 weeks. Taper and stop smoking after 2 weeks; use with nicotine patch. Insomnia, impaired concentration, dry mouth. 100 mg bid; increase to 100 mg tid after 4 days; max 450 mg/day; useful if patient had sexual dysfunction with other antidepressants; agitation, dry mouth, insomnia, headache, tremor, contraindicated in seizures. 150-200 mg bid (max 450 mg/day)
Buspirone (BuSpar)	Anxiolytic	Tab: 5, 10, 15, 30 mg	5-10 mg bid-tid; start with 5 mg and increase to 15-25 mg day; max 60 mg/day; nonaddicting
Butenafine (Mentax) Butoconazole (Femstat)	Antifungal Antifungal	Cream 1%: [2, 15, 30 gm] Vaginal cream: 2% [28 gm]	Apply to affected areas once daily x 4 weeks One applicatorful intravaginally qhs for 3-6 nights; do not use in first trimester.
Butorphanol (Stadol, Stadol NS)	Narcotic analgesic Antimigraine	Inj: 1 mg/mL Nasal spray: 1 mg/spray [2.5 mL]	0.5-2 mg IV q3-4h; max 2 mg or 1-4 mg IM **Migraine headache:** 1 spray (in one nostril only). May repeat in 60-90 min, then q3-4h. Potential for addiction. Calcitonin (Miacalcin) Anti-osteoporotic Nasal spray: [2 mL] Inj: 200 IU/mL One spray (200 IU) per day in alternating nostrils; analgesic properties are useful in patients with arthritis. 100 IU SQ/IM qod-qd.
Calcitriol (Rocaltrol, Calcijex)	Vitamin D analog	Cap: 0.25, 0.5 mcg Oral soln: 1 mcg/mL Inj: 1, 2 mcg/mL	0.25-0.5 mcg qd 1-2 mcg SQ/IM 3 X weekly. Monitor Ca, phos, and PTH.
Calcium acetate (PhosLo)	Mineral	Tab: 667 mg	2-4 tab with each meal
Calcium carbonate (Tums, Os-cal, Caltrate 600, Oscal 500)	Mineral	Tab: 500, 600 mg; 1.5 gm	One tab qd-tid Recommend daily allowance: 1500 mg calcium/day Calcium chloride Mineral Inj: 10% [10 mL] 1-2 gm IV at 1 gm/hr (1 gm in 50 mL D5W or NS).
Calcium citrate (Citracal)	Mineral	Tab: 950 mg	One tab tid
Calcium gluconate	Mineral	Soln: 10% [10, 30 mL] Tab: 500, 650, 1,000 mg	1-2 gm IV at 1 gm/hr (1 gm in 50 mL D5W or NS). 500 mg-2 g in divided doses.
Candesartan (Atacand)	Angiotensin-II receptor blocker	Tab: 4, 8, 16 mg	8-16 mg qd-bid. Headache, dizziness.
Capsaicin (Zostrix, Zostrix-HP)	Topical analgesic	Cr: 0.025% [45, 90 gm] Cr: 0.075% [30, 60 gm]	Apply to affected area(s) tid-qid.
Captopril (Capoten)	ACE-inhibitor	Tab: 12.5, 25, 50, 100 mg	12.5-150 mg bid-tid; rash, proteinuria, cough, hyperkalemia in renal failure.
Carbamazepine	Anticonvulsant	Tab: 100, 200 mg	Initially: 200-400 mg bid; increase to max 1200 mg/day; bone marrow

(Tegretol, Tegretol-XR)		Chew tab: 100 mg Tab ER: 100, 200, 400 mg	suppression, monitor CBC, reticulocytes, and serum levels. Reduces the effect of oral contraceptives. Neurotoxicity with diltiazem. 200-400 mg po bid; max 1.2 g daily. **Trigeminal neuralgia**: 100 mg bid; titrate to 400 mg bid. Macrolide antibiotics elevate carbamazepine level.
Carisoprodol (Soma)	Muscle relaxant	Tab: 350 mg	350 mg tid-qid; sedation.
Carteolol (Cartrol)	Beta-blocker	Tab: 2.5, 5 mg	2.5-10 mg qd; intrinsic sympathomimetic activity.
Carvedilol (Coreg)	Alpha-1/beta Blocker	Tab: 3.125, 6.25, 12.5, 25 mg	**Congestive heart failure**: 3.125 mg po bid x 2 weeks, then double the dose q2weeks to 25 mg bid (50 mg bid if >85 kg); take with food. **Hypertension**: 6.25 mg po bid, then double the dose q1-2weeks to 25 mg bid.
Caspofungin (Cancidas)	Antifungal	Inj: 50, 70 mg	**Invasive aspergillosis**: 70 mg IV loading, then 50 mg IV q24h. Headache, increase ALT, AST. Concurrent use with cyclosporine is not recommended.
Cefaclor (Ceclor, Ceclor CD	Antibiotic	Cap: 250, 500 mg Tab ER: 375, 500 mg	250-500 mg tid; low bioavailability; serum sickness. 375-500 mg po bid.
Cefadroxil (Duricef, Ultracef)	Antibiotic	Cap: 500 mg Tab: 1000 mg	500-1000 mg bid.
Cefazolin (Ancef)	Antibiotic	Inj: 250, 500, 1,000 mg	0.5-2 gm IV/IM q8h.
Cefdinir (Omnicef)	Antibiotic	Cap: 300 mg Susp: 125 mg/5mL	300 mg bid x 10 days; for bronchitis, sinusitis; community-acquired pneumonia.
Cefepime (Maxipime)	Antibiotic	Inj: 0.5, 1, 2 gm	1 to 2 gm IV q12h for infections due to Pseudomonas, Klebsiella pneumoniae, Enterobacter sp. **Febrile neutropenia:** 2 gm q8h as monotherapy.
Cefixime (Suprax)	Antibiotic	Tab: 200, 400 mg	200 mg q12h or 400 mg qd **Gonorrhea**: 400 mg PO once.
Cefoperazone (Cefobid)	Antibiotic	Vial: 1, 2 gm	1-2 gm IV/IM q8-12h
Cefotaxime (Claforan)	Antibiotic	Vial: 1, 2 gm	1-2 gm IV/IM q4-6h
Cefotetan (Cefotan)	Antibiotic	Vial: 1, 2 gm	1-2 gm IV/IM q12h
Cefoxitin (Mefoxin)	Antibiotic	Vial: 1, 2 gm	1-2 gm IV/IM q6-8h
Cefpodoxime (Vantin)	Antibiotic	Tab: 100, 200 mg Susp: 50, 100 mg/5mL (100 mL)	**Community acquired pneumonia**: 200 mg bid **Bronchitis, pharyngitis**: 100 mg bid **Skin, skin structure**: 400 mg bid **Cystitis**: 100 mg bid **Gonorrhea**: 200 mg x 1
Cefprozil (Cefzil)	Antibiotic	Tab: 250, 500 mg	250-500 mg qd-bid
Ceftazidime (Fortaz)	Antibiotic	Vial: 0.5, 1, 2 gm	0.5-1 gm IV/IM q8h; max 12 gm/day
Ceftibuten (Cedax)	Antibiotic	Cap: 400 mg Susp: 90, 180 mg/5 mL	400 mg qd on an empty stomach. Gram-positive cocci and gramnegative bacilli activity. Inadequate for pneumococcal otitis.
Ceftizoxime (Cefizox)	Antibiotic	Vial: 1, 2 gm	1-2 gm IV/IM q8h
Ceftriaxone (Rocephin)	Antibiotic	Vial: 250, 500 mg; 1, 2 gm	1-2 gm IV/IM q12-24h; delayed action because highly bound to serum proteins **Gonorrhea**: 250 mg IM x 1
Cefuroxime axetil (Ceftin)	Antibiotic	Tab: 125, 250, 500 mg	250-500 mg bid; max 4 g/day
Cefuroxime sodium (Zinacef)	Antibiotic	Vial: 0.75, 1.5, 7.5 gm	0.75-1.5 gm IV/IM q8h for 5-10 days
Celecoxib (Celebrex)	COX-2 inhibitor	Cap: 100, 200 mg	100-200 bid. Slightly less effective than NSAIDS. Abdominal pain, diarrhea; less GI ulceration than NSAIDS. No effect on platelet

			aggregation.
Cephalexin (Keflex)	Antibiotic	Cap: 250, 500 mg	250-500 mg q6h
Cephapirin (Cefadyl)	Antibiotic	Vial: 500 mg, 1, 2, gm	500 mg-1 gm IV q4-6h
Cephradine (Velosef)	Antibiotic	Cap: 250, 500 mg	250-500 mg q6h
Cetirizine (Zyrtec)	Antihistamine	Tab: 5, 10 mg Syr: 1 mg/mL	**Allergic rhinitis or urticaria**: 5-10 mg qd; non-sedating; arrhythmias have not been reported with macrolides, fluconazole, or ketoconazole.
Cevimeline (Evoxac)	Mouth and throat	Cap: 30 mg	30 mg PO tid for xerostomia in Sjögren's Syndrome. Cholinergic effects including sweating, bradycardia, blurred vision, vomiting.
			Charcoal, activated with sorbitol Antidote Susp: 25 gm/120 mL 50-100 gm x 1 after GI lavage; in tricyclic antidepressant or phenothiazine overdose continue 50g q6h until drug level non-toxic. Keep patient's head at 45 degree angle to prevent aspiration.
Chloral hydrate (Noctec)	Sedative	Cap: 250, 500 mg	Sleep: 500 mg qhs
Chloramphenicol (Chloromycetin)	Antibiotic	Inj: 1 gm Ophth oint: 10 mg/gm [3.5gm] Ophth soln: 5 mg/mL	0.5-1 gm IV q6h. Monitor levels and reticulocyte count. Apply tid-qid 1-2 drops q4-6h
Chlordiazepoxide (Librium, Libritabs)	Anxiolytic	Cap: 5, 10, 25 mg Tab: 5, 10, 25 mg Inj: 100 mg/amp	5-25 mg tid-qid. Prevention of alcohol withdrawal: 50-100 mg PO/IV/IM q6h x 72 hours. 25-100 mg IM/IV q4-6h
Chlorothiazide (Diuril)	Diuretic	Tab: 250 mg Inj: 500 mg/vial	250 mg bid 500 mg IV over 30 min qd-bid
Chlorpromazine (Thorazine)	Antipsychotic	Tab: 10, 25, 50, 100, 200mg Inj: 25 mg/mL Syr: 10 mg/5 mL [120 mL] Suppository: 25, 100 mg	10-100 mg PO/IM bid-qid; sedation, extrapyramidal symptoms common; alpha-adrenergic blocking effects. 25-100 mg PR q6-8h prn
Chlorzoxazone (Parafon, Paraflex)	Muscle relaxant	Tab: 250 mg Cap: 500 mg	250-750 mg tid-qid
Cholestyramine (Cholybar, Questran, Questran Light)	Antihyperlipidemic	Chewable bar: 4 gm Powder: 4 gm	4 gm bar bid with meals; up to 6 times daily; max 36 gm/day. 1 scoop or packet in cold beverage or applesauce bid before meals; increase gradually prn, up to 3 packets or scoops bid. Lowers LDL cholesterol; levothyroxine, warfarin, digoxin, diuretics should not be taken within 1 hour because of decreased absorption. May reduce effect of warfarin.
Choline magnesium salicylate (Trilisate)	Analgesic Antiinflammatory	Tab: 500, 750, 1000 mg	500-1500 mg bid
Cidofovir (Vistide)	Antiviral	Inj: 75 mg/mL	**Cytomegalovirus retinitis:** 5 mg/kg q week x 2 weeks, then biweekly; contraindicated in renal insufficiency. Coadminister with oral probenecid; nephrotoxic.
Cilostazol (Pletal)	Anti-claudicant	Tab: 50, 100 mg	100 mg bid. Reduce dose to 50 mg bid if taking azoles, macrolides, diltiazem, or omeprazole. Headache, palpitations, diarrhea. Contraindicated in class III-IV congestive heart failure
Cimetidine (Tagamet)	H2-blocker	Tab: 200, 300, 400, 800mg Liq: 300 mg/ 5 mL Inj: 300 mg/2 mL	**Initial dose**: 400 mg bid or 800 mg qhs. Increases theophylline level. **GERD**: 800 mg bid or 400 mg qid. **Maintenance:** 400 mg qhs; can cause confusion in elderly and in renal failure. 300 mg IV q6-8h or 900-1200 mg in 250 mL D5W at 11 mL/hr
Ciprofloxacin (Cipro, Ciloxan, Cipro Cystitis Pack, Cipro XR)	Antibiotic	Tab: 100, 250, 500, 750mg Inj: 200, 400 mg Ophth soln: 0.3% [2.5, 5mL] Tab: 100 mg [6] Tab ER: 500 mg	100-750 mg PO bid x 7-14 days; GI upset; contraindicated in pregnancy, seizure disorder, or <16 years of age; increases theophylline level; poor coverage for S pneumonia. 200-400 mg IV q12h 1-2 drops in affected eye(s) q2-4h 100 mg bid x 3 days. Acute uncomplicated cystitis in women. 500 mg q24h x 3 days for acute cystitis.
Cisapride (Propulsid)	GI stimulant	Tab: 10, 20 mg	10-20 mg qid; 15-30 min before meals and qhs. Fatal QT prolongation

		Susp: 1 mg/mL	may occur when used alone or in combination with azole antifungals or macrolides. Contraindicated in CHF, COPD, and multiple organ failure.
Cisatracurium (Nimbex)	Neuromuscular blocker	Inj: 2 mg/mL	0.15 mg/kg IV, then 0.3 mcg/kg/min IV infusion; titrate between 0.5-1.0 mcg/kg/min. Intermediate acting, Hoffman elimination.
Citalopram (Celexa)	Antidepressant	Tab: 10, 20, 40 mg	Oral soln: 10 mg/5 mL 20 mg qd; max 40 mg qd. SSRI. Male sexual dysfunction.
Clarithromycin (Biaxin, Biaxin XL)	Antibiotic	Tab: 250-500 mg Susp: 125, 250 mg/5 mL Tab ER: 500 mg	250-500 mg bid; increases theophylline. 2 tabs qd with food x 7 days
Clemastine (Tavist 1, Tavist)	Antihistamine	Tab: 2.68 mg Tab: 1.34 mg Syr: 0.5mg/5mL	One tab bid-tid; max 3 tabs/day 1.34 mg bid
Clindamycin (Cleocin, Cleocin-T)	Antibiotic	Cap: 75, 150, 300 mg Cream vag: 2% [40 gm] Gel, soln: 10 mg/mL [7.5, 30 gm] Inj: 150 mg/mL	150-450 mg qid One applicatorful intravaginally qhs x 7 days Apply to affected area(s) bid 600-900 mg IV q8h; diarrhea, pseudomembranous colitis.
Clofazimine (Lamprene)	Tuberculostatic	Cap: 50, 100 mg	50-200 mg qd; take with meals; may discolor skin (pink to brownish black); may cause skin dryness, GI intolerance.
Clomipramine (Anafranil)	Antipsychotic	Cap: 25, 50, 75 mg	25 mg qhs, increase to 100 mg/day; sedation, anticholinergic,seizures. Also used for obsessive-compulsive disorder.
Clonazepam (Klonopin)	Anxiolytic/ Anticonvulsant	Tab: 0.5, 1, 2 mg	0.5-2 mg qd-tid; useful in anoxic seizures.
Clonidine (Catapres, Catapres-TTS, Duraclon)	Antihypertensive	Tab: 0.1, 0.2, 0.3 mg Transdermal: 0.1 mg/24h, 0.2 mg/24h, 0.3 mg/24h	0.1-0.4 mg bid-tid; max 2.4 mg/day 0.1-0.3 mg/24h; apply new patch every 7 days; onset of effect requires 3 days; sedation, rebound hypertension.
Clofazimine (Lamprene)	Tuberculostatic	Cap: 50, 100 mg	50-200 mg qd; take with meals; may discolor skin (pink to brownish black); may cause skin dryness, GI intolerance.
Clomipramine (Anafranil)	Antipsychotic	Cap: 25, 50, 75 mg	25 mg qhs, increase to 100 mg/day; sedation, anticholinergic, seizures. Also used for obsessive-compulsive disorder.
Clonazepam (Klonopin)	Anxiolytic/ Anticonvulsant	Tab: 0.5, 1, 2 mg	0.5-2 mg qd-tid; useful in anoxic seizures.
Clonidine (Catapres, Catapres-TTS Duraclon)	Antihypertensive Analgesic	Tab: 0.1, 0.2, 0.3 mg Transdermal: 0.1mg/24h, 0.2 mg/24h, 0.3 mg/24h Inj:500 mcg/mL	0.1-0.4 mg bid-tid; max 2.4 mg/day 0.1-0.3 mg/24h; apply new patch every 7 days; onset of effect requires 3 days; sedation, rebound hypertension. 30 mcg/hr cont epidural infusion or 75-150 mcg epidural over 5 min. Clopidogrel (Plavix) Antiplatelet Tab: 75 mg 75 mg qd; irreversibly binds to platelets; neutropenia 0.04%.
Clorazepate (Tranxene, Tranxene-SD)	Anxiolytic	Tab: 3.75, 7.5, 15 mg Tab: 22.5 mg	3.75-15 mg tid One tab qd
Clotrimazole (Gyne-Lotrimin, Lotrimin, Mycelex)	Antifungal	OTC Cream vag: 1% [45, 90 gm] Tab vag: 100, 500 mg Cream: 1% [15, 30, 45, 90 gm] Troches: 10 mg	One applicatorful intravaginally qhs x 7days. 2 tab intravaginally qhs for 3 days or 500 mg qhs, single dose. Apply to affected area bid for up to 4 wk. **Oropharyngeal fungal infections**: One troche 5 times daily. Clozapine (Clozaril) Antipsychotic Tab: 25, 100 mg 25 mg qd-bid, increase by 25-50 mg/day to 350-450 mg/day; max 900 mg/day; monitor CBC; agranulocytosis; drowsiness, seizures.
Codeine	Narcotic analgesic Antitussive	Tab: 15, 30, 60 mg	15-60 mg q4-6h prn pain 10-20 mg q4-6h prn cough
Colchicine	Antigout	Tab: 0.5, 0.6 mg Inj: 1 mg	0.5-0.6 mg bid; caution in renal impairment; GI upset, diarrhea. 0.5-1 mg IV qd-bid
Colesevelam (Welchol)	Antihyperlipidemic	Tab: 625 mg	3 tabs bid or 6 tabs qd with meals alone or in combination with statins. Bile acid sequestrant. Constipation, abd pain and cramping.

Colestipol (Colestid)	Antihyperlipidemic	Granules: 5 gm/pkt Tab: 1 gm	Initially: 5 gm qd-bid with liquid; max 30 gm/day; 4 hour interval between other medications. Lowers LDL cholesterol. 2 gm PO qd-bid initially. Usual maintenance 2-8 gm bid.
Cosyntropin (Cortrosyn)	Hormone	Inj: 250 mcg	250 mcg/IVP/IM x 1. Obtain cortisol level just before and 60 minutes after for assessment of adrenal insufficiency.
Cromolyn (Intal, Nasalcrom, Opticrom, Gastrocrom)	Antiasthma Mast cell stabilizer	Intal aerosol: 800 mcg/puff [8.1, 14.2 gm] Inhaler cap: 20 mg Nebulizer soln: 20 mg/2mL Nasalcrom nasal spray: 5.2 mg [13 mL] Opticrom ophth soln: 4% [2.5, 10 mL] Gastrocrom cap: 100 mg	2 puffs qid; prophylactic agent; several days required for effect; may cause bronchospasm. One cap inhaled qid Inhale 2 mL qid 1 spray in each nostril tid-qid 1-2 drops in each eye qid 200 mg PO qid, 30 min before meals and at bedtime.
Cyanocobalamin (Vitamin B-12)	Vitamin	Tab: 500-1000 mcg Inj: 30, 100, 1000 mcg/mL	500-1000 mcg/day 30 mcg IV/IM/SQ qd x 5-10 days, then 1000 mcg /month; peripheral neuropathy at high doses.
Cyclobenzaprine (Flexeril)	Muscle relaxant	Tab: 10 mg	10 mg tid; sedative, anticholinergic effects
Cycloserine (Seromycin)	Tuberculostatic	Cap: 250 mg	250-500 mg bid. Neurotoxic, CHF. Pyridoxine 100 mg bid to prevent neurotoxicity.
Dalteparin (Fragmin)	Anticoagulant	LMW heparin Inj: 2500, 5000, 10,000 IU	**Prophylaxis:** 2500-5000 IU SC qd. **Venous thrombosis:** 100 IU/kg SC q12h or 200 IU/kg SC qd. **Acute coronary syndrome:**120 IU/kg (max 10,000 u) SC q12h.
Danaparoid (Orgaran)	Anticoagulant	LMW heparin Inj: 750 units/0.6 mL replacement.	750 units SQ bid x 7-14 days after hip **DVT and PE prophylaxis:** 750 units SC 12h x 7-14 days. May be used in patients with heparin-induced thrombocytopenia. Danazol (Danocrine) Antiestrogenic Cap: 50, 100, 200 mg 100-400 mg bid
Dantrolene (Dantrium)	Muscle relaxant	Cap: 25, 50, 100 mg Powd for Inj: 20 mg.	25 mg qd; increase by 25 mg per week to max 400 mg day in divided doses. 1 mg/kg/h IV for up to 10 hours
Dapsone	Antiprotozoal	Tab: 25, 100 mg	**P. carinii pneumonia prophylaxis**: 50 mg bid or 100 mg twice/week or 200 mg once/week
Daptomycin (Cubicin)	Antibiotic	Inj: 250, 500 mg	4 mg/kg IV q24h for treatment of skin infections, including MRSA, and vancomycin-susceptible Enterococcus faecalis.
Darbepoetin (Aranesp)	Erythrocyte Stimulating factor	Inj: 25, 40, 60, 100, 150, 200, 300, 500 mcg/mL	0.45 mcg/kg IV/SC once weekly. Avoid if hemoglobin >12 6/dL. Seizures, HTN, thrombotic events.
Delavirdine (Rescriptor)	Antiviral (HIV-1)	Tab: 100 mg	4 tabs tid. Non-nucleoside reverse transcriptase inhibitor.
Desipramine (Norpramin)	Antidepressant	Tab: 10, 25, 50, 75, 100, 150 mg	25-200 mg qhs or 25-150 mg bid; anticholinergic effects.
Desirudin (Iprivask)	Anitcoagulant	Inj: 15 mg	**Deep venous thrombosis prophylaxis:** 15 mg SC q12h. Adjust dose for azotemia.
Desloratadine (Clarinex)	Antihistamine	Tab: 5 mg	5 mg once daily. Nonsedating.
Dexamethasone (Decadron)	Corticosteroid	Tab: 0.25, 0.5, 0.75, 1, 1.5, 2, 4, 6 mg Inj : 4, 10, 20 mg/mL Ophth soln: 0.1% [5 mL]	0.25-6 mg q6h 4-10 mg IV q6h 1-2 drops in each eye q4-6h

Dexmedetomidine (Precedex)	Sedative, hypnotic	Inj: 100 mcg/ML	Loading 1mcg/kg over 10 min, then 0.2-0.7 mcg/kg/hr. Titrate to level of sedation while on mechanical ventilator. Hypotension, bradycardia. Half-life 2 hrs.
Dexmethylphenidate (Focalin)	Stimulant	Tab: 2.5, 5, 10 mg	2.5-5 mg bid; max 10 mg bid. Abdominal pain, anorexia, nausea.
Dextromethorphan (Benylin DM, Delsym)	Antitussive	Syr: 10 mg/5 mL [120, 240mL] Liq SR: 30 mg/5 mL [90mL]	10-30 mg q4-8h; max 120 mg/24 hrs 10 mL q12h
Diazepam (Valium, Diastat)	Anxiolytic Anticonvulsant	Tab: 2, 5, 10 mg Inj: 5 mg/mL Rectal gel: 10, 15, 20 mg	2-10 mg bid-qid **Seizures**: 5-10 mg slow IV q10-15 min; max 30 mg. **Sedation**: 2-5 mg IV q3-4h **Seizures**: 10-20 mg PR as an alternative to inj if IV line unavailable.
Diclofenac (Voltaren, Voltaren XR, Solaraze)	NSAID Antiallergic Keratolytic	Tab: 25, 50, 75, 100 mg Tab ER: 100 mg Ophth soln: 0.1% [2.5, 5 mL] Gel: 3% (25, 50 gm)	25-75 mg tid-qid; GI upset **Osteoarthritis**: 100 mg PO qd; max 200 mg/d **Rheumatoid arthritis**: 100 mg PO qd; max 100 mg bid Instill 1 drop into the affected eye(s) qid; allergic conjunctivitis. Apply to lesions bid. Avoid sun, skin hypertrophy, paresthesia.
Dicloxacillin (Dynapen)	Antibiotic	Cap: 125, 250, 500 mg	125-500 mg q6h; antistaphylococcal penicillin
Dicyclomine (Bentyl)	Antispasmodic	Cap: 10, 20 mg Tab: 20 mg	Initially, 20 mg qid; anticholinergic One tab qid
Didanosine, DDI (Videx)	Antiretroviral	Tab: 25, 50, 100, 150 mg Powd: 100, 167, 250, 375 mg	>60 kg: 200 mg (two 100-mg tablets) bid or 250 mg of powder bid <60 kg: 125 mg (100 mg tablet plus a 25-mg tablet) bid or 167 mg of powder bid; reduce in renal failure; diarrhea, peripheral neuropathy, pancreatitis
Diflunisal (Dolobid)	Analgesic	Tab: 250, 500 mg	250-500 mg q8-12h prn
Digoxin (Lanoxicaps, Lanoxin)	Inotrope Antidysrhythmic	Cap: 0.05, 0.1, 0.2 mg Tab/inj : 0.125, 0.25, 0.5 mg	0.05-0.2 mg qd Loading dose: 0.5 mg PO/IV, then 0.25 mg PO/IV q4h x 2 doses. Maintenance dose: 0.125-0.25 mg PO/IV qd; low potassium or magnesium levels potentiate toxicity; reduce dose in renal failure; toxicity indicated by nausea, headache, visual disturbances (yellowgreen halos), ventricular arrhythmias. Quinidine, verapamil, and amiodarone elevate digoxin level.
Digoxin immune (Digibind)	Digoxin-binding Antidote	Vial: 40 mg	Dosage: (number of 40 mg vials) = $\frac{\text{Digoxin level x body weight (kg)}}{100}$ 100-150 mL of NS IV over 15-30 minutes; use 0.22 micron in-line filter; anaphylaxis.
Dihydroergotamine (DHE45, Migranal)	Antimigraine	Inj: 1 mg/mL Nasal spray kit	1 mg IM or 2 mg IV; max 6 mg per week One spray in each nostril, may repeat in 15 min; max 6 sprays in 24h; rhinitis, nausea, altered sense of taste.
Diltiazem (Cardizem)	Calcium-blocker	Tab: 30, 60, 90, 120 mg Cap SR: 60, 90, 120 mg Cap CD: 120,180, 240, 300, 360 mg Inj: 25, 50 mg/mL	30-120 mg tid-qid; contraindicated in atrioventricular block, hypotension. 60-120 mg bid 120-360 mg qd **Rate control in atrial fibrillation or flutter**: 0.25 mg/kg (20 mg) IVP over 10 min; then 5-15 mg/hr IV infusion; may repeat bolus with 0.35 mg/kg x 1.
Diphenhydramine (Benadryl)	Antihistamine (OTC)	Cap: 25, 50 mg Inj: 10, 50 mg/mL	25-50 mg tid-qid; anticholinergic, dry mouth, urinary retention 25-50 mg IV/IM; max 400 mg/dose
Diphenoxylate (Lomotil)	Antidiarrheal	Tab: 2.5 mg Liq: 2.5 mg/5 mL [60 mL]	2.5-5.0 mg q4-6h prn; max 30 mg per day; contraindicated in acute diarrhea
Dipyridamole (Persantine)	Antiplatelet	Tab: 25, 50, 75 mg	75-100 mg tid-qid; nausea, vomiting

Disopyramide (Nor-pace, Norpace CR)	Antidysrhythmic Class IA	Cap: 100, 150 mg Cap CR: 100, 150 mg	100-300 mg tid-qid 100-300 mg bid; may induce heart failure.
Dirithromycin (Dynabac)	Antibiotic Macrolide	Tab: 250 mg	Two tabs once daily x 7-14 days.
Disulfiram (Antabuse)	Anti-alcoholic	Tab: 250, 500 mg	250-500 mg qd; max 500 mg/day; monitor blood count, liver function.
Divalproex (Depakote Depakote ER)	Anticonvulsant Antimigraine Mood stabilizer	Delayed-rel tab: 125, 250, 500 mg Sprinkle capsules: 125 mg Tab ER: 500 mg	**Epilepsy**:250-500 mg tid-qid; monitor serum levels; hepatotoxic, pancreatitis. **Mania**: 250 mg tid, titrate to max 60 mg/kg/day in 3 divided doses. **Migraine prophylaxis:** 250 mg bid for 3 days, then 500 mg bid. 500-1000 mg once daily.
Dobutamine (Dobutrex)	Inotrope	Inj: 250 mg	2.5-10 mcg/kg/min IV infusion; max of 14 mcg/kg/min
Docosanol (Abreva)	Antiviral	CR: 10% (2gm)	Apply to affected areas x 10 days. Recurrent herpes labialis.
Docusate (Colace)	Stool softener	Tab: 100 mg	100 mg qd-tid
Dofetilide (Tikosyn)	Antiarrhythmic (class III)	Caps: 125, 250, 500 mcg	500 mcg bid if creatinine clearance > 60 ml/min, 250 mcg bid if Ccr 40-60 ml/min, 125 mcg bid if Ccr 20-39 ml/min. Contraindicated if Ccr < 20 ml/min, QTc > 440 mSec, or concomitant use with verapamil, cimetidine, trimethoprim, or ketoconazole. Reduce dose by 50% if the QTc > 440 mSec or increases by > 15% after the first dose. Dose-related QT prolongation. Does not reduce contractility.
Donepezil (Aricept)	Alzheimer's agent	Tabs: 5, 10 mg	5 mg qhs x 4-6 weeks, then 10 mg qhs. Less hepatotoxic than tacrine.
Dopamine (Intropin)	Inotrope	Vial: 200 mg/5 mL, 400 mg/5 mL, 800 mg/5 mL	**Renal perfusion dose:** 1-3 mcg/kg/min (dopaminergic range) **Cardiac inotropic dose:** 5-10 mcg/kg/min (beta-adrenergic) **Vasoconstricting dose:** >10 mcg/kg/min (alpha-adrenergic)
Dorzolamide (Trusopt)	Antiglaucoma	Ophth soln: 2% (5, 10 mL)	One drop tid. Bitter taste, photophobia.
Doxapram (Dopram)	CNS stimulant	Inj: 20 mg/mL	1 mg/min IV infusion; titrate to 2-3 mg/min to correct hypercapnia; tremors, anxiety.
Doxazosin (Cardura)	Antihypertensive Prostate relaxant	Tab: 1, 2, 4, 8 mg	**Initially:** 1 mg qhs, then 2 mg/day, then increase as indicated to 10 mg day; max 20 mg/day. **Benign prostatic hyperplasia:** 1-2 mg qhs; orthostatic hypotension initially; more effective than finasteride.
Doxepin (Adapin, Sinequan)	Antidepressant Antihistamine	Cap: 10, 25, 50, 75, 100, 150 mg Cream: 5% [30 gm]	10-150 mg qhs; max 300 mg/day; anticholinergic, sedation, orthostatic hypotension; potent antihistamine. Apply thin layer qid
Doxycycline (Vibramycin, Periostat)	Antibiotic	Cap: 50, 100 mg Powd for inj: 100, 200 mg Cap: 20 mg	100 mg bid; photosensitizing, hepatotoxic. 100 mg IV q12h 20 mg bid up to 9 months following scaling and root planning.
Dronabinol (Marinol)	Antiemetic Appetite stimulant	Tab: 2.5, 5, 10 mg	2.5 mg PO bid, before lunch and dinner; up to 10 mg bid. Anticholinergic effects.
Droperidol (Inapsine)	Antiemetic	Inj: 2.5 mg/mL	0.625-2.5 mg IV/IM q3-4h prn. 0.625-2.5 mg IV/IM q3-4h prn.
Econazole (Spectazole)	Topical antifungal	Cream: 1% [15, 30, 85 gm]	Apply to affected area once daily
Efalizumab (Raptiva)	Antipsoriatic	Inj: 150 mg	0.7 mg/kg SC x 1, then 1 mg/kg (max 200 mg) SC weekly. Immunosuppression, thrombolytopenia, headache.
Efavirenz (Sustiva)	Antiretroviral	Cap: 50, 100, 200 mg	600 mg once qhs with a protease or nucleoside analog inhibitor. Depression, impaired concentration (50%), avoid clarithromycin.

Eflornithine (Vaniqa)	Facial hair removal	CR: 13.9% (30 gm)	Apply thin layer to facial area bid. Do not wash for 4 hrs.
Eletriptan (Relpax)	Antimigraine	Tab: 20,40 mg	20-40 mg at onset of headache. May repeat one time in 3 hrs; max 80 mg/day. Do not use with P450 CYP3A4 enzyme inhibitors including ketocona-zole, itraconazole, clarithromycin, or nefazodone.
Emedastine (Emadine)	Antihistamine	Ophth sol: 0.05% [5 mL]	One drop in the affected eye(s) qid; allergic conjunctivitis; headache frequent.
Emtricitabine (Emtriva)	Antiretroviral	Cap: 200 mg	200 mg PO qd in combination with other antiretroviral agents. Lactic acidosis, hepatomegaly with steatosis.
Enalapril (Vasotec)	ACE-inhibitor	Tab: 2.5, 5, 10, 20 mg	2.5-20 mg bid; first dose hypotension; hyperkalemia in renal failure; cough.
Enalaprilat (Vasotec IV)	ACE-inhibitor	Vial: 1.25 mg/mL	1.25-5.0 mg IV q6h
Enfuvirtide (Fuzeon)	Antiretroviral	Inj. 90mg/mL	90 mg SC q12h. Anorexia, pancreatitis
Enoxacin (Penetrex)	Antibiotic	Tab: 200, 400 mg	200-400 mg q12h; 1 hour before or 2 hours after meals.
Enoxaparin (Lovenox)	Anticoagulant LMW heparin	Inj: 30, 40, 60, 80, 90, 100, 120, 150 mg	**Acute coronary syndrome:** 1 mg/kg SC q12h. **Deep venous thrombosis prophylaxis:** 30 mg SC q12h or 40 mg SQ q24h. **Deep vein thrombosis/pulmonary embolus:** 1 mg/Kg SC q12h or 1.5 mg/kg SQ q24h. Continue enoxaparin for 5 days and overlap with warfarin for 3-4 days. Reduce dose to q24h if creatinine clearance is <30 ml/min and monitor anti-Xa factor if available.
Entacapone (Comtan)	Antiparkinsonian agent	Tab: 200 mg	200 mg tid-qid concurrently with levodopa/carbidopa; max 1600/day. Adjunct therapy only. Dyskinesia, hyperkinesia, GI upset. Epinastine (Elestat) Antihistamine Oph soln: 0.05% (8, 15 ml) 1 drop in each eye bid for allergic conjunctivitis. Epinephrine Vasopressor Inj: 25, 50 mg/mL 5-10 mg IV q5-10 min in cardiac arrest.
Eplerenone (Inspra)	Antihypertensive	Tab: 25, 50, 100 mg	25-50 mg qd, max 100 mg qd. Hyperkalemia; reduce dose if receiving CYP enzyme inhibitor.
Eprosartan (Teveten)	Angiotensin-II receptor blocker	Tab: 400, 600 mg	600 mg qd; max 400 mg bid.
Eptifibatide (Integrilin)	Antiplatelet	Inj: 20 mg/10 mL, 75 mg/100 mL	180 mcg/kg IV over 2 min, then 2 mcg/kg/min x 24-72 hrs. Reversible platelet binding.
Ergotamine (Ergostat)	Antimigraine	Tab: 2 mg Suppository: 100 mg	One tab under tongue with onset; max 3 tab in 24 hours; max 5 tab/week. 1-2 suppository rectally.
Ertapenem (Invanz)	Antibiotic	Inj. 1 gm	1 gm IV/IM q24h. Seizures, pseudomembranous colitis.
Erythromycin base (E-Mycin, Ery-Tabs, PCE)	Antibiotic	Tab EC: 333 mg Tab EC: 500 mg	1 tab po tid. 1 tab po tid-qid.
Erythromycin estolate (Ilosone)	Antibiotic	Cap: 250 mg Tab: 500 mg Susp: 125, 250 mg/5 mL	250-500 mg qid; increases theophylline; GI upset; cholestatic jaundice in adults.
Erythromycin ethylsuccinate (EES)	Antibiotic	Tab: 400 mg Susp: 200, 400 mg/5 mL	200-400 mg qid; increases theophylline; GI upset.
Erythromycin lactobionate	Antibiotic	Inj: 0.5, 1.0 gm/vial	0.5-1.0 gm IV q6h; increases theophylline; GI upset. **GI Stimulant:** 125-250 mg IV q8h.

Erythromycin stearate (Eramycin Ilotycin)	Antibiotic	Tab: 250, 500 Ophth oint: 0.5% [3.5 gm]	250-500 mg qid; increases theophylline; GI upset; increases theophylline. Apply to affected eye(s) 6 times daily x 7-10 days.
Erythropoietin (Epogen)	Erythrocyte stimulating factor	Inj. 2000, 3000, 4000, 10,000 units/mL	100-200 U/kg IV/SQ 3x weekly; max 300 U/kg 3x weekly. **Life-threatening anemia**: 100-150 U/kg IV/SQ qd
Escitalopram (Lexapro)	Antidepressant	Tab: 5, 10, 20 mg	10 mg once daily; max 20 mg qd. Insomnia, ejaculation disorder
Esmolol (Brevibloc)	Beta-blocker	Amps: 2.5 gm	500 mcg/kg IV over 1 min, then 50 mcg/kg/min IV infusion (5.0 gm in 500 mL D5W); titrate to heart rate; max of 300 mcg/kg/min; contraindicated in heart failure, asthma, diabetes.
Esomeprazole (Nexium)	Antiulcer	Cap: 20, 40 mg	20-40 mg qd with food. Headache, diarrhea, abdominal pain.
Estradiol Estrace	Estrogen		
Estradiol (Estrace, **Estraderm**	Estrogen	Tab: 1, 2 mg Vag cr: 0.01% [42 gm] Transdermal: 50,100 mcg/day	Apply patch twice weekly; skin irritation. Breast tenderness, headache, edema. Risk of endometrial cancer diminished by concurrent progesterone use. Contraindicated in thromboembolic disorder, breast cancer, or estrogen-dependent malignancy.
Climara,		Transdermal: 25, 50, 75, 100 mcg/day	1 patch once a week.
Estradiol **Transdermal**	Antiosteoporotic	Transdermal: 0.025 mg/patch	One patch qd.
Estrogen, conjugated (Premarin)	Estrogen	Tab: 0.3, 0.625, 0.9, 1.25, 2.5 mg Cream: 0.625 mg/gm [42.5 gm] Inj: 25 mg/vial	0.625 mg PO qd or 2-4 gm intravaginally qhs Breast tenderness, headache, edema. Risk of endometrial cancer diminished by concurrent progesterone use. Contraindicated in thromboembolic disorder, breast cancer, or any estrogen-dependent malignancy. 25 mg IV/IM
Estrogen, esterified (Estratab)	Estrogen	Tab: 0.3, 0.625, 2.5 mg	1.25-2.5 mg qd. Estropipate (Ogen) Estrogen Tab: 0.625,1.25,2.5,5 mg 0.625-5 mg qd
Etanercept (Enbrel)	Antirheumatic	Inj: 25 mg/vial	25 mg SQ biweekly. May predispose to serious infections, respiratory symptoms. Demyelination, pancytopenia.
Ethacrynate (Edecrin)	Diuretic	Powd for inj: 50 mg Tab: 25, 50 mg	50-100 mg IV in 50-100 mL D5W over 30-60 min 50-100 mg PO qd
Ethambutol (Myambutol)	Tuberculostatic	Tab scored: 100, 400 mg	15 mg/kg/d (400 mg bid-tid); can cause reversible changes in visual acuity; GI upset.
Ethinyl Estradiol (Estinyl)	Estrogen	Tab: 0.02, 0.05, 0.5 mg	0.02-2.0 mg qd
Etidronate (Didronel)	Anti-osteoporotic Bone stabilizer	Inj: 300 mg/amp Tab: 200, 400 mg	7.5 mg/kg/day x 3 days 5-10 mg/kg/day, max 6 months or 10-20 mg/kg/day, max 3 months.
Etodolac (Lodine, Lodine XL)	NSAID	Cap: 200, 300 mg Tab: 400 mg Tab ER: 400, 600 mg	200-400 mg bid-tid 400-1200 mg qd.
Etretinate (Tegison)	Antipsoriatic	Cap: 10, 25 mg	0.75-1.0 mg/kg/day in 2-3 divided doses x 8-16 wk, then 0.5-0.75 mg/kg/day for maintenance; prolonged teratogenic effects; contraindicated in women who may ever become pregnant. Ezetimibe (Zetia) AntihyperlipidemicTab: 10 mg 10 mg PO qd. May be taken with statins or bile acid sequestrants. Back pain, arthralgia.
Famciclovir (Famvir)	Antiviral	Tab: 125, 250, 500 mg	**Herpes zoster**: 500 mg q8h x 7 days. **Herpes simplex**: 125 mg bid x 10 days (initial); 125 mg bid x 5 days(recurrence). Adjust dose in renal insufficiency; most effective within 48 hours of rash;

			not more effective than acyclovir. Headache.
Famotidine (Pepcid)	H2-blocker	Tab: 20, 40 mg Inj: 10 mg/mL Susp: 40 mg/5 mL [50 mL]	20 mg PO/IV q12h or 40 mg PO/IV qhs
Felbamate (Felbatol)	Anticonvulsant	Tab: 400, 600 mg Susp: 600 mg/5 mL	1200-3600 mg/day in 3-4 divided doses; aplastic anemia rarely; for seizures that are refractory to other anticonvulsants.
Felodipine (Plendil)	Calcium-blocker	Tab: 2.5, 5, 10 mg	5-10 mg qd; max 10 mg/day
Fenofibrate (Tricor)	Antihyperlipidemic	Cap: 67 mg	67 mg qAM or qhs with meals, max 201 mg qd; pancreatitis.
Fenoldopam (Corlopam)	Vasodilator	Inj: 10 mg/mL	0.01 mcg/kg/min IV infusion, adjust dose by 0.025-0.05 mcg/kg/min q15min to 0.3 mcg/kg/min; reflex tachycardia, headache.
Fenoterol (Berotec)	Bronchodilator	Aerosol: 200 mcg/puff	2 puffs bid-qid; beta-2 agonist
Fentanyl (Duragesic)	Narcotic Analgesic	Patch: 25, 50, 75, 100 mcg/h	Apply 1 patch to hairless skin q3 days. 25 mcg/hr patch is equal to 100 mg of oral morphine per day. 1-2 days for full effect Ferrous gluconate Mineral Tab: 300, 320, 325 mg Elixir: 300 mg/5 mL One tab bid-tid
Ferrous sulfate (Fergon, Infed, Slow Fe)	Mineral	Tab: 320 mg Inj: 50 mg/mL Cap SR: 159 mg Elixir: 220 mg/5 mL Cap: 190 mg Tab SR: 160 mg	1- 2 tab bid-tid 0.5 mL IM by "Z" tract injection technique as test dose, if no reaction within an hour, then inject 1 mL in each buttock qd x 10-20 days. Watch for anaphylaxis after the test dose. 1 cap SR qd PO 5 mL bid-tid 1 cap bid 1-2 tab qd-qid
Fexofenadine (Allegra)	Antihistamine	Cap: 60 mg Tab ER: 180 mg	One cap bid; non-sedating 180 mg qd
Filgrastim (Neupogen)	Leukocyte stimulating factor	Inj: 300 mcg/mL	5 mcg/kg/day IV/SC
Finasteride (Propecia)	Hair growth Stimulant	Tab: 1 mg	1 tab qd. For men only, sexual dysfunction, decreases PSA by 50%. Requires 6-12 months of therapy.
Finasteride (Proscar)	Antiandrogen	Tab: 5 mg	5 mg qd; 3-6 months required for effect. Improvement occurs in only 33-50%; less effective than alpha-blockers.
Flecainide (Tambocor)	Antiarrhythmic	Tab: 50, 100, 150 mg	50-100 mg q12h, max 400 mg/d; class I-C antiarrhythmic. Useful in atrial and ventricular arrhythmias.
Fluconazole (Diflucan)	Antifungal	Tab: 50, 100, 150, 200 mg Inj: 200 mg/100 mL, 400 mg/200 mL	**Vulvovaginal candidiasis:** 150 mg single dose **Oropharyngeal and esophageal candidiasis:** 200 mg PO/IV initially, then 100 mg PO/IV qd x 14 days. **Candida cystitis:** 50-100 mg PO/IV qd x 5-7 days **Cryptococcal meningitis:** 400 mg PO/IV initially, then 200 mg PO/IV qd until CSF culture negative x 10-12 weeks. Not effective against non-albicans candida. **Histoplasmosis**: 400 mg bid
Flucytosine, 5-FC (Ancobon)	Antifungal	Cap: 250, 500 mg	37.5 mg/kg q6h; nausea, vomiting, diarrhea; bone marrow suppression; monitor serum levels
Fludrocortisone (Florinef)	Mineralocorticoid	Tab: 0.1 mg	0.1 mg qd-tid
Flumazenil (Romazicon)	Benzodiazepine antagonist	Inj: 0.1 mg/mL	0.2 mg IV at 1 minute intervals, up to 3 mg. Excessive dosage may precipitate seizures.
Flunisolide (AeroBid, AeroBid-M,	Corticosteroid	Aerosol: 250 mcg puff Spray: 25 mcg spray	2-4 inhalations bid; may cause oral candidiasis; not indicated for acute asthma; AeroBid-M has a menthol taste.

Nasalide)			2 sprays in each nostril bid
Fluocinolone (Synalar)	Corticosteroid	Oint: 0.25% [15, 60 gm] Soln: 0.01% [20, 60 mL] Cream: 0.025, 0.01, 0.2% [15, 60 gm]	Apply to affected area(s) bid-qid.
Fluocinonide (Lidex)	Corticosteroid	Oint, cream: 0.05% [30, 60, 120 gm]	Apply to affected area(s) bid-qid; high potency, skin atrophy, systemic steroid effects.
Fluoxetine (Prozac, Prozac Weekly, Sarafem)	Antidepressant	Caps: 10, 20, 40 mg Oral soln: 20 mg/5 mL Cap: 90 mg Caps: 10, 20 mg	**Depression:** 10-20 mg qam; max 80 mg qam. SSRI, sexual dysfunction, weight loss, irritability. **Obsessive-compulsive disorder:** 20 mg qam; max 80 mg qam. **Alcoholism:** 40 mg qam; max 80 mg qam. **Anorexia nervosa:** 20 mg qam; max 80 mg qam. **Attention-deficit hyperactivity disorder:** 20 mg qam; max 60 mg qam. **Bipolar II affective disorder:**20 mg qam; max 80 mg qam. **Personality disorder:** 5 mg qam; max 80 mg qam. **Narcolepsy:** 20 mg qam; max 40 mg qam. **Chronic daily migraine headache**: 20 mg qam; max 40 mg qam. **Panic disorder:** 10 mg qam; max 60 mg qam. **Diabetic peripheral neuropathy:** 5 mg qam; max 40 mg qam. 1 tab weekly **Premenstrual dysphoric disorder:** 20 mg qam; max 80 mg qam.
Fluphenazine (Prolixin, Permitil)	Antipsychotic	Tab: 1, 2.5, 5, 10 mg Elixir: 2.5 mg/mL Inj: 2.5 mg/mL	0.5-10 mg qd; cholestatic jaundice, neuroleptic malignant syndrome, extrapyramidal symptoms. 1.25-2.5 mg IM qd-tid
Fluphenazine decanoate (Prolixin, Decanoate)	Antipsychotic	Tab: 1, 2.5, 5, 10 mg Inj: 2.5 mg/mL Elixir: 2.5 mg/5 mL	12.5-25 mg PO/IM q4-6 wk; reduce dosage in elderly; monitor liver function; may cause drowsiness
Flurandrenolide (Cordran)	Corticosteroid	Cream, oint: 0.025, 0.05% [30, 60 gm]	Apply to affected area(s) bid-qid
Flurazepam (Dalmane)	Sedative Hypnotic	Tab: 15, 30 mg	15-30 mg qhs; reduce dosage in elderly; long half-life may cause daytime sedation.
Flurbiprofen (Ansaid)	NSAID	Tab: 50, 100 mg	25-100 mg qd-tid
Fluticasone (Flovent, Flovent Diskus, Flonase, Cutivate)	Corticosteroid	Inhaler: 44, 110, 220 mcg/puff Diskus inh: 50, 100, 250mcg Nasal spray: [9, 16 gm] Cream: 0.05% [30, 60 gm] Oint: 0.005% [15, 30, 60gm]	2 inhalations bid; not for acute bronchospasm; rinse mouth after each use to prevent oropharyngeal candidiasis. 100-500 mcg by inhalation bid. 1-2 sprays per nostril qd-bid. Apply to affected areas bid-qid.
Fluvastatin (Lescol) Fluvastatin XL (Lescol XL)	Antihyperlipidemic	Cap: 20, 40 mg Cap XL: 80 mg	20-40 mg PO qhs; reduces LDL cholesterol 80 mg PO qhs.
Fluvoxamine (Luvox)	Antidepressant	Tab: 25, 50, 100 mg	50 mg qhs, increase by 50 mg increments q4-7 days prn until 50-150 mg bid; also used for obsessive-compulsive disorder. All SSRIs use can cause impotence and abnormal ejaculation. Contraindicated with MAO-inhibitors, cisapride, astemizole.
Folic acid (Folvite)	Mineral	Tab: 0.1, 0.4, 0.8, 1 mg Inj: 5, 10 mg/mL	1 mg PO/IV/IM qd
Fomepizole (Antizol)	Antidote	Inj: 1 gm/mL	Loading dose 15 mg/kg IV, then 10 mg/kg q12h x 4, then 15 mg/kg q12h until ethylene glycol level < 20 mg/dL; infuse over 30 min.
Fondaparinux (Arixtra)	Anitcoagulant	Inj. 2.5 mg	**Prophylaxis:** 2.5 mg SC q24h for 5-9 days. May be used in patients with heparin-induced thrombocytopenia.
Formoterol (Foradil)	Bronchodilator	Inh: 12 mcg/cap	1 cap by aerosolized inhalation bid. Not for acute bronchospasm; tremor, tachycardia, insomnia.

Fosamprenavir (Lexiva)	Antiretroviral	Tab: 700 mg	700-1400 mg qd-bid in combination with other antiretroviral agents. Concurrent use with various antiarrhythmics and T.C.A. may result in significant, life-threatening blood levels.
Foscarnet (Foscavir)	Antiretroviral	Inj: 24 mg/mL	**Cytomegalovirus retinitis induction**: 60 mg/kg IV q8h x 3 wks **Maintenance**: 90-120 mg/kg IV qd; adjust dose in renal failure; nephrotoxic, hypocalcemia. Possible seizures with ciprofloxacin.
Fosfomycin (Monurol)	Antibiotic	Granules: 3 gm	3 gm in 3-4 oz. water once. For uncomplicated acute cystitis only.
Fosinopril (Monopril)	ACE-inhibitor	Tab: 10, 20, 40 mg	10-40 mg qd; decrease dosage in the elderly; persistent nonproductive cough, orthostatic hypotension after first dose
Fosphenytoin (Cerebyx)	Anticonvulsant	Inj: 150, 750 mg	20 mg/kg IV/IM at max rate of 75 mg/min, then 150 mg IV/IM q8h. Metabolized to active metabolite, phenytoin; fosphenytoin 150 mg = phenytoin 100 mg; fosphenytoin may be given IM, unlike phenytoin.
Frovatriptan (Frova)	Antimigraine	Tab: 2.5 mg	2.5 mg PO qd with fluids; MR x 1 after 2 hours (max 3 tabs/24h) Tremor, anxiety, tachycardia.
Furosemide (Lasix)	Diuretic	Tab: 20, 40, 80 mg Soln: 40 mg/5 mL; 10 mg/mL [60, 120 mL] Inj: 10 mg/mL	**Oral**: 20-80 mg qd-bid; monitor magnesium and potassium levels; high doses in the presence of azotemia may cause ototoxicity **Parenteral**: 20-80 mg IV qd-q6h, max 1000 mg/d or 20-40 mg/hr IV infusion (1000 mg in 100 mL of D5W or NS; conc: 10 mg/mL); IV infusion is more effective than large, intermittent IV doses.
Gabapentin (Neurontin)	Anticonvulsant	Cap: 100, 300, 400 Tab: 600 mg	300-400 mg bid-tid; max 1800 mg/day. Adjunctive therapy; somnolence, dizziness, nystagmus. Adjust in renal failure.
Galantamine (Reminyl)	Alzheimer's agent	Tab: 4, 8, 12 mg Oral soln: 4 mg/mL	4mg bid; max 16 mg bid. Bradycardia. Ketoconazole and paroxetine increase the galantamine by 30-40%.
Ganciclovir (Cytovene)	Antiretroviral	Vial: 500 mg Cap: 250 mg	**Cytomegalovirus retinitis induction:** 5 mg/kg IV bid x 14-21 days, followed by **maintenance** of 5 mg/kg IV qd or 6 mg/kg IV 5 days a week; neutropenia, thrombocytopenia; adjust in renal failure **Oral Maintenance**: 1000 mg PO tid or 500 mg 6 times a day with food; oral therapy is less effective than IV therapy.
Gatifloxacin (Tequin)	Antibiotic	Tab: 200, 400 mg Inj: 200, 400 mg	400 mg PO/IV q24h for bronchitis, sinusitis, community-acquired pneumonia, cystitis, pyelonephritis. **Uncomplicated urethral or rectal gonorrhea**: 400 mg PO/IV once.
Gemfibrozil (Lopid)	Antihyperlipidemic	Cap: 300 mg Tab: 600 mg	600 mg bid, 30 min before meals. GI symptoms, hepatotoxic.
Gentamicin (Garamycin)	Antibiotic	Inj: 2, 10, 40, 60, 80, 100 mg Ophth soln: 3 mg/mL [5mL] Ophth oint: 3 mg/gm [3.5 gm]	2 mg/kg, then 1-1.5 mg/kg IV q8h; monitor levels; nephrotoxic, ototoxic; decrease dose in azotemia. **Once daily dosing**: 5 mg/kg IV q24h. Maintain peak level of 20-24 and trough <0.1 mcg/mL. Not suitable in azotemia. 1-2 drops in affected eye(s) qid Apply 0.5 inch to affected eye(s) bid-tid
Glargine (Lantus)	Hypoglycemic	Inj: 100 units/mL	Initially 10U SC qhs. Faster onset and longer duration than NPH.
Glimepiride (Amaryl)	Second generation sulfonylurea	Tablets: 1, 2, 4 mg	Starting dose: 1-2 mg qAM with breakfast. Maintenance: 1-4 mg qAM; max 8 mg/d; monotherapy or combination with insulin.
Glipizide (Glucotrol, Glucotrol XL)	Hypoglycemic	Tab: 5, 10 mg Tab ER: 5, 10 mg	Initially 5 mg qd, increase by 5 mg increments; max 20 mg/day; GI upset common, SIADH, leukopenia, thrombocytopenia.
Glucagon (Glucagon)	Hyperglycemic	Vial: 1, 10 mg vials	1 mg IV bolus, then 1-2 mg/h IV
Glyburide (Micronase, DiaBeta, Glynase PresTab)	Hypoglycemic	Tab: 1.25, 2.5, 5mg Micronized: 1.5, 3, 6 mg	Initially 1.25-5 mg qd, increase if necessary to max 20 mg/day in 2 divided doses. Initially 1.5-3 mg qd; maintenance 0.75-12 mg qd

Granisetron (Kytril)	Antiemetic	Tab: 1 mg Inj: 1 mg/mL	1 mg bid or 2 mg qd an hour prior to chemotherapy. Leukopenia, anemia. 10 mcg/kg IV over 5 min; 30 min prior to chemotherapy.
Griseofulvin (Fulvicin PG, Fulvicin UF, Grifulvin V)	Antifungal	Fulvicin PG: 125, 165, 250mg Fulvicin UF: 250, 500 mg Grifulvin V: 125, 250, 500mg	330-500 mg daily in single or two divided doses; hepatotoxic; monitor LFTs with extended therapy; GI absorption is improved with food
Guaifenesin (Robitussin, Organidin)	Expectorant	Syr: 100 mg/5 mL [120 mL]	Cap: 200, 300 mg 100-400 mg q4h prn One cap bid
Guanabenz (Wytensin)	Antihypertensive	Tab: 4, 8 mg	4-8 mg bid, max 32 mg bid Guanfacine (Tenex) Antihypertensive Tab: 1, 2 mg 1-3 mg qhs; sedation, drowsiness, rebound hypertension
Halobetasol (Ultravate)	Corticosteroid	Cream, oint: 0.05% [15, 45 gm]	Apply to affected area bid
Haloperidol (Haldol)	Antipsychotic	Tab: 0.5, 1, 2, 5, 10, 20 mg Inj: 2 , 5 mg/mL	0.5-5 mg bid-tid; extrapyramidal symptoms; reduce in elderly; alphablocking effects. 2-5 mg IM/IV q4-8h
Haloperidol decanoate (Haldol Decanoate)	Antipsychotic	Inj: 50, 100 mg/mL	25-100 mg IM q4 weeks; long acting. Reduce dose in elderly; extrapyramidal symptoms, alpha-blocking effects, high doses may prolong QT interval.
Heparin	Anticoagulant	Inj: 10, 100, 1000, 10,000 U/mL	75-100 U/kg IV push, then 15 U/kg/hr; or 5000 U SQ q8h; titrate to PTT 1.5-2 x control; thrombocytopenia; antidote is protamine sulfate.
Hepatitis A vaccine (Havrix)	Vaccine	Inj: 1 mL	1 mL IM; followed by 1 mL IM 6-12 months later. 96% effective. For immediate protection, give immune globulin (0.02 mL/kg IM) simultaneously.
Hepatitis B vaccine (Recombivax-HB, Engerix-B)	Vaccine	Inj: 10 mcg/mL Inj: (dialysis form): 40 mcg/mL Inj: 20 mcg/mL	1 mL IM/SC; repeat in 1 and 6 months. Immunity to hepatitis B; also protects against hepatitis D.
Hetastarch (Hespan)	Volume expander	Inj: 500 mL	500-1000 mL IV over 30-60 min; max 1500 mL/day; platelet dysfunction
Hydralazine (Apresoline)	Vasodilator	Tab: 10, 25, 50, 100 mg	Inj: 20 mg/mL 10-100 mg qid 10-50 mg IV/IM q3-6h; 0.1-0.5 mg/kg/dose
Hydrochlorothiazide (Esidrix)	Diuretic	Tab: 25, 50, 100 mg	25 mg qd; may increase to 50-100 mg qd; hypokalemia, hyperuricemia, hyperlipidemia
Hydrocortisone (Solu-Cortef)	Corticosteroid	Inj: 100, 200, 500, 1,000mg	200-500 mg IV q4-6h
Hydrocortisone (Cortef, Cortenema, Hytone, ProctoCream-HC)	Corticosteroid	Tab: 5, 10, 20 mg Enema: 100 mg/60 mL Cream, oint: 1, 2.5% [15, 30, 60 gm] Lotion: 1, 2.5% [60, 120 mL] Cream: 2.5% [30 gm]	20-240 mg qd 1 enema PR qhs Apply to affected area(s) bid-qid Apply to affected area(s) bid-qid. Apply to affected area(s) bid-qid.
Hydrocortisone acetate (Cortdome, Anusol HC, Cortifoam)	Corticosteroid	Cream: 0.5, 1% [30 gm] Suppository: 10, 25 mg Aerosol foam: 1, 10% [20 gm]	Apply to affected area(s) bid-qid prn One suppository PR bid-qid Apply to affected area(s) tid-qid
Hydrocortisone valerate (Westcort)	Corticosteroid	Cream, oint: 0.2% [15, 45, 60, 120 gm]	Apply to affected area(s) bid-tid; low potency.
Hydromorphone (Dilaudid)	Narcotic Analgesic	Tab: 1, 2, 3, 4 mg Inj: 1, 2, 3, 4 mg	2-4 mg q4-6h prn pain 1-4 mg IM/SC/IV q4-6h
Hydroxychloroqui-ne (Plaquenil)	Antimalarial Antirheumatic	Tab: 200 mg	**Malaria:** 200-600 mg qd **Rheumatoid arthritis:** 400-600 mg qd x 1-2 weeks, then 200-400 mg qd;

			dose-dependent retinopathy.
Hydroxyzine (Vistaril, Atarax)	Antihistamine	Tab: 10, 25, 50, 100 mg Inj: 25, 50, 100 mg/mL	25-100 mg qid; drowsiness, anticholinergic. 25-100 mg IM q4-6h prn
Hyoscyamine (Levsin, Levsinex)	Antispasmodic, GI	Tab: 0.125 mg SR cap: 0.375 mg	0.125-0.25 mg tid-qid 0.375-0.75 mg bid
Ibuprofen (Advil, Medipren, Motrin)	NSAID	Tab, cap: 100, 200, 300, 400, 600, 800 mg	400-800 mg tid-qid prn; GI upset, bleeding, nephropathy.
Ibutilide (Corvert)	Antiarrhythmic Class III	Inj: 1 mg/vial	1 mg IV over 10 min (0.01 mg/kg if <60 kg), may repeat x 1. For cardioversion of atrial fibrillation or flutter; may prolong QT.
Idoxuridine (Herplex)	Antiviral	Ophth soln: 0.1% [15 mL]	One drop in affected eye(s) q3h x 7-21 days. HSV 1 and 2
Imipramine (Tofranil, Tofranil PM)	Antidepressant	Tab: 10, 25, 50 mg Inj: 25 mg/2 mL Cap: 75, 100, 125, 150 mg	75-150 mg qhs; high sedation, high anticholinergic 25-50 mg IM bid-tid 75-200 mg qhs; max 300 mg.
Imipenem (Primaxin)	Antibiotic	Inj: 250, 500 mg	0.5-1.0 gm IV q6-8h. Reduce dose in azotemia; seizures.
Indapamide (Lozol)	Diuretic	Tab: 1.25, 2.5 mg	1.25-5 mg qd
Indinavir (Crixivan)	Antiretroviral Protease inhibitor	Caps: 200 mg, 400 mg	800 mg q8h; use in combination to prevent resistance; nephrolithiasis (8%); maintain fluid intake; hyperbilirubinemia.
Indomethacin (Indocin)	NSAID Antipyretic	Cap: 25, 50 mg Cap SR: 75 mg Inj: 1 mg	25-50 mg tid; contraindicated in renal failure. 75 mg qd 1 mg IV q12-24h x 3 doses Influenza virus vaccine Vaccine Inj: 0.5 mL 0.5 mL IM in October or November of each year Influenza virus
vaccine live (FluMist)	Vaccine	Intranasal: 0.5 mL	**Influenza A and B**: 0.25 mL into each nostril. Avoid in immunocompromised patients.
Interferon Gamma-1B (Actimmune)	Antiosteoporotic	Inj: 100 mcg/0.5mL	50 mcg/m² if BSA>0.5m² and 1.5 mcg/kg if BSA <0.5m² 3 times weekly. Delays progression of disease in malignant cases. Decreased mental status, cardiomyopathy, myelosuppression.
Infliximab (Remicade)	Immuno-suppressant	Inj: 100 mg	**Rheumatoid arthritis:** 3 mg/kg IV infusion over 2 hrs, repeat at 2 and 6 weeks, then q 8 weeks. **Crohn's disease:** 5 mg/kg IV infusion over 2 hrs, repeat at 2 and 6 weeks, then q 8 weeks. Coughing, opportunistic infection.
Infliximab (Remicade)	Immuno-suppressant	Inj: 100 mg	**Rheumatoid arthritis:** 3 mg/kg IV infusion over 2 hrs, repeat at 2 and 6 weeks, then q 8 weeks. **Crohn's disease:** 5 mg/kg IV infusion over 2 hrs, repeat at 2 and 6 weeks, then q 8 weeks. Coughing, opportunistic infection.
Insulin lispro (Humalog)	Hypoglycemic	Inj: 100 U/mL	Give SQ within 15 min of meal; use with long-acting NPH insulin. Faster onset and shorter duration than regular insulin.
Insulin regular (Humulin-R)	Hypoglycemic	Inj: 100 U/mL [10 mL]	x **Subcutaneous injection:** 2-4 injections per day. Give 2/3 of total insulin requirement as NPH and 1/3 as regular; requires titration. **IV infusion:** 3-5 U/h (50 U in 250 mL of normal saline; flush IV tubing with 20 mL of soln before starting infusion).
Insulin NPH (Humulin-N)	Hypoglycemic	Inj: 100 U/mL [10 mL]	Once or twice daily dosing; 2/3 of total insulin is given as NPH and 1/3 as regular. 20-60 U/day; requires titration.
Interleukin 11 (Neumega)	Megacaryocytestimulating factor	Inj: 5 mg/vial	50 mcg/kg SC qd x 21 or until platelet >50,000. Fever, edema, atrial fibrillation
Ipratropium (Atrovent) Bronchodilator	Inhaler: [14 gm]	Nasal spray: 0.03, 0.06% Inh soln: 500	2-4 puffs tid-qid; minimal anticholinergic effects 2 sprays intranasally tid-qid; 0.06% solution is for allergic rhinitis; 0.03% is for rhinorrhea from the common cold.

		mcg/2.5mL	500 mcg nebulized 3-4 times a day
Irbesartan (Avapro)	Angiotensin-II antagonist	Tab: 75, 150,	300 mg Initially 150 mg qd, range 75-300 mg qd; hypotension common.
Iron sucrose (Venofer)	Mineral	Inj: 100 mg	100 mg IV 3 times/week at 20 mg/min through the dialysis line. Use with erythropoietin. Hypotension, flushing, urticaria, leg cramps.
Isometheptene (Midrin)	Antimigraine	Tab: 65 mg	Initially 2 tab, then 1 tab q1h prn; up to 5 tab within 12h period
Isoniazid (INH)	Tuberculostatic	Tab: 100, 300 mg Syr: 50 mg/5 mL Inj: 100 mg/mL	300 mg PO/IV qd; hepatitis; monitor LFTs if >35 years. Add pyridoxine 50-100 mg qd to prevent peripheral neuropathy. Enhances the effect of phenytoin. Consumption of tyramine-rich foods may cause palpitations, tachypnea, urticaria.
Isoproterenol (Isuprel)	Beta-1 and 2 agonist	Inj: 0.2 mg/mL	5 mcg/min IV infusion (1 mg in 500 mL of D5W) for high grade atrioventricular block.
Isosorbide (Isordil)	Antianginal	Tab SL: 2.5, 5, 10 mg Tab: 5, 10, 20, 30 40 mg Tab SR: 40 mg	2.5-10 mg SL tid 5-40 mg tid-qid; tolerance less common with shorter acting agents. 40 mg bid
Isosorbide mononitrate (ISMN, Imdur)	Antianginal ISMN	tab: 20 mg Imdur tab: 30, 60, 120 mg	20 mg bid One tab qd
Isotretinoin (Accutane)	Anti-acne	Cap: 10, 20, 40 mg	0.5-2 mg/kg/day in divided doses; teratogenic; contraception mandatory. Suicidal ideation
Isradipine (DynaCirc, DynaCirc CR)	Calcium-blocker	Tab: 2.5, 5 mg Tab CR: 5, 10 mg	2.5-5 mg bid; max 20 mg/day 5 mg qd; max 20 mg/day
Itraconazole (Sporanox)	Antifungal	Cap: 100 mg	**Blastomycosis, histoplasmosis, aspergillosis**: 200 mg bid. **Oropharyngeal, esophageal candidiasis**: 100 mg qd. **Onychomycosis**: 200 mg bid x 7 days each month x 3 months. **Vaginal candidiasis**: 200 mg qd x 3; **cutaneous mycosis**: 100 mg qd x 12-18 months. Take with food; headache, nausea, diarrhea.
Ivermectin (Stromectol)	Anthelmintic	Tab: 6 mg	**Strongyloidiasis**: 200 mcg/kg once only. **Onchocerciasis**:150 mcg/kg; repeat q3-12 months; pruritus, rash, lymph node enlargement.
Kaolin (Donnagel, Kaopectate)	Antidiarrheal	Tab: 750 mg Liq: 600 mg/15 mL [180, 480 mL]	Two tabs initially, then one tab tid prn. 2 tablespoonfuls after each loose bowel movement; max 7 doses/day.
Ketoconazole (Nizoral)	Antifungal Antiseborrheic	Tab: 200 mg Cr: 2% [15, 30, 60gm] Shampoo: 2% [4 oz]	**Oropharyngeal candidiasis**: 200-400 mg qd **Esophagitis**: 200 mg bid; hepatotoxic; long-term use requires liver function monitoring; poor absorption in low gastric acid states. Apply to affected area(s) qd-bid. Shampoo twice a week x 4 wk; equally effective to selenium shampoos, but more expensive and irritating.
Ketoprofen (Orudis, Oruvail)	NSAID Analgesic	Tab: 25, 50, 75 mg Cap SR: 200 mg	25-50 mg q6-8h prn; max 300 mg/day 1 cap qd
Ketorolac (Toradol, Acular)	NSAID Analgesic Antiallergic	Inj: 15, 30 mg Tab: 10 mg Ophth soln: 0.5% [5, 10 mL]	30-60 mg IM/IV, then 15-30 mg IM/IV q6h 10 mg q4-6h prn Instill one drop in affected eye(s) qid.
Ketotifen (Zaditor) Ophth	antihistamine	Ophth soln: 0.025% (5, 7.5 mL)	1 drop in the affected eye(s) q8-12h.
Labetalol (Trandate, Normodyne)	Antihypertensive	Tab: 100, 200, 300 mg Inj: 5 mg/mL	100-400 mg bid; max 1200 mg/day. Ideal for decreasing pulse pressure in the presence of an aneurysm. 20 mg IV bolus (0.25 mg/kg), then 20-80 mg IV q10-15min prn or 0.5- 2.0 mg/min IV infusion.

Lactulose (Chronulac, Duphalac)	Laxative	Syr: 10 gm/15 mL [480 mL]	30 mL qhs **Hepatic encephalopathy**: 30-45 mL PO tid-qid, or 250 mL PR qid [300 mL of lactulose combined with 700 mL of water]; instill via rectal tube, then clamp tube for 45 min.
Lamivudine (Epivir, 3TC Epivir-HBV)	Antiretroviral	Tab: 150, 300 mg Oral soln: 5, 10 mg/mL Tab: 100 mg	**HIV:** 150 mg PO bid or 300 mg qd in combination therapy; adjust dose in azotemia; nausea, headache. **Chronic Hepatitis B:** 100 mg PO qd. Reduce dose in azotemia.
Lamotrigine (Lamictal)	Anticonvulsant	Tab: 25, 100, 150, 200 mg	Initially: 25-50 mg qd for 2 weeks, then 50-250 mg bid; adjunctive therapy.
Lansoprazole (Prevacid)	Proton pump inhibitor	Caps: 15, 30 mg Susp: 15, 30 mg IV: 30 mg	**Peptic ulcer:** 15 mg qd **Reflux esophagitis:** 30 mg qd 30 mg IV qd. Headache, nausea.
Latanoprost (Xalatan)	Antiglaucoma	Ophth soln: 0.005% (2.5mL)	One drop qhs. Photophobia, iris hyperpigmentation.
Leflunomide (Arava)	Antirheumatic	Tab: 10, 20, 100 mg	100 mg qd x 3, then 10-20 mg qd. Alopecia, rash, anaphylaxis, diarrhea, and elevation of LFTs. No advantage over methotrexate.
Lepirudin (Refludan)	Anticoagulant (thrombininhibitor)	Inj: 50 mg/vial	0.4 mg/kg IVP, then 0.15 mg/kg/hr IV infusion. Reduce bolus dose to 0.02mg/kg IV if GFR < 50mLs/min. Reduce infusion dose by 50% if GFR < 50mLs/min, by 70% if GFR < 35mLs/min, and by 85% if GFR < 25mLs/min. Monitor aPTT. Allergic reactions common; no antidote exists, removed by hemodialysis.
Leucovorin calcium (Wellcovorin)	Folic acid derivative	Tab: 5, 10, 15, 25 mg Inj: 50, 100, 350 mg	10 to 20 mg PO/IV/IM qd (up to 50 mg qd); used with pyrimethamine in treatment of toxoplasmosis.
Levalbuterol (Xopenex)	Bronchodilator	Inh: 0.63 mg/3mL, 1.25 mg/3mL	0.63-1.25 mg by nebulization q6-8h prn. Nervousness, tremors. Nebulizer use only; no advantage over albuterol.
Levetiracetam (Keppra)	Anticonvulsant	Tab: 250, 500 mg	500 mg bid; max 1500 mg bid. Asthenia, somnolence
Levocabastine (Livostin)	Ophthalmic antihistamine	Ophth soln: 5 mL	One drop in each eye qid
Levodopa (Larodopa, Dopar)	Antiparkinsonian	Tab: 100, 250, 500 mg Cap: 100, 250, 500 mg	Initial dose of 250 mg qid, increased as tolerated to 1-2 gm/day.
Levofloxacin (Levaquin, Quixin)	Antibiotic	Tab: 250, 500 mg Inj: 250, 500 mg Ophth soln: 0.5% (2.5, 5 mL)	**Cystitis and pyelonephritis**: 250 mg qd; **bronchitis and pneumonia**: 500 mg qd. Instill 1-2 drops in affected eyes 8 times per day x 2 days, then qid for total of 7 days.
Levonorgestrel-RIS (Minera)	Contraceptive	Intrauterine system: 52 mg levonorgestrel	Insert a single unit into the uterine cavity once every 5 years. Do not use if history of PID. Syncope, depression, acne.
Levothyroxine (Synthroid)	Thyroid hormone	Tab: 25, 50, 75, 88, 100, 112, 125, 150, 175, 200, 300 mcg	25-200 mcg PO/IV qd. IV dose is 2/3 of oral dose.
Lidocaine (Xylocaine)	Antiarrhythmic Class Ib	Inj: 100 mg/5 mL, 2 gm/500 mL Oint: 2.5, 5% [50 gm] Oral soln: 2% [100, 450 mL]	50-100 mg IV, then 2-4 mg/min IV infusion (2 gm in 500 mL D5W; conc=4 mg/mL). Apply to affected area(s) prn 30 mL swish and spit prn
Lindane (Kwell)	Scabicide	Cream: 1% [60 gm] Lotion: 1% [30, 60 mL] Shampoo: 1% [30, 60 mL]	**Scabies:** Apply thin layer from neck down and wash off after 10 hours. **Pediculosis:** Apply shampoo to hair; add water after 4 min, then rinse and towel dry.
Linezolid (Zyvox)	Antibiotic	Tab: 400, 600 mg Inj: 2 mg/mL	600 mg PO/IV q12h for VRE and MRSA infections. 400 mg PO q12h for uncomplicated skin infections. Active against E. faecium, E. faecalis, and MRSA. Thrombocytopenia, myelosuppression.
Lisinopril (Zestril, Prinivil)	ACE-inhibitor	Tab: 2.5, 5, 10, 20, 30, 40 mg	5-40 mg qd; dizziness, headache, persistent cough. Hyperkalemia in renal failure; improved survival if used within 24 hours of myocardial

			infarction.
Lithium carbonate (Eskalith, Lithobid, Eskalith CR)	Mood stabilizer	Cap: 150, 300, 600 mg Lithobid SR: 300 mg Eskalith CR: 450 mg	300 mg tid-qid 300-600 mg bid; titrate to levels; polyuria, tremor common; adjust in renal impairment; hyponatremia potentiates toxicity. ACE-Inhibitors may elevate lithium levels.
Lodoxamide (Alomide)	Mast cell stabilizer	Ophth soln: 0.1% [10 mL]	1-2 drops in each eye qid; effective for contact lens conjunctivitis; several days required for effect.
Lomefloxacin (Maxaquin)	Antibiotic	Tab: 400 mg	Lower respiratory and urinary tract infections: 400 mg qd. Uncomplicated gonorrhea: 400 mg once; photosensitivity.
Loperamide (Imodium)	Antidiarrheal	Cap, tab: 2 mg	2-4 mg q6h prn; max 16 mg/day; OTC
Loracarbef (Lorabid)	Antibiotic	Cap: 200, 400 mg Susp: 100, 200 mg/5mL	200-400 mg bid; covers community-acquired lower and upper respiratory tract infections.
Loratadine (Claritin)	Antihistamine	Tab: 10 mg Syr: 1 mg/mL RediTab: 10 mg	One tab qd on an empty stomach. QT prolongation not reported with azole antifungals or macrolide antibiotics. One tab qd. Dissolves on the tongue for quick action.
Lorazepam (Ativan)	Anxiolytic	Tab: 0.5, 1, 2 mg Oral soln: 2 mg/mL Parenteral: 2, 4 mg/mL	1-2 mg tid-qid 0.5-4 mg IV/IM q4-6h prn; decrease in elderly
Losartan (Cozaar)	Angiotensin-II receptor antagonist	Tab: 25, 50 mg	25-50 mg qd-bid; hyperkalemia in renal insufficiency, cough or angioedema rare.
Lovastatin (Mevacor)	Antihyperlipidemic	Tab: 10, 20, 40	mg 20-80 mg qhs; take with food; monitor LFTs; headache, myositis.
Loxapine (Loxitane)	Antipsychotic	Tab: 5, 10, 25, 50 mg Liq conc: 25 mg/mL Parenteral: 50 mg/mL	10 mg tid, titrate to 60-100 mg/day in divided doses; max 250 mg/day 12.5-50 mg IM q4-12h
Lyme disease vaccine (LYMErix)	Vaccine	Inj: 30 mcg/0.5 mL	0.5 mL IM, repeat in 1 and 12 months. 78% efficacy.
Magaldrate (Riopan)	Antacid	Susp: 540 mg/5 mL	15-30 mL tid and qhs
Magnesium chloride (Slow-Mag)	Mineral	Tab: 64 mg	1-2 tabs bid (64 mg elemental Mg/tab)
Magnesium gluconate (Magtrate)	Mineral	Tab: 500 mg	1-2 tabs bid-tid (29 mg elemental Mg/tab) Magnesium
hydroxide (Maalox, Mylanta)	Antacid	Susp: 400 mg/5 mL	15-30 mL tid and qhs
Magnesium oxide (Mag-Ox 400)	Mineral	Tab: 400 mg	1-2 tabs bid (241mg elemental Mg/tab) Magnesium sulfate Mineral Inj: 10, 12.5, 50% 2-4 gm in 100 mL of D5W at 1 gm/hr; reduce to 1-2 g in azotemia.
Mannitol (Osmitrol)	Osmotic diuretic	Inj: 5, 10, 15, 20, 25%	0.5-1.0 gm/kg IV; may worsen heart failure.
Mazindol (Sanorex)	Anorexiant	Tab: 1, 2 mg	1 mg qd-tid an hour before meals. GI upset.
Meclizine (Antivert)	Antivertigo	Tab: 12.5, 25, 50 mg	25-50 mg tid-qid; anticholinergic effects; OTC
Medroxyprogesterone (Provera, Depo-Provera)	Progestin Contraceptive	Tab: 2.5, 5, 10 mg Inj: 150 mg/mL	2.5 mg qd continuously or 5 mg qd for 5-10 days on the 16th day of cycle; contraindicated in active thromboembolic or hepatic disease. 150 mg IM q3 months; initiation within 5 days of menses ensures patient is not pregnant and contraception is immediate; pregnancy test if >15 weeks since last dose; fertility delayed for up to 1 year after

			discontinuation.
Megestrol (Megace)	Appetite stimulant	Tab: 20, 40 mg	80 mg qid; max 800 mg qd.
Meloxicam (Mobic)	NSAID	Tab: 7.5 mg	7.5 mg qd; max 15 mg qd. GI ulceration.
Memantine (Namenda)	Alzheimer's agent	Tab: 5, 10 mg	5 mg qd–10 mg bid; max 20 mg/day. Rash, bradycardia, syncopy.
Meningococcal vaccine (Menomune)	Vaccine	Inj: 50 mcg/0.5 mL	0.5 mL SC x 1. Fever, headache, malaise.
Meperidine (Demerol)	Narcotic Analgesic	Tab: 50, 100 mg Syr: 50 mg/5 mL Inj: 50, 100 mg/mL	50-100 mg q4-6h prn; respiratory depression; accumulation of normeperidine in renal insufficiency may result in seizures. 25-100 mg IV/IM q4-6h prn; Phenergan, 25 mg, IV/IM is added to enhance analgesia and prevent nausea.
Meropenem (Merrem)	Antibiotic	Inj: 500 mg	500-1000 mg IV q8h; reduce in renal insufficiency; similar to imipenem-cilastatin for resistant infections.
Mesalamine (Asacol, Pentasa, Rowasa)	Ulcerative colitis	Tab: 400 mg Cap: 250 mg Suppository: 500 mg Rectal susp: 4000 mg/60 mL	400-800 mg tid 1 gm qid One suppository PR bid One enema PR qhs; retain for 6-8h
Metformin (Glucophage, Glucophage XR)	Antidiabetic	Tab: 500, 850, 1000 mg Tab XR: 500 mg	500-1000 mg PO bid with meals. Metabolic acidosis in presence of azotemia; GI upset; lactic acidosis in the presence of heart failure, shock, hepatic or renal failure, alcohol intoxication. 500-2000 mg PO once daily
Methimazole (Tapazole)	Anti-thyroid	Tab: 5, 10 mg	5-20 mg tid; monitor for agranulocytosis, hepatitis.
Methocarbamol (Robaxin)	Muscle relaxant	Tab: 500, 750 mg	500-1000 mg PO/IV q4-6h; drowsiness.
Methotrexate (Rheumatrex)	Antirheumatic	Tab: 2.5 mg	7.5 mg once weekly or 2.5 mg q12h x 3 doses once weekly; max 20 mg weekly; monitor CBC, LFTs monthly. Mandatory contraception, teratogenic.
Methyldopa (Aldomet)	Antihypertensive	Tab: 125, 250, 500 mg Inj: 250 mg	250-500 mg PO/IV q6h; may cause impotence.
Methylphenidate (Ritalin, Ritalin LA Metadate ER, Metadate CD)	CNS stimulant	Tab: 5, 10, 20 mg Tab LA: 20, 30, 40, 60 mg Tab ER: 10, 20 mg Cap ER: 20 mg	5-20 mg po after meals tid 20-60 mg qd 10-30 mg after meals bid 20-60 mg after meals qAM
Methylprednisolo-ne acetate (Depo-Medrol)	Glucocorticoid	Inj: 20, 40, 80 mg	20-80 mg IM q1-4 wk
Methylprednisolone (Medrol, Solu-Medrol)	Glucocorticoid	Tab: 2, 4, 8, 16, 24, 32 mg Inj: 40, 125, 500, 1000 mg	30-10 mg qd; hyperglycemia, fluid retention. 40-60 mg IV q6h
Metoclopramide (Reglan)	Antiemetic	Tab: 5, 10 mg Liq: 5 mg/5 mL Inj: 10 mg/mL	5-10 mg PO/IV/IM q6h, max 30 mg q6h; drowsiness, fatigue; dystonic reactions may occur.
Metolazone (Zaroxolyn)	Diuretic	Tab: 2.5, 5, 10 mg	2.5-10 mg qd; max 20 mg/d; 30 min before loop diuretic.
Metoprolol (Lopressor, Toprol XL)	Beta-blocker	Tab: 50, 100 mg Tab ER: 50, 100, 200 mg Inj: 5 mg	25-100 mg bid; **heart failure:** 12.5 mg bid 50-200 mg qd 5 mg IV q6h

Metronidazole (Flagyl, MetroGel, MetroGel Vaginal)	Antibiotic	Tab: 250, 375, 500 mg Inj: 500 mg Vag gel: 0.75% [70 gm]	250-750 mg tid x 7 days; disulfiram-like reaction, metallic taste. 500 mg IV q6-8h One applicatorful intravaginally bid x 5 days
Mexiletine (Mexitil)	Antiarrhythmic	Class IB Cap: 150, 200, 250 mg	150-300 mg tid; confusion and nausea common.
Miconazole (Monistat-3, Monistat-7, Monistat, Micatin)	Antifungal Monistat-3	suppository: 200 mg [3/pak] Monistat-7 suppository: 100 mg [7/pak] Monistat cr: 2% [45 gm] Micatin cr: 2% [15, 30 gm]	One suppository intravaginally qhs x 3 One 1 suppository intravaginally qhs x 7 One applicatorful intravaginally qhs x 7 Apply to affected areas bid.
Midazolam (Versed)	Hypnotic	Inj: 1, 5 mg/mL	2-5 mg IV doses q1-4h prn; or 0.02-0.1 mg/kg/hr IV infusion.
Midodrine (ProAmatine)	Pressor	Tab: 2.5, 5 mg	Initially 2.5 mg tid, titrate to 10 mg tid. Paresthesia, piloerection, urinary retention; used for orthostatic hypotension.
Midodrine (ProAmatine)	Pressor	Tab: 2.5, 5 mg	Initially 2.5 mg tid, titrate to 10 mg tid. Paresthesia, piloerection, urinary retention; used for orthostatic hypotension.
Miglitol (Glyset)	Hypoglycemic	Tab: 25, 50, 100 mg	25 mg tid, then 50-100 mg tid with the first bite of each meal. Delays carbohydrate absorption. Rash, GI upset.
Milrinone (Primacor)	Inotropic agent	Inj: 1 mg/mL [10, 20 mL]	50 mcg/kg IV over 10 min, then 0.375-0.75 mcg/kg/min infusion (40 mg in 200 mL NS); proarrhythmic
Minocycline (Minocin)	Antibiotic	Tab: 50, 100 mg	100-200 mg PO bid; photosensitivity.
Minoxidil (Loniten, Rogaine)	Antihypertensive Hair growth stimulant	Tab: 2.5, 10 mg Soln: 20 mg/mL	5-20 mg qid Apply 2-3 mL to scalp bid; OTC; effectiveness is doubtful; continuous use required to maintain hair growth.
Mirtazapine (Remeron)	Antidepressant	Tab: 15, 30,45 mg	15 mg qhs; max 45 mg qhs
Misoprostol (Cytotec)	Anti-ulcer	Tab: 100, 200 mg	100-200 mg qid; reduce dosage if diarrhea; abortifacient, contraception mandatory.
Modafinil (Provigil)	Analeptic	Tab: 100, 200 mg	200 mg qAM; max 400 mg qam. Nausea, headache. May reduce effectiveness of oral contraceptives.
Moexipril (Univasc)	ACE-inhibitor	Tab: 7.5, 15 mg	One tab qd-bid; max 30 mg/day
Mometasone (Elocon)	Corticosteroids	Cr: 0.1% (15, 45 gm)	Apply a thin layer to affected areas once daily. Pruritus, skin atrophy.
Montelukast (Singulair)	Leukotriene modifier, Antiasthma	Tab: 5, 10 mg	10 mg qd at bedtime for chronic asthma. Headache, abdominal pain; no hepatotoxicity.
Moricizine (Ethmozine)	Antiarrhythmic (Class I)	Tab: 200, 250, 300 mg	200-300 mg q8h; max 900 mg/d
Morphine sulfate (MS Contin, Oramorph SR, Roxanol Kadian)	Narcotic Analgesic	Inj: 0.5, 1, 2, 3, 4 mg Tab: 10, 15, 30 mg Tab CR: 15, 30, 60, 100, 200 mg Tab SR:15, 30, 60,100mg Supp: 5, 10, 20, 30 mg Cap SR: 20, 50, 100 mg	2-8 mg IV/IM q4h prn or 0.03-0.05 mg/kg/hr IV infusion (100 mg/D5W 250 mL). 10-30 mg PO q4h prn 1 tab q8-12h; do not crush tablets 1 tab q12h. Do not break in half or crush tabs. 5-30 mg PR Q3-4h prn 1 cap qd
Moxifloxacin (Avelox)	Antibiotic	Tab: 400 mg	400 mg po q24h for sinusitis, and community-acquired pneumonia. QT prolongation. No advantage over other fluoroquinolones.
Mycophenolate Mofetil (CellCept)	Immunosuppressant	Cap: 250 mg Tab: 500 mg Susp: 200 mg/mL	Inj: 500 mg/vial 1.0-1.5 gm IV/PO bid. Myelosuppression, hypertension, tremor, diarrhea, nausea, vomiting.

Mupirocin (Bactroban)	Topical antibiotic	Oint: 2% [15, 30 gm] Nasal oint: 2% [1 gm]	Apply to affected areas tid. Active against gram positive cocci 0.5 gm (1/2 tube) in each nostril bid x 5 days for MRSA nasal carriers
Mycophenolate		Cap: 250 mg Tab: 500 mg Susp: 200 mg/mL Inj: 500 mg/vial	**Renal transplant**: 1 gm IV/PO bid **Cardiac transplant**: 1.5 gm IV/PO bid **Hepatic transplant**: 1 gm IV bid or 1.5 gm PO bid
Nabumetone (Relafen)	NSAID	Tab: 500, 750 mg	500-1000 mg qd-bid Nadolol (Corgard) Beta-blocker Tab: 20, 40, 80, 120, 160mg 40-80 mg qd, max 320 mg qd; non-cardioselective. Adjust dose in azotemia.
Nafarelin (Synarel)	GNRH-agonist Nasal	soln: 2 mg/mL 10 mL]	One spray bid in alternating nostrils; menopausal-like side effects; usage limited to 6 months because of osteoporosis.
Nafcillin (Nafcil, Unipen)	Antibiotic	Inj: 0.5, 1, 2, 10 g Tab: 250, 500 mg	1-2 gm IV q4-6h 250-500 mg PO qid
Naftifine (Naftin)	Antifungal	Crm: 1% [15, 30, 60 gm] Gel: 1% [20, 40, 60 gm]	Apply to affected area qd-bid. Not effective against Candida sp.
Nalbuphine (Nubain)	Narcotic Analgesic	Inj: 10, 20 mg/mL	10 mg IM/SC/IV q3-6h prn
Naloxone (Narcan)	Narcotic Antagonist	Inj: 0.4, 1 mg/mL	0.4-2 mg IV; can precipitate acute withdrawal in addicts
Naproxen (Naprosyn Naprelan)	NSAID	Tab: 250, 375, 500 mg Tab SR: 375, 500 mg	250-500 mg q6-8h 750-1000 mg once daily
Naproxen sodium (Aleve, Anaprox, Anaprox-DS)	NSAID	Tab: 275 mg Tab DS: 550 mg	550 mg, then 275 mg q6-8h; gastrointestinal upset 550 mg bid
Naratriptan (Amerge)	Antimigraine	Tab: 1, 2.5 mg	1-2.5 mg x 1; may repeat in 4 hrs; max 5 mg/24 hrs. Contraindicated in coronary artery disease, severe azotemia, peripheral or cerebrovascular disease. Serotonin syndrome with SSRIs.
Nateglinide (Starlix)	Hypoglycemic	Tab: 60, 120 mg	60-120 mg tid before meals, alone or with metformin. Significantly metabolized by cytochrome p450.
Nedocromil (Tilade)	Mast cell stabilizer	Aerosol: [16.2 gm]	2 puffs qid; asthma prophylaxis in stable patients
Nefazodone (Serzone)	Antidepressant	Tab: 100, 150, 200, 250 mg	100 mg bid; increase to 200-300 mg bid; headache, somnolence, dry mouth, blurred vision.
Nelfinavir (Viracept)	Antiretroviral protease inhibitor	Tab: 250 mg Powder: 50 mg/g	750 mg tid or 1250 mg bid in a combination regimen; diarrhea, hepatotoxic.
Neomycin (Mycifradin, Myciguent)	Antibiotic	Tab: 500 mg Cream, oint: 0.5% [15, 30 gm]	1 gm q4-6h for GI tract sterilization Apply to affected area(s) qd-qid
Nesiritide (Natrecor)	Vasodilator	Inj: 1.5 mg/vial	2 mcg/kg IV bolus, then 0.01 mcg/kg/min; titrate dose no sooner than q3h to max 0.03 mcg/kg/min. Mild diuretic effect.
Nevirapine (Viramune)	Antiretroviral	Tab: 200 mg	200 mg bid in a combination regimen; rash, diarrhea, drug fever, hepatotoxic
Niacin (Niaspan)	Antihyperlipidemic	Tab: 100, 250, 500 mg Tab ER: 500, 750, 1000mg	100-250 mg qd with meals; max 3000 mg/day; flushing reaction reduced by 1 aspirin 30 min before; contraindicated in hepatic disease, Diabetes, or gout. 500 mg qhs x 1-4 weeks, then 750-1000 mg qhs. Aspirin 325 mg 30 minutes prior to each dose, may reduce flushing.

Nicardipine (Cardene, Cardene SR, Cardene IV)	Calcium blocker	Cap: 20, 30 mg Cap SR: 30, 45, 60 mg Inj: 25 mg/10mL	20-40 mg tid 30-60 mg bid 5 mg/hr IV inf, then titrate by 2.5 mg/hr q15 min to 15 mg/hr. Tachycardia, flushing, local phlebitis. Contraindicated in acute CHF.
Nicotine (Nicotrol NS, Habitrol, Nicoderm, Nicorette)	Smoking deterrent	Nasal spray: 0.5mg/spray [10 mL] Patch: 7, 14, 21 mg Gum: 2, 4 mg	1 spray in each nostril, 1-2 times/h; max 10 sprays/hr or 80 sprays/day for 8 weeks, taper over next 4 weeks; higher levels than patches. 21 mg qd x 6 wk, then 14 mg qd x 2 wk, then 7 mg qd x 2 wk; OTC Chew one piece slowly over 20 min when the urge to smoke is felt, up to 10-12/day. Caution in cardiovascular disease.
Nifedipine (Procardia, Procardia-XL)	Calcium blocker	Cap: 10, 20 mg Tab: 30, 60, 90 mg	10-20 mg q6-8h; reflex tachycardia, pedal edema. Non-sustained release formulations may cause unpredictable hypotension resulting in cardiac or CNS ischemia. 30-120 mg qd
Nimodipine (Nimotop)	Calcium blocker	Cap: 30 mg	60 mg q4h; reduces vasospasm in subarachnoid hemorrhage; initiate within 96 hours of event for 21 days; hypotension.
Nisoldipine (Sular)	Calcium blocker	Tab: 10, 20, 30, 40 mg	20-40 mg qd; max 60 mg/day.
Nitrofurantoin (Macrobid)	Antibiotic	Caps: 100 mg	100 mg bid with food; GI side effects common; take with food; interstitial pneumonitis.
Nitrofurantoin (Macrodantin)	Antibiotic	Tab: 50, 100 mg Cap: 25, 50, 100 mg	50-100 mg q6h
Nitroglycerin (Tridil, Nitro-bid, Transderm-nitro, Nitro-dur, Nitrostat SL)	Vasodilator Antianginal	Inj: 25, 50 mg Cap CR: 2.5, 6.5, 9.0 Transderm-nitro patches: 0.1, 0.2, 0.3, 0.4, 0.6 mg/h Nitrostat SL tab: 0.15, 0.3, 0.4, 0.6 mg Nitro-bid oint: 2% [30, 60 gm]	5-10 mcg/min IV infusion; titrate to reduce chest pain or blood pressure (50 mg in 500 mL D5W; conc=0.1 mg/mL). 2.5-9.0 mg bid One patch qd, applied to hairless area; tolerance is prevented with a nitrate-free period; apply after dinner, remove mid-day the next day. Anginal pain follows a circadian rhythm. One tab SL q5min x 3 prn chest pain. 1/2-2 inches topically q6h
Nitroprusside sodium (Nipride)	Vasodilator	Inj: 50 mg	Initially: 0.25-1.0 mcg/kg/min IV (50 mg in 250 mL of D5W), titrate to BP; range 0.25-8 mcg/kg/min; risk of cyanide or thiocyanate toxicity increases with prolonged use or in renal failure.
Nizatidine (Axid)	H2-blocker	Cap: 150, 300 mg	300 mg qhs or 150 mg bid
Norepinephrine (Levophed)	Vasoconstrictor	Amps: 1 mg/mL	8-12 mcg/min IV infusion (4 mg in 500 mL of D5W), titrate to adequate perfusion pressure
Norfloxacin (Noroxin, Chibroxin)	Antibiotic	Tab: 400 mg Ophth soln: 0.3% [5 mL]	400 mg bid; contraindicated in pregnancy and <16 years of age; increases theophylline. 1-2 drops into affected eye(s) q3h.
Nortriptyline (Pamelor)	Antidepressant	Tab: 10, 25, 50, 75 mg	25 mg tid-qid; max 150 mg/day; anticholinergic effects.
Nystatin (Mycostatin, Nilstat, Mycostatin)	Antifungal	Vag tab: 100,000 unit Susp: 100,000 U/mL [60 mL] Cream & oint: 100,000U/g (15, 30g)	One tab intravaginally qhs for 14 days 5-10 mL, swish and swallow, qid or 2 tab tid; not systemically absorbed. Apply to affected areas 2-3 times daily.
Octreotide (Sandostatin, Sandostatin LAR)	Somatostatin analogue	Inj: 50, 100, 500 mcg/mL Inj: 10, 20, 30 mg	**Variceal bleeding:** 50 mcg IV over 5-10 min, then 50 mcg/hr IV infusion; nausea, abdominal discomfort. **VIPoma:** 20 mg IM q4weeks.
Ofloxacin (Floxin Ocuflox)	Antibiotic	Tab: 200, 300, 400 mg Inj: 200, 400 mg Ophth soln: 0.3% (1, 5, 10 mL)	200-400 mg PO/IV bid; poor coverage for gram positive infections. **Pelvic inflammatory disease**: 400 mg PO bid x 2 weeks Instill 1-2 drops in affected eyes, 8 times per day x 2 days, then qid for total of 7 days.
Olanzapine (Zyprexa)	Antipsychotic	Tab: 2.5, 5, 7.5, 10, 15, 20mg Tab, orally disintegrating: 5, 10, 15, 20mg	5-10 mg qd; max 20 mg qd. Orthostatic hypotension, hyperthermia with heat exposure. **Schizophrenia**: 5-10 mg qd; max 20 mg qd.

		Inj: 10 mg	**Bipolar mania:** 10-15 mg qd; max 20 mg qd. 10 mg IM q2-4h prn; max 3 doses within 24 hours. Hypotension, somnolence, asthenia.
Olopatadine (Patanol)	Antihistamine	Ophth soln: 0.1% (5mL)	1-2 drops in each affected eye bid; headache frequent.
Olsalazine (Dipentum)	Ulcerative colitis	Cap: 250 mg	500 mg bid; take with food; bowel anti-inflammatory.
Omalizumab (Xolair)	Immunomodulant	Inj: 150 mg/1.2mL	Persistent asthma: 150-375 mg SC q2-4weeks. Injection site reaction, URI, headache, pharyngitis.
Omeprazole (Prilosec)	Proton pump inhibitor	Cap SR: 10, 20 mg	10-20 mg qd-bid; constipation, rash.
Ondansetron (Zofran) Zofran ODT)	Antiemetic	Tab: 4, 8, 24, mg Soln: 4 mg/5 mL Inj: 2 mg/mL Orally disintegrating tabs: 4, 8, mg	4-8 mg bid-tid or 24 mg x 1 an hour before chemotherapy. May cause EPS. 0.15 mg/kg IV over 15 min, 30 min prior to chemotherapy; diarrhea, headache. 8 mg bid-tid Orlistat (Xenical) Lipase-inhibitor Cap: 120 mg 1 capsule tid with each fatty meal. Flatulence and fecal urgency frequent.
Orphenadrine (Norflex)	Muscle relaxant	Tab SR: 100 mg Inj: 30 mg/mL	100 mg bid or 60 mg IM/IV q12h; anticholinergic effects.
Oseltamivir (Tamiflu)	Antiviral	Cap: 75 mg Susp: 12 mg/mL	75 mg bid x 5 days. GI upset, insomnia, dizziness. Influenza A and B. Decreases severity and duration of viral illness by 1-2 days .
Oxacillin (Prostaphlin)	Antibiotic	Vial: 250, 500 mg, 4 gm	1-2 gm IV q4-6h
Oxandrolone (Oxandrin)	Anabolic steroid	Tab: 2.5 mg	2.5 mg bid-qid x 2-4 weeks; may repeat course prn. Cholestatic jaundice, skin discoloration, ankle swelling, increase INR on warfarin.
Oxaprozin (Daypro)	NSAID	Tab: 600 mg	1-2 tab qd
Oxazepam (Serax)	Anxiolytic	Cap: 10, 15, 30 mg	10-15 mg tid
Oxcarbazepine (Trileptal)	Anticonvulsant	Tab: 150, 300, 600 mg	300-600 mg bid; max 600 mg q6h. Hyponatremia, headache, ataxia, nystagmus.
Oxiconazole (Oxistat)	Antifungal	Cream: 1% [15, 30, 60 gm]Lotion: 1% [30 mL]	Apply to affected areas qd-bid
Oxybutynin (Ditropan, Ditropan XL)	Antispasmodic	Tab: 5 mg Syrup: 1mg/mL Tab ER: 5, 10 mg	5 mg bid-qid; max 20 mg/day; anticholinergic effects. 5-30 mg qd.
Oxycodone (Roxicodone, OxyContin)	Narcotic Analgesic	Tab: 5 mg CR Tab: 10, 20, 40, 80mg	5 mg q4-6h prn pain 1 tab q12h
Oxymetazoline (Afrin)	Nasal decongestant	Soln and spray: 0.05%	2-3 drops or sprays bid x 3-5 days. Rebound congestion. Pamidronate (Aredia) Bone stabilizer Inj: 30, 60, 90 mg **Hypercalcemia**: 60-90 mg IV infusion over 2-24 hrs. May repeat x 1 after 7 days.
Pancuronium (Pavulon)	Neuromuscular blocker	Inj: 1 mg/mL	0.08 mg/kg IV push, then 0.03 mg/kg/hr; tachycardia.
Pantoprazole (Protonix)	Proton pump inhibitor	Tab: 20, 40 mg Inj: 40 mg	40 mg IV/PO qd
Paricalcitol (Zemplar)	Vitamin D Analog	Inj: 5 mcg/mL	0.04-0.1 mcg/kg IV 3 times/week during dialysis. Edema, chills.
Paroxetine (Paxil, Paxil CR)	Antidepressant	Tab: 10, 20, 30, 40 mg Oral soln: 10 mg/5 mL Tab CR: 12.5, 25, 37.5 mg	20-50 mg qd; SSRI, sexual dysfunction, dizziness, diarrhea, dry mouth. 25 mg qd; max 62.5 mg qd.

PCEC (RabAvert)	Rabies Vaccine	Inj: 1 mL	1 mL IM post-exposure, repeat on days 3, 7, 14, and 28 (total 5 doses). No allergic reaction.
Pemirolast (Alamast)	Antiallergic	Ophth soln: 0.1% (10 mL)	1-2 drops in each affected eye qid. Headache, rhinitis, cold/flu symptoms.
Penciclovir (Denavir)	Antiviral	Cream: 1% [2 gm/tube]	Apply to lesions q2h while awake x 4 days. For HSV-1 and 2 labialis.
Penicillin G benzathine (Bicillin L-A)	Antibiotic Bicillin L-A	inj: 0.3 MU/mL	**Syphilis**: 2.4 MU IM. **Streptococcal infections**: 1.2 MU IM. Many streptococcal strains are now resistant to penicillin.
Penicillin G potassium (Pentids)	Antibiotic	Tab: 200,000; 250,000; 400,000; 500,000 U Inj: 0.5, 1.0, 5.0 MU/vial	200,000-500,000 U q6h 1.0-2.0 million U IV q4-6h
Penicillin G procaine (Wycillin)	Antibiotic	Inj: 600,000 U/mL	0.6-1.2 MU IM qd.
Penicillin V potassium (VCillin, Veetids)	Antibiotic	Tab: 125, 250, 500 mg	250-500 mg q6h
Pentamidine (Pentam, NebuPent)	Anti-protozoal	Inj: 300 mg Aerosol: 300 mg	300 mg (4 mg/kg) in 100 mL of D5W over 1h IV qd for 14-21d; hypoglycemia; hypotension with rapid IV. 300 mg in 6 mL water nebulized over 20 min q4 wk.
Pentosan (Elmiron)	Bladder analgesic	Caps: 100 mg	100 mg tid with water on an empty stomach; used for pain of interstitial cystitis; heparin-like compound; may cause bleeding.
Pentoxifylline (Trental)	Anti-claudicant	Tab ER: 400 mg	400 mg tid with meals; minimally effective.
Pergolide (Permax)	Antiparkinson	Tab: 0.05, 0.25, 1 mg	0.05-1 mg tid. Dopamine agonist; orthostatic hypotension, hallucinations.
Perindopril (Aceon)	ACE-inhibitor	Tab: 2, 4, 8 mg	4-8 mg qd; max 16 mg/day. Higher doses may be given in 2 divided doses.
Permethrin (Elimite, Nix)	Scabicide	Cream: 5% [60 gm] Cream rinse: 1% [60 mL]	Apply liberally head to toe; rinse off in 12 hours. Apply to hair liberally for 10 minutes. May repeat in a week.
Perphenazine (Trilafon)	Antipsychotic	Tab: 2, 4, 8, 16 mg; conc: 16 mg/5 mL; inj: 5 mg/mL	8-16 mg tid-qid; max 64 mg/day 2-16 mg IV/IM q6h; intermediate potency.
Phenazopyridine (Pyridium)	Urinary analgesic	Tab: 100, 200 mg	100-200 mg tid; GI disturbances; red-orange urine can stain clothing; reduce dose in azotemia.
Phenobarbital	Anticonvulsant	Tab: 8, 16, 32, 65, 100 mg Inj: 30, 60, 65, 100 mg/mL	Loading dose 15 mg/kg IV, then 30-120 mg PO/IV/IM bid. Reduces the effect of oral contraceptives.
Phentermine (Ionamin, Fastin)	Anorexiant	Cap: 15, 30 mg	15-30 mg qAM; agitation, irritability, insomnia.
Phenylephrine (Neosynephrine)	Nasal decongestant	Soln: 0.125, 0.25, 0.5 % [15 mL]	1-2 sprays in each nostril q4h x 3-5 days. Rebound congestion.
Phenytoin (Dilantin)	Anticonvulsant	Cap: 100 mg Inj: 100 mg	200-300 mg PO/IV qd-bid; cardiac depressant IV; monitor levels; nystagmus and ataxia are early signs of toxicity; gum hyperplasia, hirsutism; avoid in pregnancy. Reduces the effect of carbamazepine and oral contraceptives.
Phosphate (K-Phos, Neutraphos)	Mineral	Cap, packet: 250 mg	1-2 cap or packet tid; may cause diarrhea.

Phytonadione (Mephyton)	Vitamin K	Tab: 5 mg Inj: 1 mg, 10 mg	5-10 mg qd Partial reversal of INR: 0.5-1 mg; complete reversal: 10 mg SQ/IV over 1 hr.
Pindolol (Visken)	Beta-blocker	Tab: 5, 10 mg	5-30 mg bid; non-selective antagonist with intrinsic sympathomimetic activity.
Pioglitazone (Actos)	Hypoglycemic	Tab: 15, 30, 45 mg	15-30 mg qd, max 45 mg qd. Hepatotoxic
Piperacillin (Pipracil)	Antibiotic	Inj: 2, 3, 4 gm	2-4 gm IV q4-6h
Pirbuterol (Maxair)	Bronchodilator	Inhaler: [25.6 gm]	2 puffs q4-6h prn; max 12 puffs/day; selective beta-2 agonist.
Piroxicam (Feldene)	NSAID	Cap: 10, 20 mg	10 mg bid or 20 mg qd
Pneumococcal vaccine (Pneumovax 23)	Vaccine	Inj: 25 mcg/0.5mL	0.5 mL SC x 1. Fever, myalgia.
Podofilox (Condylox)	Keratolytic	Soln: 0.5% [3.5 mL]	Apply to affected area(s) bid
Poliovirus (IPOL)	Vaccine	Inj: 3 types of poliovirus	0.5 mL SC; repeat in 1 and 6 months.
Podofilox (Condylox)	Keratolytic	Soln: 0.5% [3.5 mL]	Apply to affected area(s) bid
Poliovirus (IPOL)	Vaccine	Inj: 3 types of poliovirus	0.5 mL SC; repeat in 1 and 6 months.
Polyethylene glycol (CoLyte, GoLYTELY)	Laxative	Soln: 1 gal Soln: 4 Liters	8 ounces q10min until 1 gallon finished
Potassium chloride (K-Dur, Micro-K, Slow-K)	Mineral	Tab: 10, 20 mEq Tab: 10 mEq Tab: 8 mEq Liq: 20 mEq/15 mL	1-2 tabs qd-bid 1-2 tabs qd-bid 1-2 tabs qd-bid 20-40 mEq qd-bid
Potassium phosphate (K-Phos)	Mineral	Inj: 3 mmol/mL	0.25-0.5 mmol/kg IV at 10 mmol/hr
Pramipexole (Mirapex)	Antiparkinson	Tab: 0.125, 0.25, 1, 1.5 mg	0.125 mg tid; max 1.5 mg tid. Hallucinations, somnolence, dry mouth, dyskinesia. Reduce dose if azotemia.
Pravastatin (Pravachol)	Antihyperlipidemic	Tab: 10, 20, 40, 80 mg	10-80 mg qhs; myopathy, hepatitis
Praziquantel (Biltricide)	Anthelmintic	Tab: 600 mg	20 mg/kg (1200-1800 mg) tid x 3 doses.
Prazosin (Minipress)	Vasodilator Prostate relaxant	Cap: 1, 2, 5 mg	Initially 1 mg bid-tid; increase 5-15 mg bid-tid; orthostatic hypotension; first dose at bedtime; caution in coronary artery disease. **Benign prostatic hypertrophy**: 1-2 mg qhs.
Prednisolone (Delta Cortef, Pred Forte)	Glucocorticoid	Tab: 5 mg Ophth susp: 1% [5, 10, 15 mL]	5.0-60 mg qAM 1 drop in affected eye(s) tid-qid
Prednisolone	Glucocorticoid	Inj: 20 mg/mL	40-60 IV/IM qam
Prednisone (Inflamase)	Corticosteroid	Ophth soln: 1% [5, 10 mL]	1 drop in affected eye(s) q1-4h
Prednisone (Deltasone)	Glucocorticoid	Tab: 1, 2.5, 5, 10, 20, 50 mg	5-60 mg qd
Primaquine (Primaquine)	Antimalarial	Tab: 26.3 mg	One tab qd x 2 weeks concurrently with chloroquine.

Primidone (Mysoline)	Anticonvulsant	Tab Scored: 50, 250 mg	Initially 125 mg qd, increase to 250-500 mg tid-qid
Probenecid (Benemid)	Anti-gout	Tab: 500 mg	250-500 mg bid. Use in acute gout with hyperuricemia may result in urate obstructive uropathy.
Procainamide (Procan, Procanbid)	Antiarrhythmic Class IA	Cap: 250, 375, 500 mg Inj: 100, 500 mg/mL Tab SR: 500, 1000 mg	250-500 mg q4-6h; lupus syndrome. Loading Dose: 15 mg/kg IV at 20 mg/min, then 1-4 mg/min IV infusion (2 gm in 250 mL NS = 8 mg/mL); hypotension. 1-2 tabs bid
Prochlorperazine (Compazine)	Antiemetic	Tab: 5, 10, 25 mg Supp: 2.5, 5, 25 mg Inj: 5, 10 mg	5-10 mg PO/PR q4-6h prn; max 100 mg/d; anticholinergic and extrapyramidal effects. 5-10 mg IM q5-6h prn; anticholinergic and extrapyramidal effects.
Procyclidine (Kemadrin)	Antiparkinsonian	Tab: 5 mg	2.5-5 mg tid; anticholinergic effects; more effective for rigidity than tremors.
Progesterone (Progestasert)	Contraceptive	Intrauterine system: 38 mg progesterone	Insert a single unit into the uterine cavity once a year. Do not use if history of PID. Endometritis, vaginitis.
Promethazine (Phenergan)	Antihistamine	Tab: 12.5, 25, 50 mg Supp: 12.5, 25, 50 mg Inj: 25, 50 mg/mL	12.5-50 mg PO/IV/IM/PR q4-6h prn; drowsiness, anticholinergic and extrapyramidal effects.
Propafenone (Rythmol)	Antiarrhythmic Class IC	Tab: 150, 225, 300 mg	150-300 mg q8h; max 1200 mg/d; may cause dizziness, impairment of taste.
Propofol (Diprevan) Sedative	Anticonvulsant	Inj: 10 mg/mL	**ICU sedation:** 5-10 mcg/kg/min, titrated q5min to max 100mcg/kg/min. **Anticonvulsant:** 2mg/kg IV over 2-5 min, then 50 mcg/kg/min, titrated to 165 mcg/kg/min.
Propoxyphene (Darvon, Darvon-N)	Narcotic Analgesic	Cap: 65 mg Tab: 100 mg	65 mg q4-6h prn 100 mg q4-6h prn; max 600 mg/day
Propranolol (Inderal, Inderal LA)	Beta-blocker	Tab: 10, 20, 40, 60, 80 mg Cap SR: 60, 80, 120, 160 mg	Initially 40 mg bid then 60-80 mg tid 60-320 mg qd; contraindicated in asthma, diabetes, heart block or failure.
Propylthiouracil (PTU)	Anti-thyroid	Tab: 50 mg	300 mg PO, then 50-250 mg q8h; hepatotoxic, rash, arthralgia.
Protamine (Protamine)	Heparin antidote	Vial and amps: 10 mg/mL	10-50 mg IV over 10-20 min
Protriptyline (Vivactil)	Antidepressant	Tab: 5, 10 mg	5-10 mg tid; max 60 mg/day; bone marrow depression, confusion.
Pyrazinamide (PZA)	Tuberculostatic	Tab: 500 mg	15-30 mg/kg qd (1500 mg qd); hepatotoxic.
Pyridoxine (Vitamin B6)	Vitamin	Tab: 25, 50, 100 mg Inj: 100 mg/mL	25-100 mg PO/IV qd Deficiency: 10-20 mg/day for 3 wk
Pyrimethamine (Daraprim)	Antiprotozoal	Tab: 25 mg	**Acute malaria:** 50 mg qd x 2. Prophylaxis: 25 mg once a week **Toxoplasmosis:** 200 mg loading dose, then 50-75 mg qd, and folinic acid 10-20 mg PO qd. Folate deficiency, megaloblastic anemia. Quazepam (Doral) Hypnotic Tab: 7.5, 15 mg 7.5-15 mg qhs; reduce dosage in the elderly
Quetiapine (Seroquel)	Antipsychotic	Tab: 25, 100, 200 mg	25-50 mg bid; max 200 mg bid. Somnolence and dizziness common.
Quinapril (Accupril)	ACE-inhibitor	Tab: 5, 10, 20, 40 mg	Initial dose: 10 mg qd, then 20-40 mg qd-bid.
Quinidine gluconate (Quinaglute)	Antiarrhythmic Class IA	Tab: 330 mg Inj: 800 mg/10 mL	330 mg PO/IM tid; diarrhea, GI distress, light-headedness. 15 mg/kg in 150 mL D5W IV over 4-6h, then 0.06-0.08 mg/kg/h IV infusion; IV is rarely used because of hypotension.

Quinidine sulfate (Quinidex)	Antiarrhythmic Class IA	Tab: 200, 300 mg Tab SR: 300 mg	200-300 mg tid-qid 1-2 tabs bid
Quinine (Quinamm)	Antimalarial	Cap: 200, 300, 325 mg Tab: 260 mg	**Antimalarial:** 600-650 mg q8h x 5-7 days
Quinupristin (Synercid)	Antibiotic	Inj: 500 mg	**Vancomycin-resistant enterococcus and other life-threatening infections:** 7.5 mg/kg IV q8h. Active against E. faecium, but not E. faecalis. **S. aureus or S. pyogenes:**7.5 mg/kg IV q12h. Arthralgia, myalgia.
Rabeprazole (Aciphex)	Proton Pump Inhibitor	Tab: 20 mg	20 mg qd. Headache, GI upset, gynecomastia.
Raloxifene (Evista)	Anti-osteoporotic	Tab: 60 mg	60 mg qd; hot flushes, leg cramps, venous thromboembolism.
Ramipril (Altace)	ACE-inhibitor	Cap: 1.25, 2.5, 5, 10 mg	2.5-10 mg bid; first dose hypotension; chronic cough.
Ranitidine (Zantac)	H2-blocker	Tab: 150, 300 mg Oral soln: 150 mg/10mL Inj: 50 mg	150 mg bid or 300 mg qhs; reduce in renal failure. **Maintenance:** 150 mg qhs50 mg IV q8h or 6.25 mg/h IV infusion (150 mg in 250 mL D5W at 11 mL/hr).
Repaglinide (Prandin)	Hypoglycemic	Tab: 0.5, 1, 2 mg	0.5-4 mg with each meal, max 16 mg/day; hypoglycemia common; similar to glyburide.
Reteplase (Retavase)	Thrombolytic	Inj: 10 U/vial	10 U IV over 2 min, then 10 U IV 30 min later.
Rifabutin (Mycobutin)	Tuberculostatic	Cap: 150 mg	300 mg qd, or 150 mg bid; prevention or treatment of MAC in HIV infection. Rash, GI upset, neutropenia, discolored urine.
Rifampin (Rimactane, Rifadin)	Tuberculostatic	Cap: 150, 300 mg Inj: 600 mg	600 mg PO/IV qd; 10 mg/kg/day; orange-red discoloration of secretions; hepatotoxic; enhances metabolism of contraceptives and theophylline. May reduce effect of dapsone and phenytoin.
Rifapentine (Priftin)	Tuberculostatic	Tab: 150 mg	Four tabs twice a week x 2 months. Pyridoxine supplementation is recommended
Rifaximin (Xifaxan)	Antibiotic	Tab: 200 mg	**Traveler's diarrhea**: 200 mg tid x 3 days. No systemic absorption.
Rimantadine (Flumadine)	Antiviral	Tab: 100 mg	100 mg bid x 2 weeks; prophylaxis and treatment of influenza A only. GI upset.
Risedronate (Actonel)	Anti-osteoporotic Bone stabilizer	Tab: 5, 30 mg	5 mg qAM with 8 oz. water. Esophageal and gastric ulcers **Paget's disease**: 30 mg qd x 2 months
Risperidone (Risperdal)	Antipsychotic	Tab: 0.25, 0.5, 1, 2, 3, 4, mg	Oral soln: 1 mg/mL Initial dose: 0.5-1 mg bid, then 2-3 mg bid; max 8 mg bid. Anxiety, somnolence, GI and extrapyramidal symptoms. Also effective in bipolar disorders.
Ritonavir (Norvir)	Antiretroviral Protease inhibitor	Caps: 100-mg Soln: 80 mg/mL	600 mg bid; use in combination with a nucleoside analogue to prevent resistance; gastrointestinal disturbances, perioral paresthesias.
Rivastigmine (Exelon)	Alzheimer's agent	Cap: 1.5, 3, 4.5, 6 mg Soln: 2 mg/mL	1.5 mg bid; increase the dose q2weeks to 3, 4.5, 6 mg bid. Nausea, vomiting, anorexia, dizziness.
Rizatriptan (Maxalt, Maxalt-MLT)	Antimigraine	Tab: 5, 10 mg Tab SL: 5, 10 mg	5-10 mg PO/SL at least 2 hrs apart; max 30 mg/24 hrs. Max 15mg/24 hr if receiving propranolol.
Rofecoxib (Vioxx)	COX-2 inhibitor	Tab: 12.5, 25, 50 mg Susp: 12.5 mg/5 mL, 25 mg/5mL	25-50 mg qd. Less GI ulceration than NSAIDs. No effect on platelet count or aggregation.
Ropinirole (Reequip)	Antiparkinson	Tab: 0.25, 0.5, 1, 2, 5 mg	0.25 mg tid; max 8 mg tid; nausea

Rosiglitazone (Avandia)	Hypoglycemic	Tab: 2, 4, 8 mg	2 mg bid or 4 mg qd; max 8 mg/day. Less hepatotoxic than troglitazone.
Rosuvastatin (Crestor)	Antihyperlipidemic	Tab: 5, 10, 20, 40 mg	10 mg PO qhs; max 40 mg qhs. Myopathy, increased warfarin effect. Max 10 mg qhs if creatinine clearance <30 mL/min or concomitant gemfibrozil therapy.
Salmeterol (Serevent, Serevent Diskus)	Bronchodilators	Aerosol Diskus inh: 50 mcg	2 puffs bid; long acting beta-2 agonist; not for acute attacks; prevents exercise-induced or nocturnal asthma 50 mcg by inhalation bid.
Salsalate (Disalcid)	NSAID	Cap: 500 mg Tab: 500, 750 mg	500-1000 mg tid; GI upset, gastritis, nephropathy with chronic use.
Saquinavir (Invirase)	Antiretroviral Protease inhibitor	Cap: 200 mg	600 mg tid; use in combination regimen; poor bioavailability; diarrhea, nausea, abdominal pain.
Scopolamine (Transderm-scop)	Antiemetic	Transdermal patch: 1.5 mg [box of 4]	1 patch q3d; apply 1 hour prior to travel; dry mouth, drowsiness, blurred vision; pupil dilates if drug comes in contact with eye.
Selegiline (Eldepryl)	Antiparkinson	Tab: 5 mg	5 mg with breakfast and lunch every day. Adjunct to levodopa/carbidopa.
Sevelamer (Renagel)	Phosphate binder	Cap: 403 mg	2-4 caps tid with meals. Dyspepsia, vomiting.
Senna (Senokot)	Laxative, irritant	Tab: 187 mg Supp: 652 mg	1-2 tabs qhs Insert 1 PR qhs
Sertraline (Zoloft)	Antidepressant	Tab: 25, 50, 100 mg Oral conc: 20 mg/mL	50 mg qd; max 200 mg qd. Also useful in obsessive-compulsive disorder, panic disorder, and posttraumatic stress disorder. SSRI; dry mouth, sexual dysfunction.
Sibutramine (Meridia)	Anorexiant	Cap: 5, 10, 15 mg	Initially 10 mg qd, max 15 mg qd after 4 wks. Contraindicated in hypertension, tachycardia, coronary artery disease, or stroke. Serotonin syndrome with SSRIs.
Sildenafil (Viagra)	Erectogenic	Tab: 25, 50, 100 mg	50 mg PO one hour prior to intercourse; dosage range 25-100 mg; headache, flushing, indigestion, altered color perception. Contraindicated within 24 hours of nitrates.
Simvastatin (Zocor)	Antihyperlipidemic	Tab: 5, 10, 20, 40, 80 mg	5-40 mg qhs; 5-10 mg qhs in azotemia. Hepatotoxic, myositis, ocular opacity.
Sirolimus (Rapamune)	Immunosuppressant	Oral soln: 1 mg/mL	15 mg loading, then 5 mg qd with cyclosporine or corticosteroids. Anemia, leukopenia, thrombocytopenia, hypokalemia, hyperlipidemia, diarrhea.
Sodium ferric gluconate complex (Ferrlecit)	Mineral	Inj: 12.5 mg/mL elemental iron	Test dose: 25 mg IV over 1 hr, then 125 mg IV over 1 hr during each dialysis, up to total max dose 1000 mg. Flushing, hypotension.
Sodium polystyrene (Kayexalate)	Potassium exchange resin	Susp: 15 gm/30 mL	30-45 gm PO/NG/PR; premixed with 20% sorbitol.
Sotalol (Betapace, Betapace AF)	Antiarrhythmic Class III	Tab: 80, 120, 160, 240 mg Tab: 80, 120, 160 mg	40-80 mg bid; max 320 mg/day in 2-3 doses; potent beta-blocker; may prolong QT interval. Adjust dose in azotemia. 80-160 mg bid
Sparfloxacin (Zagam)	Antibiotic	Tab: 200 mg	400 mg x 1, then 200 mg qd x 10. Chronic bronchitis, communityacquired pneumonia, photosensitivity.
Spironolactone (Aldactone)	Diuretic	Tab: 25, 50, 100 mg	25-100 mg qd; hyperkalemia, gynecomastia, drug fever, GI upset, hirsutism.
Stavudine (Zerit, Zerit XR)	Antiretroviral	Cap: 15, 20, 30, 40 mg Cap ER: 37.5, 50, 75, 100 mg	40 mg bid; peripheral neuropathy, hepatotoxic. 100 mg once daily. Reduce dose in presence of peripheral neuropathy.

Streptokinase (Streptase)	Thrombolytic	Inj: 250,000, 750,000 U	**Myocardial infarction:** 1.5 million U IV infusion over 60 min. **Pulmonary embolism or venous thrombosis:** 250,000 U IV over 30 min, then 100,000 U/hr IV infusion x 72 hours. Pretreat with diphenhydramine 50 mg IV and methylprednisolone 250 mg IV; ineffective if streptokinase in last 6 months.
Sucralfate (Carafate)	Anti-ulcer	Tab: 1 gm Syr: 1 gm/10 mL	1 gm qid one hour before meals on an empty stomach; constipation frequent; antacids decrease activity.
Sulfacetamide (Bleph-10)	Ophthalmalgic Antiinfective	Ophth soln: 10, 15% [2.5, 5, 15 mL] Ophth oint: 10% [3.5 gm]	1-3 drop in lower conjunctival sac q2-3h . Apply small amount in the lower conjunctival sac qid and qhs.
Sulfasalazine (Azulfidine Azulfidine EN-tabs)	Ulcerative colitis Rheumatoid arthritis	Tab: 500 mg Susp: 250 mg/5 mL [Pint] EN-tab: 500 mg	500-1000 mg bid, increase to qid over 10 days. Headache, anorexia, GI upset, reversible oligospermia. 1-2 tabs bid
Sulfisoxazole (Gantrisin)	Antimicrobial	Tab: 500 mg Ophth soln: 4% [15 mL] Ophth oint: 4% [3.75 gm]	500-1000 mg qid 1-3 drops in affected area(s) q2-3h Apply small amount to eye(s)bid-qid
Sulindac (Clinoril)	NSAID	Tab: 150, 200 mg	150-200 mg bid
Sumatriptan (Imitrex)	Antimigraine Tab: 25, 50 mg	Inj: 12 mg/mL Nasal spray: Unit dose [5, 20 mg]	25-50 mg PO once; may repeat in 2 hours; max 200 mg/d. 6 mg SQ; may repeat in 1-2 hours; max 12 mg/day. 5, 10, or 20 mg in one nostril; may repeat after 2 hours; max 40 mg/d; one unit dose per inhaler. Contraindicated in coronary artery disease; palpitations, tingling, facial flush, dizziness.
Tacrine (Cognex)	Alzheimer's agent	Cap: 10, 20, 30, 40 mg	10 mg qid, gradually increase to 40 mg qid. Hepatotoxic; monitor LFTs bimonthly x 4 months, then every 3 months; neutropenia.
Tadalafil (Cialis)	Erectogenic	Tab: 5, 10, 20 mg	10-20 mg no more than once daily; 5 mg no more than once daily in presence of mod-severe azotemia. Metabolism impaired by CYP3A4 inhibitors. Avoid concurrent use with nitrates.
Tamsulosin (Flomax)	Prostate relaxant	Cap: 0.4 mg	0.4-0.8 mg qhs; hypotension, dizziness, rhinitis, retrograde ejaculation.
Tazarotene (Tazorac)	Antipsoriatic	Gel: 0.05, 0.1% [30, 100 gm]	Apply thin layer to dry lesions qhs; max duration 12 weeks. Mandatory contraception, teratogenic, pruritus, erythema.
Tegaserod (Zelnorm)	Bowel disease (IBS)	Tab: 2, 6 mg	6 mg bid x 4-6 weeks. Diarrhea, abdominal pain.
Telmisartan (Micardis)	Angiotensin-II receptor blocker	Tab: 40, 80 mg	One tab qd; max 80 mg/day.
Temazepam (Restoril)	Hypnotic	Cap: 7.5, 15, 30 mg	15-30 mg qhs; 7.5 mg qhs in elderly.
Tenecteplase (TNKase)	Thrombolytic	Inj: 50 mg	**Myocardial infarction:**< 60 kg 30 mg IVP; $ 60 to < 70 kg 35 mg IVP; $70 to < 80 kg 40 mg IVP; $ 80 to < 90 45 mg IVP; $ 90 kg 50 mg IVP Tenofovir (Viread) Antiretroviral Tab: 300 mg 300 mg PO qd with food. Nausea, diarrhea, vomiting.
Terazosin (Hytrin)	Antihypertensive Prostate relaxant	Tab: 1, 2, 5, 10 mg	**Hypertension:** 1-10 mg qhs; first-dose hypotension; peripheral edema; caution in atherosclerotic disease. **Benign prostatic hyperplasia:** 1-2 mg qhs Terbinafine (Lamisil) Antifungal Cream: 1% [15, 30 gm] Tab: 250 mg Apply to affected area(s) bid x 1-4 wk; ineffective against Candida sp. **Tinea nail infections:** 250 mg qd; fingernails for 6 weeks; toenails for 12 weeks; ineffective against Candida, diarrhea, dyspepsia.
Terconazole (Terazol 7, Terazol 3)	Antifungal	Cream: 0.4% [45 gm] Cream: 0.8% [20 gm] Vag suppository: 80 mg [3]	One applicatorful intravaginally qhs x 7 days One applicatorful intravaginally qhs x 3 days One suppository intravaginally qhs x 3 days

Teriparatide (Forteo)	Parathyroid hormone	Inj. 250 mcg/mL	20 mcg SC qd. Hypercalcemia, hyperuricemia, hypercalciuria.
Testosterone cypionate (Depo-Testosterone)	Androgen	Inj: 100, 200 mg/mL	100-400 mg IM q2-4 weeks; hirsutism, gynecomastia, cholestatic jaundice, decreased clotting factors.
Testosterone enanthate (Delatestryl)	Androgen	Inj: 100, 200 mg/mL	100-400 mg IM q2-4 weeks
Testosterone propionate (Testex)	Androgen	Inj: 100 mg/mL	100-400 mg IM q2-4 weeks
Testosterone transdermal (Testoderm, Androderm)	Androgen	Patch: 4 mg/24h, 6 mg/24h Patch: 2.5 mg/24h	Apply patch to hairless area of scrotum qd; hirsutism, hepatitis. Apply 2 patches qd to hairless skin; do not apply to scrotum. Tetanus toxoid Vaccine Inj: 0.5 mL 0.5 mL IM, repeat in 4-8 weeks, and in 6-12 months. Booster q5-10 years.
Tetracycline (Achromycin, Sumycin)	Antibiotic	Tab: 250, 500 mg	250-500 mg qid; enamel discoloration, photosensitivity; contraindicated in renal insufficiency or hepatic failure.
Theophylline (Constant-T, Slo-Bid, Slophyllin, Theo-Dur, Theo-24)	Bronchodilator	Constant-T: 200, 300 mg	Slo-bid cap: 50, 100,200, 300 mg Slophyllin: 100, 200 mg Theo-Dur: 100, 200, 300 mg Theo-24: 100, 200, 300, 400 mg 200-300 mg bid 50-300 mg bid 100-400 mg bid 100-400 mg bid 100-400 mg qd; cimetidine, quinolones, macrolides increase theophylline level; nausea, vomiting, tachycardia, seizures.
Theophylline (Aminophylline)	Bronchodilator	Inj: 25, 250 mg/mL	Load: 5.6 mg/kg **total** body weight IV over 60 min. Maintenance: 0.5-0.6 mg/kg **ideal** body weight/per hour IV infusion.
Thiabendazole (Mintezol)	Anthelmintic	Tab: 500 mg	22 mg/kg qd x 2 days
Thiamine (Vitamin B-1)	Vitamin	Tab: 50, 100, 250, 500	100 mg PO/IM/IV qd
Thioridazine (Mellaril)	Antipsychotic	Tab: 10, 15, 25, 50, 100, 150, 200 mg	25-100 mg bid-tid; max 800 mg/day; low extrapyramidal effects; anticholinergic effects, sedation.
Thiothixene (Navane)	Antipsychotic	Cap: 1, 2, 5, 10, 20 mg Inj: 2, 5 mg/mL	2-5 mg bid-tid, max 60 mg/day; drowsiness and extrapyramidal effects. 4 mg IM bid-qid, max 30 mg/day
Tiagabine (Gabitril)	Anticonvulsant	Tab: 2, 4, 12, 16, 20 mg	4 mg qd then increase every 4-8 weeks to 32-56 mg/day in 2-4 divided doses daily. Adjunct treatment in partial complex seizures. Decreased cognitive function, depression.
Ticarcillin (Ticar)	Antibiotic	Inj: 1, 3, 6 gm	2-3 gm IV q4-6h (300 mg/kg/day); hypokalemia, platelet dysfunction.
Ticlopidine (Ticlid)	Antiplatelet agent	Tab: 250 mg	250 mg bid with meals; reversible neutropenia.
Tiludronate (Skelid)	Bone stabilizer	Tab: 240 mg	2 tabs PO qd x 3 months. Take with 8 oz. plain water, remain upright for 1 hour. Supplement calcium and vitamin- D.
Timolol (Blocadren)	Beta-blocker	Tab: 5, 10, 20 mg	5-10 mg tid-qid; non-selective, fatigue.
Tinzaparin (Innohep)	Anticoagulant LMW heparin	Inj: 20,000 IU/ml	**DVT with or without uncomplicated PE:** 175 IU/kg SC q24h. Injection site skin necrosis, nodules, inflammation, and oozing common.

Tioconazole (Vagistat)	Antifungal	Vag oint: 6.5% [4.6 gm]	1 applicatorful intravaginally qhs
Tirofiban (Aggrastat)	Antiplatelet	Inj: 25, 50 mcg/mL	0.4 mcg/kg/min x 30 min, then 0.1 mcg/kg/min IV infusion. Reduce dosage by 50% if creatinine clearance is <30 mL/min.
Tissue plasminogen activator (Activase, t-PA, Alteplase)	Thrombolytic	Vial: 20, 50, 100 mg	**Myocardial infarction:** 15 mg IV push, then 0.75 mg/kg (up to 50 mg) IV over 30 min, then 0.5 mg/kg (up to 35 mg) IV over 60 min. **Pulmonary embolism:** 100 mg IV over 2 hours **Ischemic stroke:** 0.9 mg/kg (max 90 mg); give 10% of dose IVP, then remainder over 60 min. Give within 3 hours of stroke; exclude hemorrhage first.
Tizanidine (Zanaflex)	Muscle relaxant	Tab: 4 mg	1-2 tabs q6-8h prn; max 36 mg/day. Orthostatic hypotension, sedation, dry mouth
Tobramycin (Nebcin, Tobrex, Tobi)	Antibiotic	Vial: 20, 80 mg/2 mL Ophth soln: 0.3% [5 mL] Ophth oint: 0.3% [3.5 gm] Nebulizer soln: 300 mg/5mL	2 mg/kg IV, then 1.5 mg/kg IV q8h; nephrotoxic, ototoxic; decrease in renal insufficiency; monitor levels **Once daily dosing**: 5 mg/kg IV q24h. Maintain peak level of 20-24 and trough <0.1 mcg/mL; not suitable in azotemic patients. 1-2 drops into affected eye(s) q1-4h Apply ointment to affected eye(s) q3-8h **Cystic fibrosis**: 300 mg over 15 min bid via hand-held nebulizer x 28 days, then off x 28 days; repeat cycle.
Tocainide (Tonocard)	Antiarrhythmic Class IB	Tab: 400, 600 mg	400-600 mg q8-12h; confusion, GI upset.
Tolcapone (Tasmar)	Antiparkinson	Tab: 100, 200 mg	100-200 mg tid; max 600 mg daily; somnolence, anorexia. Hepatotoxic, monitor liver function q2 weeks x 1 year.
Topiramate (Topamax)	Anticonvulsant	Tab: 25, 100, 200 mg	Initially 50 mg qd, then titrate to max 200 mg bid. Adjunctive treatment of partial onset seizures. Speech difficulties, depression, weight loss.
Torsemide (Demadex)	Loop diuretic	Tab: 5, 10, 20, 100 mg Inj : 10 mg/mL	5-20 mg PO/IV once daily; max 200 mg qd; good oral absorption, (Furosemide 2 mg = Torsemide 1 mg.)
Tramadol (Ultram)	Analgesic	Tab: 50 mg	1-2 tabs q4-6h prn; max 400 mg/day. Non-narcotic; use in patients at high risk of addiction. Risk of seizures.
Trandolapril (Mavik)	ACE-inhibitor	Tab: 1, 2, 4 mg	2-4 mg qd. Black patients may require the higher dose.
Trazodone (Desyrel)	Antidepressant	Tab: 50, 100, 150, 300 mg	150-400 mg in qd-bid; 1-2 weeks required for effect; anticholinergic; priapism rare, orthostatic hypotension, sedation
Treprostinil (Remodulin)	Vasodilator	Inj: 10 mg/mL	**Pulmonary arterial hypertension:** 1.25 ng/kg/min continuos SC infusion. Headache, nausea, emesis, restlessness, anxiety.
Tretinoin (Retin A, Renova)	Anti-acne	Cream: 0.05, 0.1% [20, 45 gm] Gel: 0.01, 0.025% [15, 45 gm] Liq: 0.05% [28 mL] Emollient cream: 0.05% [40, 60 gm]	Apply to affected area(s) qhs; apply to dry skin after washing; photosensitivity may occur; teratogenic, mandatory contraception Apply qhs, 20 minutes after washing; modest improvement in fine wrinkling, hyperpigmentation, rough skin during the first 5-6 months.
Triamcinolone (Azmacort, Aristocort, Kenalog, Nasacort, TriNasal)	Corticosteroid	Inhaler: [20 gm] Tab: 1, 2, 4, 8 mg Cream, oint: 0.025, 0.1, 0.5% [15, 80 gm] Lotion: 0.025% [60 mL], 0.1% [15, 60 mL] Nasal spray: 55 mcg/spray [15 mg]	Spray: Triamcinolone 50 mcg/spray 2-4 puffs bid **Adrenal insufficiency**: 4-12 mg qAM. **Rheumatism**: 8-32 mg qAM Apply to affected area(s) bid-qid 2 sprays in each nostril qd 2-4 sprays in each nostril once daily.
Triazolam (Halcion)	Sedative	Tab: 0.125, 0.25 mg	0.125-0.5 mg qhs prn insomnia; short acting
Trifluoperazine (Stelazine)	Antipsychotic	Tab: 1, 2, 5, 10 mg Inj: 2 mg/mL	2-5 mg bid; anticholinergic effects. 1-2 mg IM q4-6h; max 10 mg/day; decrease dosage in elderly Trifluridine (Viroptic) Antiviral Ophth soln: 1% [7.5 mL]

			1 drop in affected eye(s) q3h x 7-21 days. Active against HSV 1 and 2.
Trihexyphenidyl (Artane)	Anticholinergic	Tab: 2, 5 mg Cap SR: 5 mg	**Extrapyramidal symptoms**: 2-5 mg bid-tid; contraindicated in glaucoma.
Trimethobenzamide (Tigan)	Antiemetic	Cap: 100, 250 mg Suppository: 100, 200 mg Inj: 100 mg/mL	100-250 mg q6h prn. 100-200 mg IM/PR q6h prn nausea
Trimethoprim (Proloprim, Trimpex)	Antibiotic	Tab: 100, 200 mg	Pneumocystis carinii pneumonia: 5 mg/kg tid x 21 days with dapsone 100 mg qd Trospium (Sanctura) Antispasmodic Tab: 20 mg 20 mg PO bid. 20 mg PO qd if age $ 75. Anticholinergic effects.
Trovafloxacin (Trovan)	Antibiotic	Tab: 100, 200 mg Inj: 5 mg/mL Cap	300 mg IV, then 200 mg IV/PO qd x 10-14 days for resistant nosocomial infections only. Fatal hepatotoxicity.
Typhoid vaccine	Vaccine	Inj	SC: 0.5 mL SC x 1, and repeat in 4 weeks Oral: One cap on day #1, 3, 5, and 7
Urokinase (Abbokinase)	Thrombolytic	Vial: 250,000 IU, 5,000 IU	**Pulmonary embolism/venous thrombosis:** 4,400 IU/kg IV over 10 min, then 4,400 IU/kg/hr IV infusion x 12h. **Central line thrombosis:** Inject 5000 U in lumen for 10 min, then aspirate and check for patency; may repeat x 1. **Arterial thrombosis:** 4,000 U/min x 4h, then 1000-2000 U/min by intra-arterial infusion x 24h intra-arterially. Use heparin concurrently.
Valacyclovir (Valtrex)	Antiviral	Caplet: 500 mg Tab: 1 gm	**Herpes zoster:** 1000 mg tid x 7 days. Reduce dose in azotemia. **Herpes simplex:** 500 mg bid x 5 days
Valdecoxib (Bextra)	COX-2 inhibitor	Tab: 10 mg	**Arthritis:** 10 mg qd **Dysmenorrhea:** 20 mg bid prn. Edema, hypertension
Valganciclovir (Valcyte)	Antiviral, antiretrovira	Tab: 450 mg	**CMV retinitis:** 900 mg bid x 21 days, then 900 mg qd. Dosage reduction required if Cr Cl <60 mL/min. Administer with food.
Valproic acid (Depakene)	Anticonvulsant	Cap: 250 mg Inj: 500 mg/5mL Syr:250 mg/mL	250-1000 mg PO/IV tid-qid; max 60 mg/kg/d; hepatotoxic, pancreatitis, GI upset; monitor serum level. Useful when seizures refractory to phenytoin. **Migraine**: 250 mg bid; max 500 mg bid **Mania:** 250 mg tid-500 mg bid
Valsartan (Diovan)	Angiotensin-II receptor antagonist	Cap: 80, 160 mg	80 mg qd; max 320 mg qd. Addition of diuretic is more effective than increasing > 80 mg qd.
Vancomycin (Vancocin)	Antibiotic	Inj: 0.5, 1.0, 5, 10 gm Cap: 125, 250 mg	1 gm IV q12h; monitor serum levels; ototoxic, nephrotoxic. 125-250 mg PO/NG q6h; used for C. Difficile colitis; no systemic absorption. **Recurrent C. difficile:** 500 mg qid x 14 days.
Vardenafil (Levitra)	Erectogenic	Tab: 2.5, 5, 10, 20 mg	5-10 mg PO an hour prior to intercourse. Reduce dose to 2.5 mg if taking CYP3A4 inhibitors. Maximum 10-20 mg once daily. Metabolism impaired by CYP3A4 inhibitors. Avoid concurrent use with nitrates.
Varicella vaccine (Varivax)	Vaccine	Inj: 0.5 mL	0.5 mL SQ and repeat in 4-8 weeks
Vasopressin (Pitressin)	Hormone	Inj: 20 U/mL	**Variceal bleeding**: 20 U IV over 20-30 min, then 0.2-0.3 U/min [100 U in 250 mL of D5W] for 30 min, followed by increases of 0.2 U/min until bleeding stops or max of 0.9 U/min; taper over 48 hours; bradycardia.
Vecuronium (Norcuron)	Neuromuscularblocker	Inj: 10 mg/vial	Induction: 0.1 mg/kg IV push. Maintenance: 0.06 mg/kg/hr IV push or IV infusion (50 mg in 100 mL of D5W; conc = 0.5 mg/mL).
Venlafaxine (Effexor, Effexor XR)	Antidepressant	Tab: 25, 37.5, 50, 75, 100 mg 37.5, 75, or 150 mg	75-225 mg daily in 2-3 divided dosages; max 375 mg qd; hypertension, anxiety, insomnia, somnolence, sexual dysfunction, headache. 37.5-150 mg qd.

Verapamil (Calan, Isoptin, Verelan)	Calcium-blocker	Tab: 40, 80, 120 mg Tab SR: 120, 180, 240 mg Inj : 5 mg/2 mL Caps: 200, 400 IU	40-120 mg tid-qid; constipation common. 120-240 mg qd 2.5-10 mg IV q3-6h Vitamin E Vitamin, Antioxidant 400 IU qd-bid
Voriconazole (Vfend)	Antifungal	Tab: 50, 200 mg Inj: 200 mg	6 mg/kg IV q12h x 2 doses, then 4 mg/kg IV q12h or 200 mg PO q12h (reduce dose to 100mg PO q12h if <40 kg). Fever, rash, nausea, vomiting, headache.
Warfarin (Coumadin)	Anticoagulant	Tab: 1, 2, 2.5, 3, 5, 6, 7.5, 10 mg	5-10 mg qd x 2-3 d, then 2-5 mg qd; titrate to INR 2.0-3.0 (2.5-3.5 for mechanical prosthetic valves); warfarin effect is enhanced by amiodarone, quinolones, cimetidine, zafirlukast, and azole antifungals. Teratogenic.
Zafirlukast (Accolate)		Tab: 20 mg	**Asthma prophylaxis:** 20 mg bid; not for acute attacks; prolongs INR when taken with warfarin.
Zalcitabine, ddC (Hivid)	Antiretroviral	Tab: 0.375, 0.75 mg	0.75 mg tid; oral ulcers, peripheral neuropathy (17-31%), pancreatitis
Zaleplon (Sonata)	Hypnotic	Cap: 5, 10 mg	10 mg immediately before bedtime; range 5-20 mg qhs. Rapid onset, ultra-short duration. Does not alter REM sleep. Less potent and shorter duration of action than zolpidem.
Zanamivir (Relenza)	Antiviral	Inh: 5 mg/ blister	Two inhalations (10 mg) q12h x 5 days. Bronchospasm. Effective against influenza A and B. Decreases severity and duration of viral illness by 1-2 days.
Zidovudine (Retrovir, AZT, ZDV)	Antiretroviral	Cap: 100 mg Tab: 300 mg Syr: 50 mg/5mL Inj: 10 mg/mL	200 mg tid; anemia; anorexia, granulocytopenia, headaches, nausea, myositis 1-2 mg/kg IV q4h
Zileuton (Zyflo)	Leukotriene modifier	Tab: 600 mg	**Asthma prophylaxis**: 600 mg qid, not for acute attacks; inhibition of theophylline and warfarin metabolism. Hepatotoxic.
Ziprasidone (Geodon)	Antipsychotic	Cap: 20, 40, 60, 80 mg Inj. 20 mg/mL	20 mg bid; then 40-80 mg bid. Greater propensity to prolong QTc interval compared to other antipsychotics. Rash, weight gain, EPS, QT prolongation. 10-20 mg IM q4h prn; max 40 mg/day.
Zoledronic acid (Zometa)	Bone stabilizer	Inj: 4 mg/vial	4 mg IV infusion over 15-30 min; precede with saline hydration.
Zolmitriptan (Zomig)	Antimigraine	Tab: 2.5, 5 mg Nasal spray: 5 mg/spray	2.5 mg once, may repeat after 2 hrs; max 10 mg/24 hrs. Contraindicated in coronary artery disease; may cause chest tightness, paresthesia, flushing. Serotonin syndrome with SSRIs. 1 spray into a nostril; may repeat x 1 in 2 hrs. Max 2 sprays per 24 hrs.
Zolpidem (Ambien)	Hypnotic	Tab: 5, 10 mg	5-10 mg qhs; 5 mg in elderly; rapid onset, short duration; no daytime sedation; does not alter REM sleep.
Zonisamide (Zonegran)	Anticonvulsant	Cap: 100 mg	100 mg qd-bid; max 300 mg bid. Effective in partial and refractory seizures. Nephrolithiasis (2%).

Chapter 9.

COMBINED THERAPEUTICAL AGENTS

The given table of combination drugs four columns. First entitled “Name,” of drug describes the primary drugs, by generic. The drugs are arranged alphabetically and listed according to their therapeutic classes. Second column “dosage forms,” describe pharmaceutical dosage form and potencies of individual active components of each drug. Third column, “Dosage, Side effect and comments” gives a short description of the clinical profile and possible therapeutical outcomes. The given detail is possible, not definite. Pharmacist and clinicians must be aware of patient’s personal history, social background and past medical history to design more accurate regimens. It is responsibility of the individual’s involver to provide the pharmaceutical care to develop the strategies for prevention, monitoring, and managing any potential interactions. If combination therapy of interacting drugs cannot be avoided, the patient should be warned/ advised of any potential adverse effects.

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Name	Class	Dosage Forms	Dosage, Side Effects and Comments
Accuretic	Antihypertensive	Tab: Quinapril 10 mg, HCTZ 12.5 mg Quinapril 20 mg, HCTZ 12.5 mg Quinapril 20 mg, HCTZ 25 mg	1 tab qd
Actifed with codeine (C-V)	Decongestant Antihistamine Antitussive	Syr per 5 mL: Pseudoephedrine 30 mg, triprolidine 1.25 mg, codeine 10 mg [480 mL]	10 mL q4-6h; max 4 doses per day; drowsiness.
Actifed 12-hour	Decongestant Antihistamine	Cap SR : Pseudoephedrine 120 mg, triprolidine 5 mg	1 cap bid prn
Activella	Antiosteoporotic	Patch: Estradiol 0.05 mg, norethindrone 0.14 mg/24 hrs. Estradiol 0.05 mg, norethindrone 0.25 mg/24 hrs.	Apply patch to lower abdomen qd. Breast pain, dysmenorrhea.
Adderall	Stimulant	Tab (Amphetamine, dextroamphetamine): 5, 10, 20, 30 mg	5-30 mg bid. Xerostomia, unpleasant taste, impotence, hypertension.
Advair Diskus	Bronchodilator Corticosteroid	Powder for inhalation (28 and 60 blisters): fluticasone 100 mcg/salmeterol 50 mcg fluticasone 250 mcg/salmeterol 50 mcg fluticasone 500 mcg/salmeterol 50 mcg	One inhalation bid. Not appropriate for management of acute attacks.
Advicor	Antihyperlipidemic	ER niacin 500 mg/lovastatin 20 mg ER niacin 750 mg/lovastatin 20 mg ER niacin 1000 mg/lovastatin 20 mg	One tab PO qhs. Hepatitis, myositis, myopathy
Aggrenox	Antiplatelet	Cap ER: Aspirin 25 mg, Dipyridamole 200 mg	1 cap bid for stroke prevention. GI bleeding, headache, diarrhea.
Aldactazide	Diuretic Antihypertensive	Tab: Spironolactone 25, hydrochlorothiazide 25mg Tab: Spironolactone 50, hydrochlorothiazide 50mg	1-2 tab qd; gynecomastia. 1 tab qd
Alesse-21 Alesse-28	Contraceptive	Tab: Levonorgestrel 0.1 mg, ethinyl estradiol 0.02 mg Tab: Levonorgestrel 0.1 mg, ethinyl estradiol 0.02 mg	1 tab qd x 21; off x 7 days, then repeat. 21-day pack. 1 tab qd; 28-day pack.
Arthrotek	NSAID	Tab: Diclofenac 50 mg/misoprostol 200 mcg, Diclofenac 75 mg/misoprostol 200 mg	1 tab bid-qid; diarrhea, nausea.
Atacand-HCT	Antihypertensive	Tab: Candesartan 16 mg, HCTZ 12.5 mg Candesartan 32 mg, HCTZ 12.5 mg	1 tab qd
Augmentin 250 Augmentin 500 Augmentin 875	Antibiotic	Tab: Amoxicillin 250 mg, clavulanate 125 mg Tab: Amoxicillin 500 mg, clavulanate 125 mg Tab: Amoxicillin 875 mg, clavulanate 125 mg	One tab mg tid; diarrhea, GI upset. One tab mg bid; less diarrhea than with 500 mg tab.
Auralgan	otic Analgesic	topical Otic soln per mL: Benzocaine 1.4%, antipyrine 5.4% [10 mL]	Fill ear canal and insert saturated pledget tid-qid prn pain.
Avandamet	Hypoglycemic	Tab: Rosiglitazone 1 mg, metformin 500 mg Rosiglitazone 2 mg, metformin 500 mg Rosiglitazone 2 mg, metformin 1000 mg Rosiglitazone 4mg, metformin 500 mg Rosiglitazone 4 mg, metformin 1000 mg	1-2 tabs bid. Lactic acidosis, contraindicated in azotemics.
Bactrim DS Bactrim SS	Antibiotic	Tab: Sulfamethoxazole 800 mg, trimethoprim 160 mg Tab: Sulfamethoxazole 400 mg, trimethoprim 80 mg	**Urinary tract infections:** One tab bid x 3-10d; rash, erythema multiforme.

			Shigellosis: 1 tab bid x 3-5d **Exacerbation of chronic bronchitis:** 1 tab bid. **UTI prophylaxis:** 1 tab qhs; rash, neutropenia.
Bactrim IV	Antibiotic	Inj per 5 mL: Sulfamethoxazole 400 mg, trimethoprim 80 mg	**P. carinii pneumonia:** 15 mg/kg/day (based on TMP) IV in 3 doses x 21 days (each dose in 250 mL of D5W over 2 hours). **Urinary tract infections and shigellosis:** 8-10 mg/kg daily based on trimethoprim in 3 equal doses (q8h by IV infusion) for 7 days.
Benzamycin	Anti-Acne	Gel:Erythromycin3%, benzoyl peroxide 5% [23.3 gm]	Apply topically bid; dryness, urticaria.
Blephamide	Antibiotic Corticosteroid	Ophth susp: Sulfacetamide 10%, prednisolone 0.2% [5, 10 mL] Ophth oint: Sulfacetamide 10%, prednisolone 0.2% [3.5 gm]	1 drop in affected eye(s) bid-qid; local irritation, allergic sensitization. Apply to affected eye tid-qid.
Caduet	Antihypertensive Antihyperlipidemic	Tab: Amlodipine 5 mg, atorvastatin 10 mg Amlodipine 5 mg, atorvastatin 20 mg Amlodipine 5 mg, atorvastatin 40 mg Amlodipine 5 mg, atorvastatin 80 mg Amlodipine 10 mg, atorvastatin 10 mg Amlodipine 10 mg, atorvastatin 20 mg Amlodipine 10 mg, atorvastatin 40 mg Amlodipine 10 mg, atorvastatin 80 mg	One tab qhs. Fatigue, muscle pain, peripheral edema.
Cafergot	Antimigraine	Tab: Ergotamine 1 mg, caffeine 100 mg Rectal suppository: Ergotamine 2 mg, caffeine 100 mg	1-2 tabs initially, then 1-2 tabs q30min prn; max 6/day or 10 tabs/week; nausea, leg weakness. 1/2-1 suppository PR initially, then q1h prn; max 2 suppository/day or 5 suppository/week.
Capozide 25/15 Capozide 25/25 Capozide 50/15 Capozide 50/25	Antihypertensive	Tab: Captopril 25mg, hydrochlorothiazide 15mg Tab: Captopril 25mg, hydrochlorothiazide 25mg Tab: Captopril 50mg, hydrochlorothiazide 15mg Tab: Captopril 50mg, hydrochlorothiazide 25mg	1-2 tab bid; cough, proteinuria, dysgeusia.
Claritin-D	Antihistamine Decongestant	Tab: Loratadine 5mg, pseudoephedrine 120 mg	1 tab qAM on an empty stomach; insomnia, dry mouth.
Coly-Mycin S	Antibacterial Corticosteroid	Otic susp per mL: Neomycin 4.71 mg, colistin 3 mg, hydrocortisone 1% [5, 10 mL]	5 drops in affected ear(s) tid-qid
Combivent	Bronchodilator Anticholinergic	Inhaler: Albuterol/ipratropium [14.7 gm]	2-4 puffs qid; dysphonia, increased salivation, taste perversion.
Combivir	Antiretroviral	Tab: Lamivudine 150 mg, zidovudine 300 mg	1 tab bid; nausea, headache, anorexia, anemia, granulocytopenia.
Cortisporin	Antibiotic Corticosteroid	Ophth susp per mL: Polymyxin B 10,000 U, neomycin 0.35%, hydrocortisone 1% [7.5 mL] Otic solution, susp per mL: Polymyxin B 10,000 U, neomycin 5 mg, hydrocortisone 1% [10 mL]	1-2 drops in affected eye(s) q3-4h; secondary infection. 4 drops in affected ear(s) tid-qid
Cosopt	Antiglaucoma	Ophth soln: Dorzolamide 2%, timolol 0.5% (5, 10 mL)	One drop bid. Bitter taste, photophobia.
Darvocet-N 50 Darvocet-N 100	Analgesic (C-IV)	Tab: Propoxyphene 50 mg, acetaminophen 325mg Tab: Propoxyphene 100 mg, acetaminophen 650 mg	2 tab q4h prn pain; drowsiness, nausea. 1 tab q4h prn pain; renal papillary necrosis.
Darvon Compound- 65	Analgesic (C-IV)	Cap: Propoxyphene 65 mg, aspirin 389 mg, caffeine 32.4 mg	1 cap q4h prn pain; aspirin nephropathy.
Demulen 1/35 Demulen 1/50	Contraceptive	Tab: Ethinyl estradiol 35 mcg, ethynodiol diacetate 1 mg; 21-day and 28-day compaks Tab: Ethinyl estradiol 50 mcg, ethynodiol diacetate 1 mg; 21-day and 28-day compaks	1 tab qd; low androgenic; useful for patients with acne.
Desogen	Contraceptive	Tab: Ethinyl estradiol 30 mcg, desogestrel 0.15 mg	1 tab qd; 28-day packs
Dimetane DX	Antihistamine Decongestant	Syr: (5 mL): Pseudoephedrine 30 mg, brompheniramine 2 mg, dextromethorphan 10mg	10 mL q4h prn
Dimetapp	Antihistamine Decongestant	Elixir per 5 mL: Brompheniramine 1 mg, pseudoephedrine 15 mg	10-20 mL q4-6h prn
Dimetapp-DM	Antihistamine Antitussive Decongestant	Elixir per 5 mL: Brompheniramine 1 mg, dextromethorphan 5 mg, pseudoephedrine 15mg	10-20 mL q4-6h prn
Diovan/HCT	Antihypertensive	Tab: Valsartan 80 mg/HCTZ 12.5 mg Valsartan 160 mg/HCTZ 12.5 mg	1 tab qd

Donnatal	Antispasmodic Anticholinergic	Cap, tab: Hyoscyamine 0.1037, phenobarbital 16.2 mg atropine 0.0194, scopolamine 0.0065,	1-2 cap or tab tid-qid; drowsiness.
Donnatal Extentabs	Antispasmodic Anticholinergic	Tab ER: Hyoscyamine 0.3111, phenobarbital 48.6 mg atropine 0.0582, scopolamine 0.0195,	1 tab bid-tid; drowsiness, dizziness.
Duratuss	Decongestant Expectorant	Tab: Pseudoephedrine 120 mg, guaifenesin 600 mg	1 tab q12h
Dyazide	Diuretic	Cap: Triamterene 50 mg, hydrochlorothiazide 25 mg	1-2 cap qd; hyperuricemia.
Esgic	Analgesic	Cap, tab: Acetaminophen 325 mg, butalbital 50mg, caffeine 40 mg	1-2 cap or tab q4h prn pain; drowsiness, dizziness.
Esgic-plus	Analgesic	Tab: Acetaminophen 500 mg, butalbital 50 mg, caffeine 40mg	1 tab q4h prn pain 1-2 tab q4h
Estratest	Estrogen	Tab: Esterified estrogen 0.625 mg, methyltestosterone 1.25 mg	1 tab qd
Estratest-HS	Estrogen	Tab: Esterified estrogen 1.25 mg, methyltestosterone 2.5mg	1 tab qd
Fansidar	Antimalarial	Tab: Sulfadoxine 500 mg, pyrimethamine 25mg	**Acute malaria:** 3 tabs once **Prophylaxis:** 1 tab weekly, begin 2 days before departure; continue 4-6 weeks after return. **Maintenance toxoplasmosis:** 1 tab PO 3 times a week; blood dyscrasias, allergic reactions.
Ferro-sequels	Hematinic	Tab SR: Ferrous fumarate 150 mg, docusate 100 mg	1 tab qd-bid
Fioricet	Analgesic	Tab: Acetaminophen 325 mg, butalbital 50 mg, caffeine 40mg	1-2 tab q4h prn, max 6 tab/day; renal papillary necrosis.
Fioricet with codeine (C-III)	Analgesic	Cap: Acetaminophen 325 mg, butalbital 50 mg, caffeine 40 mg, codeine 30 mg	1-2 cap q4h prn; max 6 cap/day
Fiorinal	Analgesic	Cap, tab: Aspirin 325 mg, caffeine 40 mg, butalbital 50 mg	1-2 cap or tab q4h; max of 6/day; drowsiness.
Fiorinal codeine (CIII)	Analgesic	Cap: Aspirin 325 mg, caffeine 40 mg, butalbital 50 mg, codeine 30 mg	1-2 cap q4-6h prn; max 6 cap/day.
Glucovance	Antidiabetic	Tab: Glyburide 1.25 mg, metformin 250 mg Glyburide 2.5 mg, metformin 500 mg Glyburide 5 mg, metformin 500 mg	1-2 tabs bid with meals. GI upset diarrhea, lactic acidosis in presence of azotemia.
Humulin 70/30	Insulin	NPH 70%/regular insulin 30%; 100 U/mL [10 mL]	30-80 U/day in 2 daily injections
Hycodan (C-III)	Antitussive Anticholinergic	Syr/5 mL: Hydrocodone 5 mg, homatropine 1.5mg Tab: Hydrocodone 5 mg, homatropine 1.5 mg	5 mL q4-6h; dry mouth, urinary retention. 1 tab q4-6h
Hycomine (C-III)	Antitussive Decongestant	Syr per 5 mL: Hydrocodone 5 mg, phenylpropanolamine 25 mg [pint]	5 mL q4h prn; urethral spasm, urinary retention, blurred vision.
Hyzaar	Antihypertensive	Tab: Losartan 50 mg, hydrochlorothiazide 12.5mg	One tab qd-bid; drowsiness.
Kaletra	Antiretroviral	Cap: Lopinavir 133.3 mg/ritonavir 33.3 mg Oral soln: Lopinavir 80 mg/ritonavir 20 mg/mL	3 caps or 5 mL tid with food. Asthenia, rash, GI symptoms.
Levlen	Contraceptive	Tab: Ethinyl estradiol 30 mcg, levonorgestrel 0.15 mg	1 tab qd; 21 day and 28 day slidecases
Lexxel	Antihypertensive	Tab: Enalapril 5 mg, Felodipine 5 mg	1 tab qd. Less peripheral edema than felodipine alone.
Lo/Ovral	Contraceptive	Tab: Ethinyl estradiol 30 mcg, norgestrel 0.3mg	1 tab qd; 21 and 28 day pilpaks
LoEstrin 21 1/20 LoEstrin 21 1.5/30	Contraceptive	Tab: Ethinyl estradiol 20 mcg, norethindrone 1mg Tab: Ethinyl estradiol 30 mcg, norethindrone 1.5 mg	1 tab qd; 21-day petipacs
LoEstrin FE 1/20 LoEstrin FE 1.5/30	Contraceptive	Tab: Ethinyl estradiol 20 mcg, norethindrone 1 mg; ferrous fumarate 75 mg (7) Tab: Ethinyl estradiol 30 mcg, norethindrone 1.5 mg; ferrous fumarate 75 mg (7)	1 tab qd; 21-day, 28-day pilpaks 1 tab qd; 28-day petipacs
Lomotil (C-V)	Antidiarrheal	Liquid per 5 mL: Diphenoxylate 2.5 mg, atropine 0.025 mg [60 mL] Tab: Diphenoxylate 2.5 mg, atropine 0.025 mg	10 mL qid until diarrhea controlled; confusion, toxic megacolon, paralytic ileus, pancreatitis. 2 tab qid until diarrhea controlled
Lopressor/HCT 50/25	Antihypertensive	Tab: Metoprolol 50 mg, hydrochlorothiazide 25mg Tab: Metoprolol 100 mg, hydrochlorothiazide 25mg	1-2 tab qd; fatigue, lethargy, flu-like symptoms, vertigo, somnolence.

Lopressor/HCT 100/25 Lopressor/HCT 100/50		Tab: Metoprolol 100 mg, hydrochlorothiazide 50mg	
Lortab (C-III) Lortab 25/500 Lortab 5/500 Lortab 7.5/500 Lortab 10/500	Analgesic	Liquid per 5 mL: Hydrocodone 2.5 mg, acetaminophen 120mg [118mL] Tab: Hydrocodone 2.5mg, acetaminophen 500mg Tab:Hydrocodone 5mg, acetaminophen 500mg Tab: Hydrocodone 7.5 mg, acetaminophen 500mg Tab: Hydrocodone 10 mg, acetaminophen 500mg	15 mL q4h prn pain 1-2 tab q4-6h prn pain; sedation, nausea.
Lotrel 2.5/10 Lotrel 5/10 Lotrel 5/20	Antihypertensive	Cap: Amlodipine 2.5 mg/benazepril 10 mg Cap: Amlodipine 5 mg/benazepril 10 mg Cap: Amlodipine 5 mg/benazepril 20 mg	1 cap qd
Lotrisone	Antifungal Corticosteroid	Cream: Clotrimazole 1%, betamethasone dipropionate 0.05% [15, 45 gm]	Massage into affected areas bid; skin atrophy and systemic steroid effects common.
Lunelle	Contraceptive	Inj: Medroxyprogesterone 25 mg/0.5 mL, estradiol 5mg/0.5 mL	0.5 mL IM every 33 days. Return to ovulation within 2-4 months.
Malarone	Antimalarial	Tab: Atovaquone 250 mg, proguanil 100 mg	**Prophylaxis**: 1 tab qd starting 2 days before and continuing for 7 days after travel. **Treatment**: 4 tabs qd x 3 with food. Abdominal pain, nausea, vomiting, headache.
Maxitrol Antibiotic	Corticosteroid	Ophth susp: Neomycin 0.35%, polymyxin 10,000 U, dexamethasone 0.17% [5 mL] Ophth oint: Neomycin 0.35%, polymyxin 10,000 U, dexamethasone 0.17% [3.5 gm]	1-2 drops q3-4h. Apply to affected eye(s) q3-4h.
Maxzide Maxzide-25	Antihypertensive Diuretic	Tab: Triamterene 75 mg, hydrochlorothiazide 50mg Tab: Triamterene 37.5 mg, hydrochlorothiazide 25mg	1 tab qd; jaundice, pancreatitis, interstitial nephritis, renal stones. 1-2 tab qd
Metaglip	Antidiabetic	Tab: Glipizide 2.5 mg/metformin 250 mg Glipizide 2.5 mg/metformin 500 mg Glipizide 5 mg/metformin 500 mg	1-2 tabs bid with meals. Lactic acidosis in presence of azotemia.
Midrin	Antimigraine	Cap: Isometheptene 65 mg, dichloralphenazone 100 mg, acetaminophen 325 mg	**Tension headache**: 1-2 cap q4h prn, max 8/day; dizziness, rash. **Migraine**: 2 cap, then 1 cap q1h until relieved, max 5 cap/12 hours. Caution in coronary artery disease.
Moduretic	Diuretic	Tab: Amiloride 5 mg, hydrochlorothiazide 50 mg	Initially 1-2 tab qd; headache, hyperuricemia.
Monopril-HCT	Antihypertensive	Tab: Fosinopril 10 mg, HCTZ 12.5 mg Fosinopril 20 mg, HCTZ 12.5 mg	1 tab qd
Mycolog-II	Corticosteroid Antifungal	Cream, oint per gm: Triamcinolone 1.0 mg, nystatin 100,000 U [15, 30, 60, 120 gm]	Apply to the affected area(s) bid; skin atrophy common.
Naphcon-A	Decongestant Antihistamine	Ophth soln: Naphazoline 0.025%, pheniramine 0.3% [15 mL]	1-2 drops in each eye q3-4h; urinary retention, exacerbation of hypertension.
Neosporin	Antibiotic	Ophth soln per mL: Polymyxin B 10,000 U, neomycin 1.75mg, gramicidin 0.025 mg [10 mL] Ophth oint per gm: Polymyxin B 10,000 U, neomycin 3.5mg, bacitracin 400 U [3.75 gm] Cream per gm: Polymyxin B 10,000 U, neomycin 3.5 mg [15 gm] Oint per gm: Polymyxin B 5,000 U, neomycin 3.5 mg, bacitracin 400 U [15, 30 gm]	1-2 drops in affected eye(s) bid-qid. Apply to affected eye(s) q3-4h Apply to affected area(s) qd-tid Apply to affected area(s) qd-tid
Neosporin Maximum Strength	Antibiotic	Oint per gm: Polymyxin B 10,000 U, neomycin 3.5mg, bacitracin 500 U [15 gm]	Apply to affected area(s) qd-tid
Neosporin Plus	Antibiotic Local Anesthetic	Cream per gm: Polymyxin B 10,000 U, neomycin 3.5 mg, lidocaine 40 mg [15 gm] Oint per gm: Polymyxin B 10,000 U, neomycin 3.5 mg, bacitracin 500 U, lidocaine 40 mg [15 gm]	Apply to affected area(s) qd-tid Apply to affected area(s) qd-tid
Nordette	Contraceptive	Tab: Ethinyl estradiol 30 mcg, levonorgestrel 0.15mg	1 tab qd; 21-day and 28-day pilpaks
Norethin 1/35E Norethin 1/50M	Contraceptive	Tab: Ethinyl estradiol 35 mcg, norethindrone 1 mg Tab: Mestranol 50 mcg, norethindrone 1 mg	1 tab qd; 21-day and 28-day compaks

Norgesic Forte	Muscle relaxant Analgesic	Tab: Orphenadrine 50 mg, aspirin 770 mg, caffeine 60 mg	1/2-1 tab tid-qid
Norgesic	Muscle relaxant Analgesic	Tab: Orphenadrine 25 mg, aspirin 385 mg, caffeine 30 mg	1-2 tab tid-qid; mild anticholinergic effects.
Norinyl 1+35	Contraceptive	Tab: Ethinyl estradiol 35 mcg, norethindrone 1 mg	1 tab qd; 21-day and 28-day wallet
Norinyl 1+50		Tab: Mestranol 50 mcg, norethindrone 1 mg	
Norlestrin 1/50	Contraceptive	Tab: Ethinyl estradiol 50 mcg, norethindrone 1 mg	1 tab qd; 21-day and 28 day compacts
Norlestrin 2.5/50		Tab: Ethinyl estradiol 50 mcg, norethindrone 2.5mg	
Norlestrin Fe 2.5/50	Contraceptive	Tab: Ethinyl estradiol 50 mcg, norethindrone 2.5mg, ferrous fumarate 75 mg (7 Tab)	1 tab qd; 28-day compacts
Norlestrin Fe 1/50	Contraceptive	Tab: Ethinyl estradiol 50 mcg, norethindrone 1mg; ferrous fumarate 75 mg (7 tab);	28-day compacts 1 tab qd
Novolin 70/30	Insulin	NPH insulin 70%/regular insulin 30%; 100 U/mL [10 mL, PenFill]	30-80 U per day SQ in 2-4 injections
Ortho Tri-Cyclen	Contraceptive	Tab: Ethinyl estradiol 35 mcg, norgestimate 0.18 mcg (7 tab); ethinyl estradiol 35 mcg, norgestimate 0.215 mg (7 tab); ethinyl estradiol 35 mcg, norgestimate 0.25 mg (7 tab)	1 tab qd; 21-day and 28-day dialpaks
Ortho-Cept	Contraceptive	Tab: Ethinyl estradiol 30 mcg, desogestrel 0.15mg	1 tab qd; 21-day and 28-day dialpaks
Ortho-Cyclen	Contraceptive	Tab: Ethinyl estradiol 35 mcg, norgestimate 0.25mg	1 tab qd; 21-day and 28-day dialpaks
Ortho Evra	Contraceptive	Patch: Norelgestromin 0.15 mg/ethinyl estradiol0.02 mg	per 24 hours Place one patch weekly x 3 weeks, then off 1 week. Fluid retention, jaundice.
Ortho-Novum 1/35		Tab: Norethindrone 1 mg, ethinyl estradiol 35 mcg	1 tab qd; 21-day and 28-day dialpaks
Ortho-Novum1/50	Contraceptive	Tab: Norethindrone 1 mg, mestranol 50 mcg	
Ortho-Novum 7/7/7	Contraceptive	Tab: Ethinyl estradiol 35 mcg, norethindrone 0.5mg (7 tab); ethinyl estradiol 35 mcg, norethindrone 0.75 mg (7 tab); ethinyl estradiol 35 mcg, norethindrone 1 mg (7 tab)	1 tab qd; 21-day or 28-day dialpaks
Os-Cal 500+D	Mineral	Tab: Calcium 500 mg, vitamin D 200 IU	One tab qd-tid.
PediOtic	Antibacterial Corticosteroid	Otic susp per mL: Polymyxin B 10,000 U, neomycin 3.5 mg, hydrocortisone 1% [7.5 mL]	4 drops in affected ear(s) tid-qid
Pepcid Complete	Anti-ulcer	Tab, chewable: Famotidine 10 mg, calcium carbonate 800 mg, Mg hydroxide 165 mg.	Chew and swallow 1 tab qd-bid.
Percocet (C-II)	Analgesic	Tab: Oxycodone 5 mg, acetaminophen 325 mg	1 tab q6h prn pain
Percodan (C-II)	Analgesic	Tab: Oxycodone 4.88 mg, aspirin 325 mg	1 tab q6h prn pain
Peri-Colace	Laxative, stool softener	Cap: Casanthranol 30 mg, docusate 100 mg	1 tab qd-bid prn; nausea abdominal cramps.
Phenergan codeine (C-V)	Antihistamine Antitussive	Syr per 5 mL: Promethazine 6.25 mg, codeine 10 mg [118 mL]	5 mL q4-6h; max 30 mL/day; nausea, extrapyramidal effects.
Phenergan DM	Antihistamine Antitussive	Syr per 5 mL: Promethazine 6.25 mg, dextromethorphan 15 mg [120, pint]	5 mL q4-6h; max 30 mL/day; sedation.
Phenergan VC	Antihistamine Decongestant	Syr per 5 mL: Promethazine 6.25 mg, phenylephrine 5 mg [118 mL, pint]	5 mL q4-6h
Phenergan VC with codeine (C-V)	Antihistamine Decongestant Antitussive	Syr per 5 mL: Promethazine 6.25 mg, phenylephrine 5 mg, codeine 10 mg [118, 480 mL]	5 mL q4-6h; max 30 mL/day
Polysporin	Antibacterial	Ophth oint per g: Polymyxin B 10,000 U, bacitracin 500 U [3.75 gm] Powder, oint per gm: Polymyxin B 10,000 U, bacitracin 500 U [powder 10 gm; oint 15, 30 gm] Spray per 90 gm can: Polymyxin B 200,000 U, bacitracin 10,000 U [90 gm]	Apply to affected eye(s) q3-4h Apply to affected area(s) qd-tid Apply spray to affected area(s) qd-tid
Polytrim	Antibiotic	Ophth soln: Trimethoprim 1 mg/mL, polymyxin B 10,000 U/mL (10mL)	1 drop in affected eye(s) 6 times daily x 7-10 days.
			Premphase Menopausal hormone Maroon tab: Conjugated estrogen 0.625 mg Light blue tab: Conjugated estrogen 0.625 mg, medroxyprogesterone 5 mg 1 maroon tab daily on days 1-14 and 1 light blue tab daily on days 15 through 28.
Prempro	Menopausal hormone	Tab: Estrogen 0.45 mg, medroxyprogesterone 1.5mg Tab: Estrogen 0.625 mg, medroxyprogesterone 2.5 mg	One tab qd continuously

		Tab: Estrogen 0.625 mg, medroxyprogesterone 5mg.	
ProctoCream-HC	Anesthetic Corticosteroid	Cream: Pramoxine 1%, hydrocortisone 1% [30gm]	Apply to affected area(s) tid-qid
ProctoFoam-HC	Anesthetic Corticosteroid	Aerosol foam: Pramoxine 1%, hydrocortisone 1% [10 gm]	Apply to affected area(s) tid-qid
RID	Pediculicide	Shampoo:Pyrethrin 0.3%, piperonyl butoxide 3% [60, 120, 240 mL]	Apply to the infected and adjacent hairy area and washed off after 10 minutes; OTC
Rifamate	Tuberculostatic	Cap: Rifampin 300 mg, isoniazid 150 mg	1 cap qd; monitor for hepatotoxicity
Rifater	Tuberculostatic	Tab: Rifampin 120 mg, isoniazid 50 mg, pyrazinamide 300 mg	6 tabs once daily. Reduce dose to 5 tabs if <54 kg, and to 4 tabs if <44 kg
Robitussin A-C (CV)	Antitussive Expectorant	Syr per 5 mL: Codeine 10 mg, guaifenesin 100 mg [60, 120 mL, pint]	10 mL q4h; nausea, constipation.
Robitussin-CF	Antitussive Decongestant Expectorant	Syr per 5 mL: Dextromethorphan 10 mg, phenylpropanolamine 12.5 mg, guaifenesin 100 mg [120, 240, 360, 480 mL]	10 mL q4-6h
Robitussin-DAC (CV)	Antitussive Decongestant Expectorant	Syr per 5 mL: Codeine 10 mg, pseudoephedrine 30 mg, guaifenesin 100 mg [480 mL]	10 mL q4h; nausea, constipation.
Robitussin-PE	Decongestant Expectorant	Syr per 5 mL: Pseudoephedrine 30 mg, guaifenesin 100 mg [120, 240, 480 mL]	10 mL q4h; max 4 doses/day
Rynatan	Antihistamine Decongestant	Tab: Azatadine 1 mg, pseudoephedrine 120 mg	1 tab qd-bid Senokot-S Laxative, stool softener Tab: Docusate 50 mg, Senna 187 mg 1-2 tab qhs prn
Septra DS Septra SS	Antibiotic	Tab: Sulfamethoxazole 800 mg, trimethoprim 160mg Tab: Sulfamethoxazole 400 mg, trimethoprim 80mg	**Urinary tract infections:** 1 tab bid x 7-10 days **Shigellosis:** 1 tab bid x 3-5 days **Bronchitis:** 1 tab bid x 2 weeks **Travelers diarrhea:** 1 tab bid x 5 days Rash common; Stevens Johnson Syndrome (erythema multiforme) rarely UTI Prophylaxis: 1 tab qhs Septra IV Antibiotic Inj per 5 mL: Sulfamethoxazole 400 mg, trimethoprim 80 mg **P. carinii pneumonia:** 15 mg/kg/day (based on TMP) IV in 3 doses x 21 days (each dose in 250 mL of D5W over 2 hours). **Urinary tract infections and shigellosis:** 8-10 mg/kg daily based on trimethoprim in 3 equal doses (q8h by IV infusion) for 7 days.
Sinemet 10/100 Sinemet 25/100 Sinemet 25/250	Antiparkinsonian	Tab: Carbidopa 10 mg, levodopa 100 mg Tab: Carbidopa 25 mg, levodopa 100 mg Tab: Carbidopa 25 mg, levodopa 250 mg	1 tab tid-qid; dyskinesia, nausea, mental status changes, paranoia, psychosis, depression.
Soma with codeine (C-III)	Muscle relaxant Analgesic	Tab: Carisoprodol 200 mg, aspirin 325 mg, codeine 16 mg	1-2 tab qid prn
Soma compound	Muscle relaxant Analgesic	Tab: Carisoprodol 200 mg, aspirin 325 mg	1-2 tab qid prn; vertigo, ataxia, tremor, facial flushing, pancytopenia (rare).
Stavelo 50 Stavelo100 Stavelo 150	Antiparkinsonian agent	Tab: Carbidopa 12.5 mg, levodopa 50 mg, entacapone 200 mg Tab: Carbidopa 25 mg, levodopa 100 mg, entacapone 200mg Tab: Carbidopa 37.5 mg, levodopa 150 mg, entacapone 200 mg	1 tab tid-qid; max 8 tabs/day 1 tab tid-qid; max 8 tabs/day 1 tab tid-qid; max 8 tabs/day
Symbyax	Antidepressant Mood Stabilizer	Tab: Olanzapine 6 mg, fluoxetine 25 mg Olanzapine 6 mg, fluoxetine 50 mg Olanzapine 12 mg, fluoxetine 25 mg Olanzapine 12 mg, fluoxetine 50 mg	One tab qhs. Fluoxetine is a cytochrome CYP2D6 inhibitor.
Talwin NX	Analgesic	Tab: Pentazocine 50 mg, naloxone 0.5 mg	1 tab q3-4h
Tavist-D	Decongestant Antihistamine	Tab: Phenylpropanolamine 75 mg, clemastine 1.34 mg	1 tab bid
Teczem	Antihypertensive	Tab ER: Enalapril 5 mg, diltiazem 180 mg	1-2 tab qd
Tenoretic 100 Tenoretic 50	Antihypertensive	Tab: Atenolol 100 mg, chlorthalidone 25 mg Tab: Atenolol 50 mg, chlorthalidone 25 mg	1 tab qd; erectile dysfunction, depression.
Timentin	Antibiotic	Inj: 3.1 gm (ticarcillin 3 gm, clavulanic acid 0.1 gm)	3.1 gm IV q4-6h; hypokalemia.

TobraDex	Antibiotic Corticosteroid	Ophth susp: Dexamethasone 1%, tobramycin 0.3% [5 mL] Ophth oint: Dexamethasone 1%, tobramycin 0.3% [3.5 gm]	1-2 drops in affected eye(s) q3-4h Apply to affected eye(s) q3-4h.
Tri-Levlen	Contraceptive	Tab: Ethinyl estradiol 30 mcg, levonorgestrel 0.05 mg (6); ethinyl estradiol 40 mcg, levonorgestrel 0.075 mg (5); ethinyl estradiol 30 mcg, levonorgestrel 0.125 mg (10)	1 tab qd; 21-day and 28-day compacts
Tri-Norinyl	Contraceptive	Tab: Ethinyl estradiol 35 mcg, norethindrone 0.5 mg (7); ethinyl estradiol 35 mcg, norethindrone 1 mg (9); ethinyl estradiol 35 mcg, norethindrone 0.5 mg (5)	1 tab qd; 21-day and 28-day wallets
Triphasil	Contraceptive	Tab: Ethinyl estradiol 30 mcg, levonorgestrel 0.05 mg (6 tab); ethinyl estradiol 40 mcg, levonorgestrel 0.075 mg (5 tab); ethinyl estradiol 30 mcg, levonorgestrel 0.125 mg (10 tab)	1 tab qd; 21-day or 28-day Pilpaks
Tritec	Anti-helicobacter pylori	Tab: 400 mg Ranitidine 162 mg, bismuth 128 mg, citrate 110 mg	1 tab bid x 28 days with clarithromycin 500 mg tid x 14 days; 73-84% effective.
Trizivir	Antiviral	Tab: Abacavir 300 mg, lamivudine 150 mg, zidovudine 300 mg	1 tab bid. Life-threatening hypersensitivity 5%.
Tussi-Organidin (CV)	Antitussive Expectorant	Liquid per 5 mL: Codeine 10 mg, guaifenesin 100 mg [pint]	5-10 mL q4h prn; nausea, constipation.
Tussi-Organidin	DM Antitussive Expectorant	Liquid per 5 mL: Dextromethorphan 10 mg, guaifenesin 100 mg [pint]	5-10 mL q4h prn
Tussionex (C-III)	Antihistamine Antitussive	Extended-release susp per 5 mL: chlorpheniramine 8 mg, hydrocodone 10 mg [480]	5 mL bid; drowsiness.
Tylox (C-II)	Analgesic	Cap: Oxycodone 5 mg, acetaminophen 500 mg	1 cap q6h prn pain
Ultracet	Ultracet	Tramadol 37.5 mg, acetaminophen 325 mg	1-2 tabs q4-6h prn; max 8 tabs/day. For max 5 days
Unasyn	Antibiotic	Inj: 1.5 gm (ampicillin 1 gm, sulbactam 0.5 gm), 3.0 gm (ampicillin 2 gm, sulbactam 1 gm)	1.5-3 gm IV q6h; diarrhea, rash, enterocolitis agranulocytosis.
Uniretic	Antihypertensive	Tab: Moexipril/hydrochlorothiazide 7.5/12.5 and 15/25	1-2 tab qd; cough, dizziness, hyperlipidemia.
Vaseretic 5-12.5 Vaseretic 10-25	Antihypertensive	Tab: Enalapril 5 mg, hydrochlorothiazide 12.5 mg Tab: Enalapril 10 mg, hydrochlorothiazide 25 mg	1 tab qd; cough, asthenia
Vasocidin Antibiotic	Corticosteroid	Ophth soln: Sulfacetamide 10%, prednisolone 0.25% [5,10 mL] Ophth oint: Sulfacetamide 10%, prednisolone 0.5% [3.5 gm]	2 drops into affected eye(s) q4h Apply to affected eye(s) tid-qid
Vicodin (C-III) Vicodin ES (C-III)	Analgesic	Tab: Hydrocodone 5 mg, acetaminophen 500 mg Tab: Hydrocodone 7.5 mg, acetaminophen 750mg	1-2 tab q4-6h prn pain, drowsiness, incoherence. 1 tab q4-6h prn pain
Wigraine	Antimigraine	Rectal supp: Ergotamine 2 mg, caffeine 100 mg Tab: Ergotamine 1 mg, caffeine 100 mg	1 supp initially, may repeat prn x 1; max 2 supp/attack. Chest and muscle pain, paresthesia 2 tab initially, then 1 tab q30min prn; max 6 tab/attack or 10 tab/week.
Zestoretic 10/12.5 Zestoretic 20/12.5 Zestoretic 20/25	Antihypertensive	Tab: Lisinopril 10 mg, hydrochlorothiazide 12.5mg Tab: Lisinopril 20 mg, hydrochlorothiazide 12.5mg Tab: Lisinopril 20 mg, hydrochlorothiazide 25 mg	1-2 tab qd; dizziness, headache, cough, fatigue.
Ziac 2.5 Ziac 5 Ziac 10	Antihypertensive	Tab: Bisoprolol 2.5 mg, hydrochlorothiazide 6.25mg Tab: Bisoprolol 5 mg/hydrochlorothiazide 6.25 mg Tab: Bisoprolol 10 mg/hydrochlorothiazide 6.25mg	1 tab qd; ataxia, vertigo, paresthesias, arthralgias.
Zosyn	Antibiotic	Inj: Piperacillin 3 gm, tazobactam 0.375 gm	2.25-4.5 gm IV q6h; hypokalemia.
Zyrtec-D	Antihistamine, decongestant	Tab: Cetirizine 5 mg, pseudoephedrine 120 mg	One tablet q12h

APPENDIX 1.

THE ABBREVIATIONS AND MEANINGS USED IN CLINICAL PHARMACY PRACTICE MEANINGS

Abbreviations	Meanings	Abbreviations	Meanings
A	Accommodation; acetum; angström unit; anode; anterior	ARD	Acute respiratory disease
		arg	Silver
a	Accommodation; ampere; anterior; area	As	Arsenic
A_2	Aortic second sound	As.	Astigmatism

ABG	Arterial blood gas
ABO	Three basic blood groups
AC	Alternating current; air conduction; axiocervical; adrenal cortex
acc.	Accommodation
ACE	Adrenocortical extract
ACh	Acetylcholine
ACH	Adrenocortical hormone
ACTH	Adrenocorticotropic hormone
AD	Right ear (*auris dextra*)
add	Add to (*adde*)
ADH	Antidiuretic hormone
ADL	Activities of daily living
ADS	Antidiuretic substance
A/G; A-G ratio	Albumin-globulin ratio
Ag	Silver, antigen
ah	Hypermetropic astigmatism
AHF	Antihemophilic factor
AIDS	Acquired immunodeficiency syndrome
aj	Ankle jerk
Al	Aluminum
Alb	Albumin
ALH	Combined sex hormone of the anterior lobe of the hypophysis
ALT	Alanine aminotransferase (formerly SGPT)
alt. dieb.	Every other day (*alternis diebus*)
alt. hor.	Alternate hours (*alternis horis*)
alt. noct.	Alternate nights (*alternis noctes*)
Am	Mixed astigmatism
AM	Morning
a.m.a.	Against medical advice
amp.	Ampere
ana	So much of each, or
anat	Anatomy or anatomic
AO	Anodal opening; atrioventricular valve openings
AOP	Anodal opening picture
AOS	Anodal opening sound
A-P; AP; A/P	Anterior-posterior
A.P.	Anterior pituitary gland
APA	Antipernicious anemia factor
AQ	Achievement quotient
ARC	Anomalous retinal orrespondence; AIDS-related complex
AS	Left ear (*auris sinistra*)
ASD	Atrial septal defect
AsH	Hypermetropic astigmatism
ASHD	Arteriosclerotic heart disease
AsM	Myopic astigmatism
ASS	Anterior superior spine
AST	Aspartate aminotransferase (formerly SGOT)
Ast	Astigmatism
ATS	Anxiety tension state; antitetanic serum
AU	Angstrˆm unit
Au	Gold
A-V;AV; A/V	Arteriovenous; atrioventricular
Av	Average or avoirdupois
ax	Axis
B	Boron; bacillus
Ba	Barium
BAC	Buccoaxiocervical
Bact	Bacterium
BBB	Blood-brain barrier
BBT	Basal body temperature
BE	Barium enema
Be	Beryllium
BFP	Biologically false positivity (in syphilis tests)
Bi	Bismuth
Bib	Drink
bid; b.i.d.	Twice a day (*bis in die*)
BM	Bowel movement
BMR	Basal metabolic rate
BP	Blood pressure; buccopulpal
bp	Boiling point
BPH	Benign prostatic hypertrophy
BRP	Bathroom privileges
BSA	Body surface area
BSP	Bromsulphalein
BUN	Blood urea nitrogen
C	Carbon; centigrade; Celsius
c	With
C_{alb}	Albumin clearance
C_{cr}	Creatinine clearance
C_{in}	Inulin clearance
CA	Chronologic age; cervicoaxial
Ca	Calcium, cancer, carcinoma
CABS	Coronary artery bypass surgery

Abbreviations	Meanings	Abbreviations	Meanings
$CaCO_3$	Calcium carbonate	diff	Differential blood count
Cal	Large calorie	dil	Dilute or dissolve
cal	Small calorie	dim	One half
CAT	Computerized (axial) tomography scan	DJD	Degenerative joint disease
CBC or cbc	Complete blood count	dl	Deciliter
CC	Chief complaint	DNA	Deoxyribonucleic acid
cc	Cubic centimeter	DOA	Dead on arrival

CCl_4	Carbon tetrachloride
CCU	Coronary care unit; critical care unit
cf	Compare or bring together
CFT	Complement-fixation test
Cg; Cgm	Centigram
CH	Crown-heel (length of fetus)
$CHCL_3$	Chloroform
CH_3COOH	Acetic acid
ChE	Cholinesterase
CHF	Congestive heart failure
$C_5H_4N_4O_3$	Uric acid
C_2H_6O	Ethyl alcohol
CH_2O	Formaldehyde
CH_4O	Methyl alcohol
Cl	Chlorine
cm	Centimeter
CMR	Cerebral metabolic rate
CNS	Central nervous system
c/o	Complains of
CO	Carbon monoxide
CO_2	Carbon dioxide
Co	Cobalt
CPC	Clinicopathologic conference
CPD	Cephalopelvic disproportion
CPR	Cardiopulmonary resuscitation
CR	Crown-rump length (length of fetus)
CSF	Cerebrospinal fluid
CSM	Cerebrospinal meningitis
CT	Computed tomography
Cu	Copper
$CuSO_4$	Copper sulfate
CVA	Cerebrovascular accident; costovertebral angle
CVP	Central venous pressure
cyl	Cylinder
D	Dose; vitamin D; right (*dexter*)
DAH	Disordered action of the heart
D & C	Dilation (dilatation) and curettage
DC	Direct current
DCA	Deoxycorticosterone acetateDcg Degeneration; degree
dg	Decigram
dr	Dram
DTR	Deep tendon reflex
Dx	Diagnosis
E	Eye
EAHF	Eczema, asthma, and hayfever
ECG	Electrocardiogram, Electrocardiograph
ECT	Electroconvulsive therapy
ED	Erythema dose, effective dose
ED_{50}	Median effective dose
EDC	Estimated date of confinement
EDD	Estimated date of delivery
EEG	Electroencephalogram, electroencephalograph
EENT	Eye, ear, nose, and throat
EKG	Electrocardiogram, electrocardiograph
Em	Emmetropia
EMB	Eosin-methylene blue
EMC	Encephalomyocarditis
EMF	Erythrocyte maturation factor
EMG	Electromyogram
EMS	Emergency medical service
ENT	Ear, nose, and throat
EOM	Extraocular movement
EPR	Electrophrenic respiration
ER	Emergency room (hospital); external resistance
ERG	Electroretinogram
ERPF	Effective renal plasma flow
ESR	Erythrocyte sedimentation rate
EST	Electroshock therapy
Et	Ethyl
ext	Extract
F	Fahrenheit; field of vision; formula
FA	Fatty acid
FANA	Fluorescent antinuclear antibody test
F & R	Force and rhythm (pulse)
FBS	Fasting blood sugar
ED	Fatal dose; focal distance
Fe	Iron
$FeCl_3$	Ferric chloride
Fl	Fluid
fld	Fluid
fl dr	Fluid dram

Abbreviations	Meanings	Abbreviations	Meanings
fl oz	Fluid ounce	HNO_3	Nitric acid
FR	Flocculation reaction	H_2O	Water
FSH	Follicle-stimulating hormone	H_2O_2	Hydrogen peroxide
ft	Foot	HOP	High oxygen pressure
FUO	Fever of unknown origin	H_2SO_4	Sulfuric acid
Gm; g; gm	Gram	Ht	Total hyperopia
GA	Gingivoaxial		

Galv	Galvanic
GB	Gallbladder
GBS	Gallbladder series
GC	Gonococcus or gonorrheal
GFR	Glomerular filtration rate
GH	Growth hormone
GI	Gastrointestinal
GL	Greatest length (small flexed embryo)
GLA	Gingivolinguoaxial
GP	General practitioner; general paresis
gr	Grain
Grad	By degrees (*gradatim*)
Grav I, II, III, etc.	Pregnancy one, two, three, etc. (*gravida*)
GSW	Gunshot wound
gt	Drop (*gutta*)
GTT	Glucose tolerance test
gtt	Drops (*guttae*)
GU	Genitourinary
Gyn	Gynecology
H	Hydrogen
H+	Hydrogen ion
H & E	Hematoxylin and eosin stain
Hb; Hgb	Hemoglobin
H_3BO_3	Boric acid
HC	Hospital corps
HCG	Human chorionic gonadotropin
HCHO	Formaldehyde
HCl	Hydrochloric acid
HCN	Hydrocyanic acid
H_2CO_3	Carbonic acid
HCT	Hematocrit
HD	Hearing distance
HDL	High density lipoprotein
HDLW	Distance at which a watch is heard by the left ear
HDRW	Distance at which a watch is heard by the right ear
He	Helium
HEENT	Head, eye, ear, hose, and throat
Hg	Mercury
Hgb	Hemoglobin
HIV	Human immunodeficiency (AIDS) virus
Hy	Hyperopia
I	Iodine
^{131}I	Radioactive isotope of iodine (atomic weight 131)
^{132}I	Radioactive isotope of iodine (atomic weight 132)
IB	Inclusion body
IBW	Ideal body weight
ICP	Intracranial pressure
ICS	Intercostal space
ICSH	Interstitial cell-stimulating hormone
ICT	Inflammation of connective tissue
ICU	Intensive care unit
Id.	The same (*idem*)
IH	Infectious hepatitis
IM	Intramuscular; infectious mononucleosis
IOP	Intraocular pressure
IQ	Intelligence quotient
IS	Intercostal space
IU	Immunizing unit
IV	Intravenous
IVP	Intravenous pyelogram, intravenous push
IVT	Intravenous transfusion
IVU	Intravenous urogram/urography
K	Potassium
k	Constant
Ka	Cathode or kathode
KBr	Potassium bromide
kc	Kilocycle
KCl	Potassium chloride
kev	Kilo electron volts
kg	Kilogram
KI	Potassium iodide
kj	Knee jerk
km	Kilometer
KOH	Potassium hydroxide
KUB	Kidney, ureter, and bladder
kv	Kilovolt
kw	Kilowatt
L	Left; liter; length; lumbar; lethal; pound
L & A	Light and accommodation

Abbreviations	Meanings
lb	Pound (*libra*)
LB	Large bowel (x-ray film)
LCM	Left costal margin
LD	Lethal dose; perception of light difference
LDL	Low density lipoprotein
LE	Lupus erythematosus
l.e.s.	Local excitatory state
LFD	Least fatal dose of a toxin
LH	Luteinizing hormone
Li	Lithium
LIF	Left iliac fossa
lig	Ligament
Liq	Liquor
LLL	Left lower lobe
LLQ	Left lower quadrant
LMP	Last menstrual period
LP	Lumbar puncture
LPF	Leukocytosis-promoting factor
LTH	Luteotrophic hormone
LUL	Left upper lobe
LUQ	Left upper quadrant
LV	Left ventricle
L & W	Living and well
M	Myopia; meter; muscle; thousand
m	Meter
MA	Mental age
Mag	Large (*magnus*)
MAP	Mean arterial pressure
MBD	Minimal brain dysfunction
mc; mCi	Millicurie
c	Microcurie
mcg	Microgram
MCH	Mean corpuscular hemoglobin
MCHC	Mean corpuscular hemoglobin concentration
MCV	Mean corpuscular volume
Me	Methyl
MED	Minimal erythema dose; minimal effective dose
mEq	Milliequivalent
mEq/L	Milliequivalent per liter
ME ratio	Myeloid-erythroid ratio
Mg	Magnesium
mg	Milligram
g	Microgram
MHD	Minimal hemolytic dose
m Hg	Millimeters of mercury
MI	Myocardial infarction
MID	Minimum infective dose
ML	Midline
ml	Milliliter
MLD	Median or minimum lethal dose
MM	Mucous membrane
mm	Millimeter, muscles
mmm	Millimicron
m	Millimicron, Micromicron
Mn	Manganese
mN	Millinormal
MRI	Magnetic resonance imaging
MS	Multiple sclerosis
MSL	Midsternal line
MT	Medical technologist; membrane tympani
mu	Mouse unit
MW	Molecular weight
My	Myopia
N	Nitrogen
n	Normal
Na	Sodium
NaBr	Sodium bromide
NaCl	Sodium chloride
$Na_2C_2O_4$	Sodium oxalate
Na_2CO_3	Sodium carbonate
NAD	No appreciable disease
NaF	Sodium fluoride
$NaHCO_3$	Sodium bicarbonate
Na_2HPO_4	Sodium phosphate
NAI	Sodium iodide
$NaNO_3$	Sodium nitrate
Na_2O_2	Sodium peroxide
NaOH	Sodium hydroxide
Na_2SO_4	Sodium sulfate
NCA	Neurocirculatory asthenia
Ne	Neon
NH_3	Ammonia
Ni	Nickel
NIH	National Institutes of Health
NMR	Nuclear magnetic resonance
NPN	Nonprotein nitrogen
NPO; n.p.o.	Nothing by mouth (*non per os*)
NRC	Normal retinal correspondence
NTP	Normal temperature and pressure
NYD	Not yet diagnosed
O	Oxygen; oculus; pint
O_2	Oxygen; both eyes
O_3	Ozone
OB	Obstetrics
OBS	Organic brain syndrome
OD	Right eye (*oculus dexter*); optical density
OPD	Outpatient department
OR	Operating room
ORIF	Open reduction and internal fixation
OS	Left eye (*oculus sinister*)

Abbreviations	Meanings
Os	Osmium
OT	Occupational therapy
OTD	Organ tolerance dose
OU	Each eye (*oculus uterque*)
oz;	Ounce
P	Phosphorus; pulse; pupil
P_2	Pulmonic second sound
P-A; P/A; PA	Posterior-anterior
P & A	Percussion and auscultation
PAB; PABA	Para-aminobenzoic acid
Pap test	Papanicolaou smear
Para I, II, III, etc,	Unipara, bipara, tripara, etc.
PAS; PASA	Para-aminosalicylic acid
Pb	Lead
PBi	Protein-bound iodine
PCV	Packed cell volume
PD	Interpupillary distance
pd	Prism diopter; pupillary distance
PDA	Patent ductus arteriosus
PDR	*Physician's Desk Reference*
PE	Physical examination
PEG	Pneumoencephalography
PET	Positron emission tomography
PFF	Protein-free filtrate
PGA	Pteroylglutamic acid (folic acid)
PH	Past history
pH	Hydrogen ion concentration (alkalinity and acidity in urine and blood analysis)
Pharm; Phar.	Pharmacy
PI	Previous illness; protamine insulin
PID	Pelvic inflammatory disease
PK	Psychokinesis
PKU	Phenylketonuria
PL	Light perception
PM	Postmortem; evening
PMB	Polymorphonuclear basophil leukocytes
PME	Polymorphonuclear eosinophil leukocytes
PMI	Point of maximal impulse
PMN	Polymorphonuclear neutrophil leukocytes (polys)
PMS	Premenstrual syndrome
PN	Percussion note
PNH	Paroxysmal nocturnal hemoglobinuria
PO; p.o.	Orally (*per os*)
PPD	Purified protein derivative (TB test)
Pr	Presbyopia; prism
PRN, p.r.n	As required (*pro re nata*)
pro time	Prothrombin time
PSP	Phenolsulfonphthalein
pt	Pint
Pt	Platinum; patient
PT	Prothrombin time; physical therapy
PTA	Plasma thromboplastin antecedent
PTC	Plasma thromboplastin component
PTT	Partial thromboplastin time
Pu	Plutonium
PUO	Pyrexia of unknown origin
Px	Pneumothorax
PZI	Protamine zinc insulin
Q	Electric quantity
qns	Quantity not sufficient
qt	Quart
Quat	Four (*quattuor*)
R	Respiration; right; *Rickettsia*; roentgen Take
RA	Rheumatoid arthritis
Ra	Radium
rad	Unit of measurement of the absorbed dose of ionizing radiation; root
RAI	Radioactive iodine
RAIU	Radioactive iodine uptake
RBC; rbc	Red blood cell; red blood count
RCD	Relative cardiac dullness
RCM	Right costal margin
RE	Right eye; reticuloendothelial tissue or cell
Re	Rhenium
Rect	Rectified
Reg umb	Umbilical region
RES	Reticuloendothelial system
Rh	Symbol of rhesus factor; symbol for rhodium
RhA	Rheumatoid arthritis
RHD	Relative hepatic dullness, rheumatic heart disease
RLL	Right lower lobe
RLQ	Right lower quadrant
RM	Respiratory movement
RML	Right middle lobe of lung
Rn	Radon
RNA	Ribonucleic acid
R/O	Rule out
RPF	Renal plasma flow
RPM; rpm	Revolutions per minute
RPS	Renal pressor substance
RQ	Respiratory quotient
RT	Reading test
RU	Rat unit
RUL	Right upper lobe
RUQ	Right upper quadrant
S	Sulfur
S.	Sacral
S-A; S/A; SA	Sinoatrial
SAS	Sodium acetate solution

Abbreviations	Meanings
SB	Small bowel (x-ray film), sternal border
Sb	Antimony
SC	Closure of semilunar valves
Se	Selenium
SD	Skin dose
Sed rate	Sedimentation rate
SGOT	Serum glutamic oxaloacetic transaminase
SGPT	Serum glutamic pyruvic transaminase
SH	Serum hepatitis
S.I.	Soluble insulin
Si	Silicon
SIDS	Sudden infant death syndrome
Sn	Tin
SOB	Shortness of breath
sol	Solution, dissolved
SP	Spirit
sp. gr., SG, s.g.	Specific gravity
sph	Spherical
SPI	Serum precipitable iodine
spir	Spirit
SR	Sedimentation rate
Sr	Strontium
SSS	Specific soluble substance, sick sinus syndrome
sss	Layer upon layer (*stratum super stratum*)
St	Let it stand (*stet; stent*)
Staph	*Staphylococcus*
stat	Immediately (*statim*)
STD	Sexually transmitted disease, skin test dose
STH	Somatotrophic hormone
Strep	*Streptococcus*
STS	Serologic test for syphilis
STU	Skin test unit
sv	Alcoholic spirit (*spiritus vini*)
Sym	Symmetrical
T	Temperature; thoracic
t	Temporal
T_3	Triiodothyronine
T_4	Thyroxine
TA	Toxin-antitoxin
Ta	Tantalum
T & A	Tonsillectomy and adenoidectomy
TAB	Vaccine against typhoid, paratyphoid A and B
Tab	Tablet
TAH	Total abdominal hysterectomy
TAM	Toxoid-antitoxoid mixture
TAT	Toxin-antitoxin, tetanus antitoxin
TB	Tuberculin; tuberculosis; tubercle bacillus
Tb	Terbium
TCA	Tetrachloracetic acid
Te	Tellurium; tetanus
TEM	Triethylene melamine
Th	Thorium
TIA	Transient ischemic attack
TIBC	Total iron-binding capacity
Tl	Thallium
Tm	Thulium; symbol for maximal tubular excretory capacity (kidneys)
TNT	Trinitrotoluene
TNTC	Too numerous to mention
TP	Tuberculin precipitation
TPI	*Treponema pallidum* immobilization test for syphilis
TPR	Temperature, pulse, and respiration
tr	Tincture
Trans D	Transverse diameter
TRU	Turbidity reducing unit
TS	Test solution
TSH	Thyroid-stimulating hormone
TSP	Trisodium phosphate
TST	Triple sugar iron test
TUR; TURP	Transurethral resection
U	Uranium; unit
UA	Urinalysis
UBI	Ultraviolet blood irradiation
UIBC	Unsaturated iron-binding capacity
Umb; umb	Umbilicus
URI	Upper respiratory infection
US	Ultrasonic
USP	*U.S. Pharmacopeia*
V	Vanadium; vision; visual acuity
v	Volt
VA	Visual acuity
V & T	Volume and tension
VC	Vital capacity
VD	Venereal disease
VDA	Visual discriminatory acuity
VDG	Venereal disease—gonorrhea
VDM	Vasodepressor material
VDRL	Venereal Disease Research Laboratories (sometimes used loosely to mean venereal disease report)
VDS	Venereal disease—syphilis
VEM	Vasoexcitor material
Vf	Field of vision
VHD	Valvular heart disease
VIA	Virus inactivating agent
VLDL	Very low density lipoprotein

Abbreviations	Meanings	Abbreviations	Meanings
VMA	Vanillylmandelic acid	WD	Well developed
VR	Vocal resonance	WL	Wavelength
VS	Volumetric solution	WN	Well nourished
Vs	Venisection	WR	Wassermann reaction
VsB	Bleeding in arm (*venaesectio brachii*)	wt	Weight
VSD	Ventricular septal defect	X-ray	Roentgen ray
VW	Vessel wall	Z	Symbol for atomic number
W	Tungsten	Zn	Zinc
w	Watt	Zz	Ginge
WBC; wbc	White blood cell; white blood count		

APPENDIX 2.

COMMON ABBREVIATIONS USED IN WRITING A PRESCRIPTION

Abbreviations		Abbreviations
Abbreviation	Derivation	Meaning
à à	ana	of each
a.c.	ante cibum	before meals
ad	ad	to, up to
ad lib.	ad libitum	freely as desired
alt. dieb.	alternis diebus	every other day
alt. hor.	alternis horis	alternate hours
alt. noct.	alternis noctes	alternate nights
aq.	aqua	water
aq. dest.	aqua destillata	distilled water
b.i.d.	bis in die	two times a day
b.i.n.	bis in noctis	two times a night
c.	cum	with
Cap.	capiat	let him take
caps.	capsula	capsule
c.m.s.	cras mane sumendus	to be taken tomorrow morning
c.n.	cras nocte	tomorrow night
c.n.s.	cras nocte sumendus	to be taken tomorrow night
comp.	compositus	compound
Det.	detur	let it be given
Dieb. tert.	diebus tertiis	every third day
dil.	dilutus	dilute
elix.	elixir	elixir
ext.	extractum	extract
fld.	fluidus	fluid
Ft.	fiat	make
g	gramme	gram
gr	granum	grain
gt	gutta	a drop
gtt	guttae	drops
h.	hora	hour
h.d.	hora decubitus	at bedtime
h.s.	hora somni	hour of sleep (bedtime)
M.	misce	mix
m.	minimum	a minim
mist.	mistura	mixture
non rep.	non repetatur	not to be repeated
noct.	nocte	in the night
O	octarius	pint
ol.	oleum	oil
o.d.	omni die	every day
o.h.	omni hora	every hour
o.m.	omni mane	every morning

o.n.	omni nocte	every night
os	os	mouth
oz	uncia	ounce
p.c.	post cibum	after meals
per	per	through or by
pil.	pilula	pill
p.o.	per os	orally
p.r.n.	pro re nata	when required
q.d.	quaque die	everyday
q.h.	quaque hora	every hour
q. 2 h.		every two hours
q. 3 h.		every three hours
q. 4 h.	every four hours	
q.i.d.	quater in die	four times a day
q.l.	quantum libet	as much as desired
q.n.	quaque nocte	every night
q.p.	quantum placeat	as much as desired
q.v.	quantum vis	as much as you please
q.s.	quantum sufficit	as much as is required
	recipe	take
Rep.	repetatur	let it be repeated
s	sine	without
seq. luce.	sequenti luce	the following day
Sig. or S.	signa	write on label
s.o.s.	si opus sit	if necessary
sp.	spiritus	spirits
ss	semis	a half
stat.	statim	immediately
syr.	syrupus	syrup
t.d.s.	ter die sumendum	to be taken three times daily
t.i.d.	ter in die	three times a day
t.i.n.	ter in nocte	three times a night
tr. or tinct.	tinctura	tincture
ung.	unguentum	ointment
ut. dict.	ut dictum	as directed
vin.	Vini	wine

APPENDIX 3.

NORMAL REFERENCE VALUES TO INTERPRET THE LABORATORY TESTS

REFERENCE VALUES FOR HEMATOLOGY

Test	Conventional Units	SI Units
Acid hemolysis (Ham test)	No hemolysis	No hemolysis
Alkaline phosphatase, leukocyte	Total score 14–100	Total score 14–100
Cell counts		
Erythrocytes		
Males	4.6–6.2 million/mm3	4.6–6.2 * 1012/L
Females	4.2–5.4 million/mm3	4.2–5.4 * 1012/L
Children (varies with age)	4.5–5.1 million/mm3	4.5–5.1 * 1012/L
Leukocytes, total	4500–11,000/mm3	4.5–11.0 * 109/L
Leukocytes, differential counts		
Myelocytes	0%	0/L
Band neutrophils	3–5%	150–400 * 106/L
Segmented neutrophils	54–62%	3000–5800 * 106/L
Lymphocytes	25–33%	1500–3000 * 106/L
Monocytes	3–7%	300–500 * 106/L
Eosinophils	1–3%	50–250 * 106/L
Basophils	0–1%	15–50 * 106/L
Platelets	150,000–400,000/mm3	150–400 * 109/L
Reticulocytes	25,000–75,000/mm3 (0.5–1.5% of erythrocytes)	25–75 * 109/L
Coagulation tests		
Bleeding time (template)	2.75–8.0 min	2.75–8.0 min
Coagulation time (glass tube)	5–15 min	5–15 min
D-Dimer	<0.5 mg/Ml	<0.5 mg/L
Factor VIII and other coagulation factors	50–150% of normal	0.5–1.5 of normal
Fibrin split products (Thrombo-Wellco test)	<10 mg/mL	<10 mg/L
Fibrinogen	200–400 mg/dL	2.0–4.0 g/L
Partial thromboplastin time, activated (aPTT)	20–35 s	20–35 s
Prothrombin time (PT)	12.0–14.0 s	12.0–14.0 s
Coombs' test		
Direct	Negative	Negative
Indirect	Negative	Negative
Corpuscular values of erythrocytes		
Mean corpuscular hemoglobin (MCH)	26–34 pg/cell	26–34 pg/cell
Mean corpuscular volume (MCV)	80–96 mm3	80–96 fL
Mean corpuscular hemoglobin concentration (MCHC)		
	32–36 g/dL	320–360 g/L
Haptoglobin	20–165 mg/dL	0.20–1.65 g/L
Hematocrit		
Males	40–54 mL/dL	0.40–0.54
Females	37–47 mL/dL	0.37–0.47
Newborns	49–54 mL/dL	0.49–0.54
Children (varies with age)	35–49 mL/dL	0.35–0.49

Hemoglobin		
Males	13.0–18.0 g/dL	8.1–11.2 mmol/L
Females	12.0–16.0 g/dL	7.4–9.9 mmol/L
Newborns	16.5–19.5 g/dL	10.2–12.1 mmol/L
Children (varies with age)	11.2–16.5 g/dL	7.0–10.2 mmol/L
Hemoglobin, fetal	<1.0% of total	<0.01 of total
Hemoglobin A1c	3–5% of total	0.03–0.05 of total
Hemoglobin A2	1.5–3.0% of total	0.015–0.03 of total
Hemoglobin, plasma	0.0–5.0 mg/dL	0.0–3.2 mmol/L
Methemoglobin	30–130 mg/dL	19–80 mmol/L
Sedimentation rate (ESR)		
Wintrobe: Males	0–5 mm/h	0–5 mm/h
Females	0–15 mm/h	0–15 mm/h
Westergren: Males	0–15 mm/h	0–15 mm/h
Females	0–20 mm/h	0–20 mm/h

REFERENCE VALUES FOR CLINICAL CHEMISTRY (BLOOD, SERUM, AND PLASMA)

Analyte	Conventional Units	SI Units
Acetoacetate plus acetone		
Qualitative	Negative	egative
Quantitative	0.3–2.0 mg/dL	30–200 mmol/L
Acid phosphatase, serum (thymolphthalein monophosphate substrate)	0.1–0.6 U/L	0.1–0.6 U/L
ACTH (see Corticotropin)		
Alanine aminotransferase (ALT) serum (SGPT)	1–45 U/L	1–45 U/L
Albumin, serum	3.3–5.2 g/dL	33–52 g/L
Aldolase, serum	0.0–7.0 U/L	0.0–7.0 U/L
Aldosterone, plasma		
Standing	5–30 ng/dL	140–830 pmol/L
Recumbent	3–10 ng/dL	80–275 pmol/L
Alkaline phosphatase (ALP), serum		
Adult	35–150 U/L	35–150 U/L
Adolescent	100–500 U/L	100–500 U/L
Child	100–350 U/L	100–350 U/L
Ammonia nitrogen, plasma	10–50 mmol/L	10–50 mmol/L
Amylase, serum	25–125 U/L	25–125 U/L
Anion gap, serum, calculated	8–16 mEq/L	8–16 mmol/L
Ascorbic acid, blood	0.4–1.5 mg/dL	23–85 mmol/L
Aspartate aminotransferase (AST) serum (SGOT)		
	1–36 U/L	1–36 U/L
Base excess, arterial blood, calculated	0 ± 2 mEq/L	0 ± 2 mmol/L
Bicarbonate		
Venous plasma	23–29 mEq/L	23–29 mmol/L
Arterial blood	21–27 mEq/L	21–27 mmol/L
Bile acids, serum	0.3–3.0 mg/dL	0.8–7.6 mmol/L

Bilirubin, serum		
Conjugated	0.1–0.4 mg/dL	1.7–6.8 mmol/L
Total	0.3–1.1 mg/dL	5.1–19.0 mmol/L
Calcium, serum	8.4–10.6 mg/dL	2.10–2.65 mmol/L
Calcium, ionized, serum	4.25–5.25 mg/dL	1.05–1.30 mmol/L
Carbon dioxide, total, serum or plasma	24–31 mEq/L	24–31 mmol/L
Carbon dioxide tension (PCO2), blood	35–45 mm Hg	35–45 mm Hg
b-carotene, serum	60–260 mg/dL	1.1–8.6 mmol/L
Ceruloplasmin, serum	23–44 mg/Dl	230–440 mg/L
Chloride, serum or plasma	96–106 mEq/L	96–106 mmol/L
Cholesterol, serum or ethylenediaminetetraacetic acid (EDTA)		
Plasma		
Desirable range	<200 mg/dL	<5.20 mmol/L
Low-density lipoprotein (LDL) cholesterol	60–180 mg/dL	1.55–4.65 mmol/L
High-density lipoprotein (HDL) cholesterol	30–80 mg/dL	0.80–2.05 mmol/L
Copper	70–140 mg/dL	11–22 mmol/L
Corticotropin (ACTH), plasma, 8 AM	10–80 pg/mL	2–18 pmol/L
Cortisol, plasma		
8 AM	6–23 mg/dL	170–630 nmol/L
4 PM	3–15 mg/dL	80–410 nmol/L
10 PM	<50% of 8 AM value	<50% of 8 AM value
Creatine, serum		
Males	0.2–0.5 mg/dL	15–40 mmol/L
Females	0.3–0.9 mg/dL	25–70 mmol/L
Creatine kinase (CK), serum		
Males	55–170 U/L	55–170 U/L
Females	30–135 U/L	30–135 U/L
Creatine kinase MB isoenzyme, serum	<5% of total CK activity <5.0 ng/mL by immunoassay	<5% of total CK activity <5.0 ng/mL by immunoassay
Creatinine, serum	0.6–1.2 mg/dL	50–110 mmol/L
Estradiol-17b, adult		
Males	10–65 pg/mL	35–240 pmol/L
Females		
Follicular	30–100 pg/mL	110–370 pmol/L
Ovulatory	200–400 pg/mL	730–1470 pmol/L
Luteal	50–140 pg/mL	180–510 pmol/L
Ferritin, serum	20–200 ng/mL	20–200 mg/L
Fibrinogen, plasma	200–400 mg/dL	2.0–4.0 g/L
Folate, serum	3–18 ng/mL	6.8–41 nmol/L
Erythrocytes	145–540 ng/mL	330–1220 nmol/L
Follicle-stimulating hormone (FSH), plasma		
Males	4–25 mU/mL	4–25 U/L
Females, premenopausal	4–30 mU/mL	4–30 U/L
Females, postmenopausal	40–250 mU/mL	40–250 U/L
Gamma-glutamyltransferase (GGT), serum	5–40 U/L	5–40 U/L
Gastrin, fasting, serum	0–100 pg/mL	0–100 mg/L

Glucose, fasting, plasma or serum	70–115 mg/dL	3.9–6.4 nmol/L
Growth hormone (hGH), plasma, adult, fasting	0–6 ng/mL	0–6 mg/L
Haptoglobin, serum	20–165 mg/dL	0.20–1.65 gm/L
Immunoglobulins, serum (see table of Reference Intervals for Tests of Immunologic Function)		
Iron, serum	75–175 mg/dL	13–31 mmol/L
Iron binding capacity, serum		
Total	250–410 mg/dL	45–73 mmol/L
Saturation	20–55%	0.20–0.55
Lactate		
Venous whole blood	5.0–20.0 mg/dL	0.6–2.2 mmol/L
Arterial whole blood	5.0–15.0 mg/dL	0.6–1.7 mmol/L
Lactate dehydrogenase (LD), serum	110–220 U/L	110–220 U/L
Lipase, serum	10–140 U/L	10–140 U/L
Lutropin (LH), serum		
Males	1–9 U/L	1–9 U/L
Females		
Follicular phase	2–10 U/L	2–10 U/L
Midcycle peak	15–65 U/L	15–65 U/L
Luteal phase	1–12 U/L	1–12 U/L
Postmenopausal	12–65 U/L	12–65 U/L
Magnesium, serum	1.3–2.1 mg/dL	0.65–1.05 mmol/L
Osmolality	275–295 mOsm/kg water	275–295 mOsm/kg water
Oxygen, blood, arterial, room air		
Partial pressure (Pao2)	80–100 mm Hg	80–100 mm Hg
Saturation (Sao2)	95–98%	95–98%
pH, arterial blood	7.35–7.45	7.35–7.45
Phosphate, inorganic, serum		
Adult	3.0–4.5 mg/dL	1.0–1.5 mmol/L
Child	4.0–7.0 mg/dL	1.3–2.3 mmol/L
Potassium		
Serum	3.5–5.0 mEq/L	3.5–5.0 mmol/L
Plasma	3.5–4.5 mEq/L	3.5–4.5 mmol/L
Progesterone, serum, adult		
Males	0.0–0.4 ng/mL	0.0–1.3 mmol/L
Females		
Follicular phase	0.1–1.5 ng/mL	0.3–4.8 mmol/L
Luteal phase	2.5–28.0 ng/mL	8.0–89.0 mmol/L
Prolactin, serum		
Males	1.0–15.0 ng/Ml	1.0–15.0 mg/L
Females	1.0–20.0 ng/mL	1.0–20.0 mg/L
Protein, serum, electrophoresis		
Total	6.0–8.0 g/dL	60–80 g/L
Albumin	3.5–5.5 g/dL	35–55 g/L
Globulins		
Alpha1	0.2–0.4 g/dL	2.0–4.0 g/L
Alpha2	0.5–0.9 g/dL	5.0–9.0 g/L

Beta	0.6–1.1 g/dL	6.0–11.0 g/L
Gamma	0.7–1.7 g/dL	7.0–17.0 g/L
Pyruvate, blood	0.3–0.9 mg/dL	0.03–0.10 mmol/L
Rheumatoid factor	0.0–30.0 IU/mL	0.0–30.0 kIU/L
Sodium, serum or plasma	135–145 mEq/L	135–145 mmol/L
Testosterone, plasma		
Males, adult	300–1200 ng/dL	10.4–41.6 nmol/L
Females, adult	20–75 ng/dL	0.7–2.6 nmol/L
Pregnant females	40–200 ng/dL	1.4–6.9 nmol/L
Thyroglobulin	3–42 ng/mL	3–42 mg/L
Thyrotropin (hTSH), serum	0.4–4.8 mIU/mL	0.4–4.8 mIU/L
Thyrotropin-releasing hormone (TRH)	5–60 pg/mL	5–60 ng/L
Thyroxine (FT4), free, serum	0.9–2.1 ng/dL	12–27 pmol/L
Thyroxine (T4), serum	4.5–12.0 mg/dL	58–154 nmol/L
Thyroxine-binding globulin (TBG)	15.0–34.0 mg/mL	15.0–34.0 mg/L
Transferrin	250–430 mg/dL	2.5–4.3 g/L
Triglycerides, serum, 12-h fast	40–150 mg/dL	0.4–1.5 g/L
Triiodothyronine (T3), serum	70–190 ng/dL	1.1–2.9 nmol/L
Triiodothyronine uptake, resin (T3RU)	25–38%	0.25–0.38
Urate		
Males	2.5–8.0 mg/dL	150–480 mmol/L
Females	2.2–7.0 mg/dL	130–420 mmol/L
Urea, serum or plasma	24–49 mg/dL	4.0–8.2 nmol/L
Urea nitrogen, serum or plasma	11–23 mg/dL	8.0–16.4 nmol/L
Viscosity, serum	1.4–1.8 * water	1.4–1.8 * water
Vitamin A, serum	20–80 mg/dL	0.70–2.80 mmol/L
Vitamin B12, serum	180–900 pg/mL	133–664 pmol/L

Reference values may vary, depending on the method and sample source used.

REFERENCE URINE VALUES

Analyte	Conventional Units	SI Units*
Acetone plus acetoacetate (ketone bodies)	Negative	Negative
Addis count (12-hour)	Adults:	Negative
	WBCs and epithelial cells:	
	1.8 million/12 hours	
	RBCs: 500,000/12 hours	
	Hyaline casts: Up to 5000/12 hours	
	Children:	
	WBCs: <1 million/12 hours	
	RBCs: <250,000/12 hours	
	Casts: >5000/12 hours	
	Protein: <20 mg/12 hours	
Albumin	Random: 8 mg/dl	Negative
Aldosterone	24-hour: 10-100 mg/24 hours 2-16 μg/24 hours	10-100 mg/24 hr 5.5-72 nmol/24 hours
Alpha-aminonitrogen	0.4-1.0 g/24 hours	28-71 nmol/24 hours

Amino acid	50-200 mg/24 hours	
Ammonia (24-hour)	30-50 mEq/24 hours	30-50 nmol/24 hours
	500-1200 mg/24 hours	
Amylase	5000 Somogyi units/24 hours	6.5-48.1 U/hr
	3-35 IU/hour	
Arsenic (24-hour)	<50 μg/L	<0.65 mol/L
Ascorbic acid (vitamin C)	Random: 1-7 ng/dl	0.06-0.40 mmol/L
	24-hour: >50 mg/24 hours	>0.29 mmol/24 hours
Bacteria	None	None
Bence Jones protein	Negative	Negative
Bilirubin	Negative	Negative
Blood or hemoglobin	Negative	Negative
Borate (24-hour)	<2 mg/L	<32 μmol/L
Calcium	Random: 1 + turbidity	1 + turbidity
	24-hour: 1-300 mg (diet dependent)	
Catecholamines (24-hour)	Epinephrine: 5-40 μg/24 hours	<55 nmol/24 hours
	Norepinephrine: 10-80 μg/24 hours	<590 nmol/24 hours
	Metanephrine: 24-96 μg/24 hours	0.5-8.1 μmol/24 hours
	Normetanephrine: 77-375 μg/24 hours	
Chloride (24-hour)	140-250 mEq/24 hours	140-250 mmol/24hours
Color	Amber-yellow	Amber-yellow
Concentration test (Fishberg test)	Specific gravity: >1.025	>1.025
	Osmolality: 850 mOsm/L	>850 mOsm/L
Copper (CU) (24-hour)	Up to 25 μg/24 hours	0-0.4 μmol/24 hours
Coproporphyrin (24-hour)	100-300 μg/24 hours	150-460 nmol/24hours
Creatine	Adults: <100 mg/24 hours or <6%	
	creatinine	
	Pregnant women: ≤12%	
	Infants <1 year: equal to creatinine	
	Older children: ≤30% of creatinine	
Creatinine (24-hour)	15-25 mg/kg body wt/24 hours	0.13-0.22 nmol/kg^{-1} body wt/24 hours
Creatinine clearance (24-hour)	Men: 90-140 ml/min	90-140 ml/min
	Women: 85-125 ml/min	85-125 ml/min
Crystals	Negative	Negative
Cystine or cysteine	Negative	Negative
Delta-aminolevulinic acid (ALA)	1-7 mg/24 hours	10-53 μmol/24 hours
Epinephrine (24-hour)	5-40 μg/24 hours	
Epithelial cells and casts	Occasional	Occasional
Estriol (24-hour)	>12 mg/24 hours	
Fat	Negative	Negative
Fluoride (24-hour)	<1 mg/24 hours	0.053 mmol/24 hours
Follicle-stimulating hormone (FSH)(24-hour)	Men: 2-12 IU/24 hours	
	Women:	
	During menses: 8-60 IU/24 hours	
	During ovulation: 30-60 IU/24 hours	
	During menopause: >50 IU/24 hours	
Glucose	Negative	Negative

Granular casts	Occasional	Occasional
Hemoglobin and myoglobin	Negative	Negative
Homogentistic acid	Negative	Negative
Human chorionic gonadotropin (HCG)	Negative	Negative
Hyaline casts	Occasional	Occasional
17-Hydroxycorticosteroids (17-OCHS)	Men: 5.5-15.0 mg/24 hours	8.3-25 μmol/24 hours
(24-hour)	Women: 5.0-13.5 mg/24 hours Children: lower than adult values	5.5-22 μmol/24 hours
5-Hydroxyindoleacetic acid (5-HIAA,	Men: 2-9 mg/24 hours	10-47 μmol/24 hours
serotonin) (24-hour)	Women: lower than men	
Ketones (see Acetone plus acetoacetate)		
17-Ketosteroids (17-KS) (24-hour)	Men: 8-15 mg/24 hours	21-62 μmol/24 hours
	Women: 6-12 mg/24 hours	14-45 μmol/24 hours
	Children:	
	12-15 yr: 5-12 mg/24 hours	
	<12 yr: <5 mg/24 hours	
Lactose (24-hour)	14-40 mg/24 hours	41-116 m
Lead	<0.08 g/ml or <120 g/24 hours	0.39 μmol/L
Leucine aminopeptidase (LAP)	2-18 U/24 hours	
Magnesium (24-hour)	6.8-8.5 mEq/24 hours	3.0-4.3 mmol/24 hours
Melanin	Negative	Negative
Odor	Aromatic	Aromatic
Osmolality	500-800 mOsm/L	38-1400 mmol/kg water
pH	4.6-8.0	4.6-8.0
Phenolsulfonphthalein (PSP)	15 min: at least 25%	At least 0.25
	30 min: at least 40% 120 min: at least 60%	At least 0.40 At least 0.60
Phenylketonuria (PKU)	Negative	Negative
Phenylpyruvic acid	Negative	Negative
Phosphorus (24-hour)	0.9-1.3 g/24 hours	29-42 mmol/24 hours
Porphobilinogen	Random: negative 24-hour: up to 2 mg/24 hours	Negative
Porphyrin (24-hour)	50-300 mg/24 hours	
Potassium (K^+) (24-hour)	25-100 mEq/24 hours	25-100 nmol/24 hours
Pregnancy test	Positive in normal pregnancy or	Positive in normal
	with tumors producing HCG	pregnancy or with
		tumors producing
		HCG
Pregnanediol	After ovulation: >1 mg/24 hours	
Protein (albumin)	Random: 8 mg/dl	
	10-100 mg/24 hours	>0.05 g/24 hours
Sodium (Na^+) (24-hour)	100-260 mEq/24 hours	100-260 nmol/24 hours
Specific gravity	1.010-1.025	1.010-1.025
Steroids (see 17-Hydroxycorticosteroids and 17-Ketosteroids)		
Sugar (see Glucose)		
Titratable acidity (24-hour)	20-50 mEq/24 hours	20-50 mmol/24 hours
Turbidity	Clear	Clear

Urea nitrogen (24-hour)	6-17 g/24 hours	0.21-0.60 mol/24 hours
Uric acid (24-hour)	250-750 mg/24 hours	1.48-4.43 mmol/24 hours
Urobilinogen	0.1-1.0 Ehrlich U/dl	0.1-1.0 Ehrlich U/dl
Uroporphyrin	Negative	Negative
Vanillylmandelic acid (VMA) (24-hour)	1-9 mg/24 hours	<40 µmol/day
Zinc (24-hour)	0.20-0.75 mg/24 hours	

*The use of the System of International Units (SI) was recommended at the 30th World Health Assembly in 1977 to implement an international language of measurement. Because this system is being adopted by many laboratories, many of the common values are expressed in both conventional and SI units. SI units are calculated by multiplying the conventional unit by a number factor. The SI measurement system uses *moles* as the basic unit for the amount of a substance, *kilograms* for its mass, and *meters* for its length.

REFERENCE VALUES FOR TESTS PERFORMED ON CEREBROSPINAL FLUID

Test	Conventional Units	SI Units
Cells	<5/mm3, all mononuclear	<5 * 106/L, all mononuclear
Protein electrophoresis	Albumin predominant	Albumin predominant
Glucose	50–75 mg/dL (20 mg/dL less than in serum)	2.8–4.2 mmol/L (1.1 mmol less than in serum)
IgG		
Children under 14	<8% of total protein	<0.08 of total protein
Adults	<14% of total protein	<0.14 of total protein
IgG index = (CSF/serum IgG ratio) / CSF/serum albumin ratio	0.3–0.6	0.3–0.6
Oligoclonal banding on electrophoresis	Absent	Absent
Pressure, opening	70–180 mm H2O	70–180 mm H2O
Protein, total	15–45 mg/dL	150–450 mg/L

REFERENCE VALUES FOR TESTS OF GASTROINTESTINAL FUNCTION

Test	Conventional Units
Bentiromide test	6-h urinary arylamine excretion greater than 57% excludes pancreatic Insufficiency
b-Carotene, serum	60–260 ng/dL
Fecal fat estimation	
Qualitative	No fat globules seen by high-power microscope
Quantitative	<6 g/24 h (>95% coefficient of fat absorption)
Gastric acid output	
Basal	
Males	0.0–10.5 mmol/h
Females	0.0–5.6 mmol/h
Maximum (after histamine or pentagastrin)	
Males	9.0–48.0 mmol/h
Females	6.0–31.0 mmol/h
Ratio: basal maximum	
Males	0.0–0.31
Females	0.0–0.29

Secretin test, pancreatic fluid	
Volume	>1.8 mL/kg/h
Bicarbonate	>80 mEq/L
D-Xylose absorption test, urine	>20% of ingested dose excreted in 5 h

REFERENCE VALUES FOR TESTS OF IMMUNOLOGIC FUNCTION

Test	Conventional Units	SI Units
Complement, Serum		
C3	85–175 mg/dL	0.85–1.75 gm/L
C4	15–45 mg/dL	150–450 mg/L
Total hemolytic (CH50)	150–250 U/mL	150–250 U/mL
Immunoglobulins, Serum, Adult		
IgG	640–1350 mg/dL	6.4–13.5 g/L
IgA	70–310 mg/dL	0.70–3.1 g/L
IgM	90–350 mg/dL	0.90–3.5 g/L
IgD	0.0–6.0 mg/dL	0.0–60 mg/L
IgE	0.0–430 ng/dL	0.0–430 mg/L

LYMPHOCYTE SUBSETS, WHOLE BLOOD, HEPARINIZED

Antigen(s) Expressed	Cell Type	Percentage	Absolute Cell Count
CD3	Total T cells	56–77%	860–1880
CD19	Total B cells	7–17%	140–370
CD3 and CD4	Helper-induced cells	32–54%	550–1190
CD3 and CD8	Suppressor-cytotoxic cells	24–37%	430–1060
CD3 and DR	Activated T cells	5–14%	70–310
CD2	E rosette T cells	73–87%	1040–2160
CD16 and CD56	Natural killer (NK) cells	8–22%	130–500
Helper/suppressor ratio: 0.8–1.8			

REFERENCE VALUES FOR SEMEN ANALYSIS

Test		Conventional Units	SI Units
Volume		2–5 Ml	2–5 mL
Liquefaction		Complete in 15 min	Complete in 15 min
pH		7.2–8.0	7.2–8.0
Leukocytes		Occasional or absent	Occasional or absent
Spermatozoa			
	Count	60–150 * 106/mL	60–150 * 106/mL
	Motility	>80% motile	>0.80 motile
	Morphology	80–90% normal forms	>0.80–0.90 normal forms
Fructose		>150 mg/dL	>8.33 mmol/L

APPENDIX 4.

REFERENCE VALUES FOR THERAPEUTIC DRUG MONITORING (SERUM)

Analyte	Therapeutic Range	Toxic Concentrations	Brand Name(s)
Analgesics			
Acetaminophen	10–20 mg/mL	>250 mg/mL	Tylenol, Datril
Salicylate	100–250 mg/mL	>300 mg/mL	Aspirin, Bufferin
Antibiotics			
Amikacin	25–30 mg/mL	Peak >35 mg/mL	Amikin
		Trough >10 mg/mL	
Gentamicin	5–10 mg/mL	Peak >10 mg/mL	Garamycin
		Trough >2 mg/mL	
Tobramycin	5–10 mg/mL	Peak >10 mg/mL	Nebcin
		Trough >2 mg/mL	
Vancomycin	5–35 mg/mL	Peak >40 mg/mL	Vancocin
		Trough >10 mg/mL	
Anticonvulsants			
Carbamazepine	5–12 mg/mL	>15 mg/mL	Tegretol
Ethosuximide	40–100 mg/mL	>150 mg/mL	Zarontin
Phenobarbital	15–40 mg/Ml	40–100 ng/mL (varies widely)	Luminal
Phenytoin	10–20 mg/mL	>20 mg/mL	Dilantin
Primidone	5–12 mg/mL	>15 mg/mL	Mysoline
Valproic acid	50–100 mg/mL	>100 mg/mL	Depakene
Antineoplastics and Immunosuppressives			
Cyclosporine	50–400 ng/mL	>400 ng/mL	Sandimmune
Methotrexate, high dose, 48-h	Variable	>1 mmol/L 48 h after dose	
Tacrolimus (FK-506), whole blood			
	3–10 mg/L	>15 mg/L	Prograf
Bronchodilators and Respiratory Stimulants			
Caffeine	3–15 ng/mL	>30 ng/mL	
Theophylline (aminophylline)	10–20 mg/mL	>20 mg/mL	Elixophyllin,
			Quibron
Cardiovascular Drugs			
Amiodarone	1.0–2.0 mg/mL	>2.0 mg/mL	Cordarone
(obtain specimen more than 8 h after last dose)			
Digitoxin	15–25 ng/Ml	>35 ng/mL	Crystodigin
(obtain specimen 12–24 h after last dose)			
Digoxin	0.8–2.0 ng/mL	>2.4 ng/mL	Lanoxin
(obtain specimen more than 6 h after last dose)			
Disopyramide	2–5 mg/mL	>7 mg/mL	Norpace
Flecainide	0.2–1.0 ng/Ml	>1 ng/mL	Tambocor
Lidocaine	1.5–5.0 mg/mL	>6 mg/mL	Xylocaine
Mexiletine	0.7–2.0 ng/mL	>2 ng/mL	Mexitil
Procainamide	4–10 mg/Ml	>12 mg/mL	Pronestyl
Procainamide plus N-acetyl-p- aminophenol (NAPA)			
	8–30 mg/mL	>30 mg/mL	
Propranolol	50–100 ng/mL	Variable	Inderal

Quinidine	2–5 mg/mL	>6 mg/mL	Cardioquin
			Quinaglute
Tocainide	4–10 ng/mL	>10 ng/mL	Tonocard
Psychopharmacologic Drugs			
Amitriptyline	120–150 ng/mL	>500 ng/mL	Elavil
			Triavil
Bupropion	25–100 ng/mL	Not applicable	Wellbutrin
Desipramine	150–300 ng/mL	>500 ng/mL	Norpramin
Imipramine	125–250 ng/mL	>400 ng/mL	Tofranil
Lithium (obtain specimen 12 h after last dose)			
	0.6–1.5 mEq/L	>1.5 mEq/L	Lithobid
Nortriptyline	50–150 ng/Ml	>500 ng/mL	Aventyl, Pamelor

REFERENCE VALUES FOR TOXIC SUBSTANCES

Test	Conventional Units	SI Units
Arsenic, urine	<130 mg/24 h	<1.7 mmol/d
Bromides, serum, inorganic	<100 mg/dL	<10 mmol/L
Toxic symptoms	140–1000 mg/dL	14–100 mmol/L
Carboxyhemoglobin, blood:	Saturation	
Urban environment	<5%	<0.05
Smokers	<12%	<0.12
Symptoms		
Headache	>15%	>0.15
Nausea and vomiting	>25%	>0.25
Potentially lethal	>50%	>0.50
Ethanol, blood	<0.05 mg/dL	<1.0 mmol/L
	<0.005%	
Intoxication	>100 mg/dL	>22 mmol/L
	>0.1%	
Marked intoxication	300–400 mg/dL	65–87 mmol/L
	0.3–0.4%	
Alcoholic stupor	400–500 mg/dL	87–109 mmol/L
	0.4–0.5%	
Coma	>500 mg/dL >109 mmol/L	>0.5%
Lead, blood		
Adults	<25 mg/dL	<1.2 mmol/L
Children	<15 mg/dL	<0.7 mmol/L
Lead, urine	<80 mg/24 h	<0.4 mmol/d
Mercury, urine	<30 mg/24 h	<150 nmol/d

APPENDIX 5.

DESIRABLE WEIGHT FOR MEN AND WOMEN OF AGE 25YEARS AND OVER

Weight in pounds (in indoor clothing)

Height	Small Frame	Medium Frame	Large frame
Men			
5'-2"	112-120	118-129	126-141
5'-3"	115-123	121-133	129-144
5'-4"	118-126	124-136	132-148
5'-5"	121-129	127-139	135-152
5'-6"	124-133	130-143	138-156
5'-7"	128-137	134-147	142-161
5'-8"	132-141	138-152	147-166
5'-9"	136-145	142-156	151-170
5'-10"	140-150	146-160	155-174
5'-11"	144-154	150-165	159-179
6'-0"	148-158	154-170	164-184
6'-1"	152-162	158-175	168-189
6'-2"	156-167	162-180	173-194
6'-3"	160-171	167-185	178-199
6'-4"	164-175	172-190	182-204
Women			
4'-10"	92-98	96-107	104-119
4'-11"	94-101	98-110	106-122
5'-0"	96-104	101-113	109-125
5'-1"	99-107	104-116	112-128
5'-2"	102-110	107-119	115-131
5'-3"	105-113	110-122	118-134
5'-4"	108-116	113-126	121-138
5'-5"	111-119	116-130	125-142
5'-6"	114-123	120-135	129-146
5'-7"	118-127	124-139	133-150
5'-8"	122-131	128-143	137-154
5'-9"	126-135	132-147	141-158
5'-10"	130-140	136-151	145-163
5'-11"	134-144	140-155	149-168
6'-0"	138-148	144-159	153-173

From Metropolitan Life Insurance Company. Data are based on weight associated with lowest death rates. To obtain weight for adults younger than 25, subtract 1 pound for each year under 25.

APPENDIX 6.

CLINICAL CALCULATION

CALCULATION FORMULAS AND NORMAL RANGES

Parameter	Formula	Normal range
Cardiac output (CO)	HR x SV	4-8 L/min
Cardiac index (CI)	$\frac{CO}{BSA}$	2.8-4.2 L/min/m^2
Stroke volume (SV)	$\frac{CO \times 1000}{HR}$	60-130 ml/beat
Stroke volume index (SVI)	$\frac{SV}{BSA}$	33-75 ml/m^2/beat
Stroke index (SI)	$\frac{CI}{HR} \times 1000$	30-65 ml/m^2/beat
Mean arterial pressure (MAP)	$\frac{2(DBP) + SBP}{3}$	70-105 mm Hg
Coronary perfusion pressure (CPP)	Arterial DP - PAWP	60-80 mm Hg
Systemic vascular resistance (SVR)	$\frac{MAP - CVP}{CO} \times 80$	700-1600 dynes/sec/cm^{-5}
Pulmonary vascular resistance (PRV)	$\frac{PAM - PAWP}{CO} \times 80$	20-130 dynes/sec/cm^{-5}
Left ventricular stroke work index (LVSWI)	(MAP - PAWP)SVI x 0.136	35-85 g/m^2/beat
Right ventricular stroke work index (RVSWI)	(PAM - CVP)SVI x 0.136	8.5-12 g/m^2/beat
Ejection fraction (EF)	$\frac{SV}{\text{end diastolic volume}} \times 100$	60%
Rate pressure product (RPP)	HR x SBP	<12,000
Arterial oxygen content (CaO_2)	(SaO_2 x Hb x 1.38) + (PaO_2 x .0031)	18-20 ml/100 ml or 20 vol %
Venous oxygen content (CvO_2)	(SvO_2 x Hb x 1.38) + (PvO_2 x .0031)	15.5 ml/100 ml
Arterial venous oxygen content difference ($C_{(a-v)}O_2$)	$CaO_2 - CvO_2$	4-6 ml/100 ml
Arterial oxygen delivery (DO_2)	CO x 10 x CaO_2	900-1200 ml/min
Venous oxygen delivery (DO_2)	CO x 10 x CvO_2	775 ml/min
Oxygen consumption (VO_2)	CO x 10 x $C_{(a-v)}O_2$	200-250 ml/min
Mixed venous oxygen saturation (SvO_2)	$1 - VO_2/DO_2$	60%-80%
Alveolar-arterial oxygen gradient ($AaDO_2$)	$PAO_2 - PaO_2$	<15 mm Hg
Alveolar partial pressure of oxygen (PaO_2)	$FIO_2 - PaCO_2/0.8$	
Respiratory quotient (RQ)	$\frac{O_2 \text{ consumption}}{CO_2 \text{ production}}$	0.8-1
Neurologic		
Cerebral perfusion pressure (CPP)	MPA – ICP	80-100 mm Hg
Intracranial pressure (ICP)		0-15 mm Hg
Renal		
Anion gap (GAP)	Na – (HCO_3 + Cl)	8-16 mEq/L
Osmolality (OSM)	(2Na) + K + BUN/3 + Glucose/18	275-295 mOsm

Glomerular filtration rate (GRF)	$\frac{(140 - \text{Age}) \times \text{wt (kg)}}{\text{(male) } 75 \times \text{serum Cr}}$ $\frac{}{\text{(female) } 85 \times \text{serum Cr}}$	80-120 ml/min

DRUG DOSAGE FORMULA

Parameter	Formula	Normal range

Use the following formulas for quick calculation of drug dosages.

$$\text{Drug volume to be administered (ml)} = \frac{\text{desired dose (mg)}}{\text{drug concentration (mg / ml)}}$$

$$\text{or} = \frac{\text{desired dose (mg)} \times \text{volume (ml)}}{\text{amount (mg)}}$$

$$\text{NOTE: drug concentration (mg/ml)} = \frac{\text{amount (mg)}}{\text{volume (ml)}}$$

IV FLOW RATE FORMULA

Parameter	Formula	Normal range

Use the following formulas to create IV flow rates.

$$\text{Flow rate (ml/hr)} = \frac{\text{desired dose (mg / min)} \times 60 \text{ (min/ hr)}}{\text{drug concentration (mg / ml)}}$$

$$\text{or} = \frac{\text{desired dose (}\mu\text{g / kg / min} \times 60 \text{(min/ hr)} \times \text{wt (kg)}}{\text{drug concentration (}\mu\text{g / ml)}}$$

$$\text{or} = \frac{\text{drip rate (drops / min)} \times 60 \text{ (min/ hr)}}{60 \text{ (drops / ml)}}$$

$$\text{Drip rate (drops/min)} = \frac{\text{total volume to be infused (ml)} \times \text{drop factor (drops / ml)}}{\text{total time for the infusion (min)}}$$

$$\text{or} = \frac{\text{drops / ml}}{60 \text{ (min/ hr)}} \times \frac{\text{volume to be infused (ml / hr)}}{1}$$

APPENDIX 7.

MATHEMATICAL ABBREVIATIONS USED IN PHARMACEUTICAL CLINICAL PRACTICE

Symbol	Meaning	Symbol	Meaning
	Dram	+	Plus; excess; acid reaction, positive
€	Fluid dram	-	Minus; deficiency; alkaline reaction; negative
	Ounce	±	Plus or minus; either positive or negative; indefinite
	Fluid ounce	↑	Increased
lb	Pound	↓	Decreased
Þ	Recipe; take	#	Number; following a number, pounds
M	Misce; mix	÷	Divided by
A, Ä	Angstrom unit	X	Multiplied by; magnification
E_0	Electroaffinity	=	Equals
F_1	First filial generation	≈	Approximately equals
F_2	Second filial generation	≠	Not equal to
mµ	Millimicron, micromillimeter	>	Greater than; from which is derived
µg	Microgram	<	Less than; derived from
mEq	Milliequivalent	Ž	Not less than
Mg	Milligram		Not greater than
m%	Milligrams percent; milligrams per 100 ml	≤	Equal to or less than
Q O_2	Oxygen consumption	≥	Equal to or greater than
m-	Meta-	√	Root; square root; radical
o-	Ortho-	2√	Square root
p-	Para	3√	Cube root
Po_2	Partial pressure of oxygen	∞	Infinity
Pco_2	Partial pressure of carbon dioxide	:	Ratio; "is to"
µm	Micrometer	°	Degree
µ	Micron	%	Percent
µµ	Micromicron	⇌	A reversible reaction

APPENDIX 8.

PHARMACEUTICAL CALCULATIONS AND CONVERSIONS

Multiples and Submultiples of the Metric System

Multiples and Submultiples	Prefix	Symbol
1,000,000,000,000 $(10)^{12}$	tera-	T
1,000,000,000 $(10)^{9}$	giga-	G
1,000,000 $(10)^{6}$	mega-	M
1,000 $(10)^{3}$	kilo-	k
100 $(10)^{2}$	hecto-	h
10 (10)	deka-	da
0.1 $(10)^{-1}$	deci-	d
0.01 $(10)^{-2}$	centi-	c
0.001 $(10)^{-3}$	milli-	m
0.000 001 $(10)^{-6}$	micro-	m
0.000 000 001 $(10)^{-9}$	nano-	n
0.000 000 000 001 $(10)^{-12}$	pico-	p
0.000 000 000 000 001 $(10)^{-15}$	femto-	f
0.000 000 000 000 000 001 $(10)^{-18}$	atto-	a

Tables of Weights and Measures

Avoirdupois Weight

Grains	Drams	Ounces	Pounds	Metric Equivalents (grams)
1	0.0366	0.0023	0.00014	0.0647989
27.34	1	0.0625	0.0039	1.772
437.5	16	1	0.0625	28.350
7000	256	16	1	453.5924277

Apothecaries' Weight

Grains	Scruples (%)	Drams (y)	Ounces (k)	Pounds (£)	Metric Equivalents (grams)
1	0.05	0.0167	0.0021	0.00017	0.0647989
20	1	0.333	0.042	0.0035	1.296
60	3	1	0.125	0.0104	3.888
480	24	8	1	0.0833	31.103
5760	288	96	12	1	373.24177

Length Conversion	
1 meter	= 39.37 inch
1 inch	= 2.54 cm

Volume Conversion	
1 ml	= 16.23minims
1 minims	= 0.06 ml
1 fl oz	= 3.69ml
1 pt	= 473 ml
1 gal	= 3785 ml

Mass Conversion	
1 g	= 15.432 gr
1 kg	= 2.20 lb
1 oz	= 28.35 g
1 lb	= 454 g
1 lb	= 373.2 g

Other Equivalents	
1 oz	= 437.5 gr
1 gal (US)	= 128 fl oz
1 fl oz (water)	= 455 gr
1 gr (apoth)	= 1gr (avoir)

APPENDIX 9.

NATIONAL AND PROVINCIAL PHARMACEUTICAL COMMITTEES, BOARDS, AND OTHER INFORMATIONS

Pakistan meets 80% of its domestic demand of medicines from local production and 20% through imports. The pharmaceuticals market size is Rs. 70 Billion (US $ 1.2 Billion), approximately. The market for pharmaceuticals in Pakistan has been expanding at a rate of around 10 to15% since last few years. Pakistan is also exporting its surplus drugs to a large number of countries particularly to the Asian and African regions with an expanding trade in the newly emerged Central Asian States. About a hundred million strong populations of the Central Asian States, with almost no local manufacture of medicines, offers an attractive market for industries located in Pakistan. Local manutacturers are producing all the major pharmaceutical dosage forms and some special products e.g. immunological, anticancer drugs, anti-diabetics, antidotes and biotechnological products are still being imported, in the finished form. Only few bulk pharmaceutical raw materials are being manufactured locally and most of the pharmaceutical raw materials are being imported in large quantities from different countries of the world. There are five units operating in Pakistan for the Semi Basic Manufacturing of pharmaceutical raw material.

The Drugs Control Organization, Ministry of Health functions mainly as Secretariat of Central Licensing and Registration Boards under the Drugs Act, 1976. The Drugs Act, 1976 comprises Federal and Provincial subjects. The Federal Govt. regulates manufacture, registration, pricing, import and export of drugs. 80% of country's requirement is being met from the drugs manufactured in Pakistan while 20% requirement are being met from import of drugs.

At present 30 multinational pharmaceutical organizations are producing their products in Pakistan. 411 units are involved in local pharmaceutical manufacturing.

HEALTH FACILITIES

Hospitals	965
Dispensaries	4,916
Basic Health Units	4,872
MCH Centers	1,138
TB Centers	371
First Aid Points:	1,080

DRUGS FACTS

Human Local Drugs	10807
Human Imported Drugs	655
Veterinary Drugs	1122

HEALTH DAYS

Heart Day	30th Sep
TB Day	24th Mar

DRUGS REGISTERED DURING JAN. 1999 TO SEP. 2004

HUMAN DRUGS

Locally Manufactured Drugs

Year	Drugs Registered
1999	731
2000	699
2001	865
2002	3395
2003	2762
Jan, 2004 to July 2004	2373
Total	10807

IMPORTED HUMAN DRUGS

Year	Drugs Registered
1999	255
2000	50
2001	33
2002	90
2003	103
Jan. 2004 to Sep. 2004	124
Total	655

VETERINARY DRUGS

Year	Drugs Registered
1999	203
2000	322
2001	102
2002	193
2003	210
Jan, 2004 to Sep. 2004	92
Total	1122

BOARDS AND COMMITTEES

- Committee for Monitoring Drug Sector
- Expert Committee on Research & Development
- Expert Committee On Advertising
- Price Review Committee
- Quality Control Committee
- Committee on Biological Drugs
- Veterinary Expert Committee
- Drug Appellate Board
- Central Licensing and Registration Board

DRUG COURTS

Nine Drugs Courts has been established by the Federal Government in pursuance of Section 31 of the Drugs Act 1976. Following is the detail of the courts with the Top management:

Chairman, Drug Court
24-Kanpoor Road
Lahore, Punjab

Chairman, Drug Court
Quetta, Balochistan.

Chairman, Drug Court
Faisalabad, Punjab

Chairman, Drug Court
Bahawalpur (Inside Paramedical School)
Bahawalpur, Punjab

Chairman, Drug Court
N.W.F.P., 13-A Qulfa Road
Tehkal Payaz,
Peshawar, NWFP

Registrar
Drug Court
Gujaranwala Division at Lahore, Punjab

Chairman, Drug Court
Karachi, Sindh.

Chairman, Drug Court
Multan, Punjab

District and Session Judge
Chairman, Drug Court
Rawalpindi and Capital Territory Islamabad.

TOP MANAGEMENT

Field Offices of Drugs Control Organization

1. **Deputy Director General (E&M)**
   Building No. 4. Block 'B', S.M.C.H.S.
   Phone No. 92-21-4382979
   92-21-4383079

2. **Deputy Director General (E&M)**
   N.I.N.R.T. Building,
   Lahore.
   Phone No. 92-42-7569552

3. **Officer Incharge / F.I.D.**
   Drugs Controller Administration
   C.G.S. Colony Satellit Town
   Quetta.
   Phone No. 92-81-9211334

4. **Officer Incharge / F.I.D.**
   Drugs Control Administartion
   5th floor Hall No. 609-610
   Benovelent Fund Building
   Peshawar Cantt.
   Phone No. 92-91-9213025

5. **Federal Inspector of Drugs**
   Islamabad
   Phone No. 92-51-9202841

For General Information and complaints:
info@dcomoh.gov.pk

For Reporting Adverse Drugs Reaction:
adr@dcomoh.gov.pk

For Provincial Health Departments:
drugscontroller@dcomoh.gov.pk

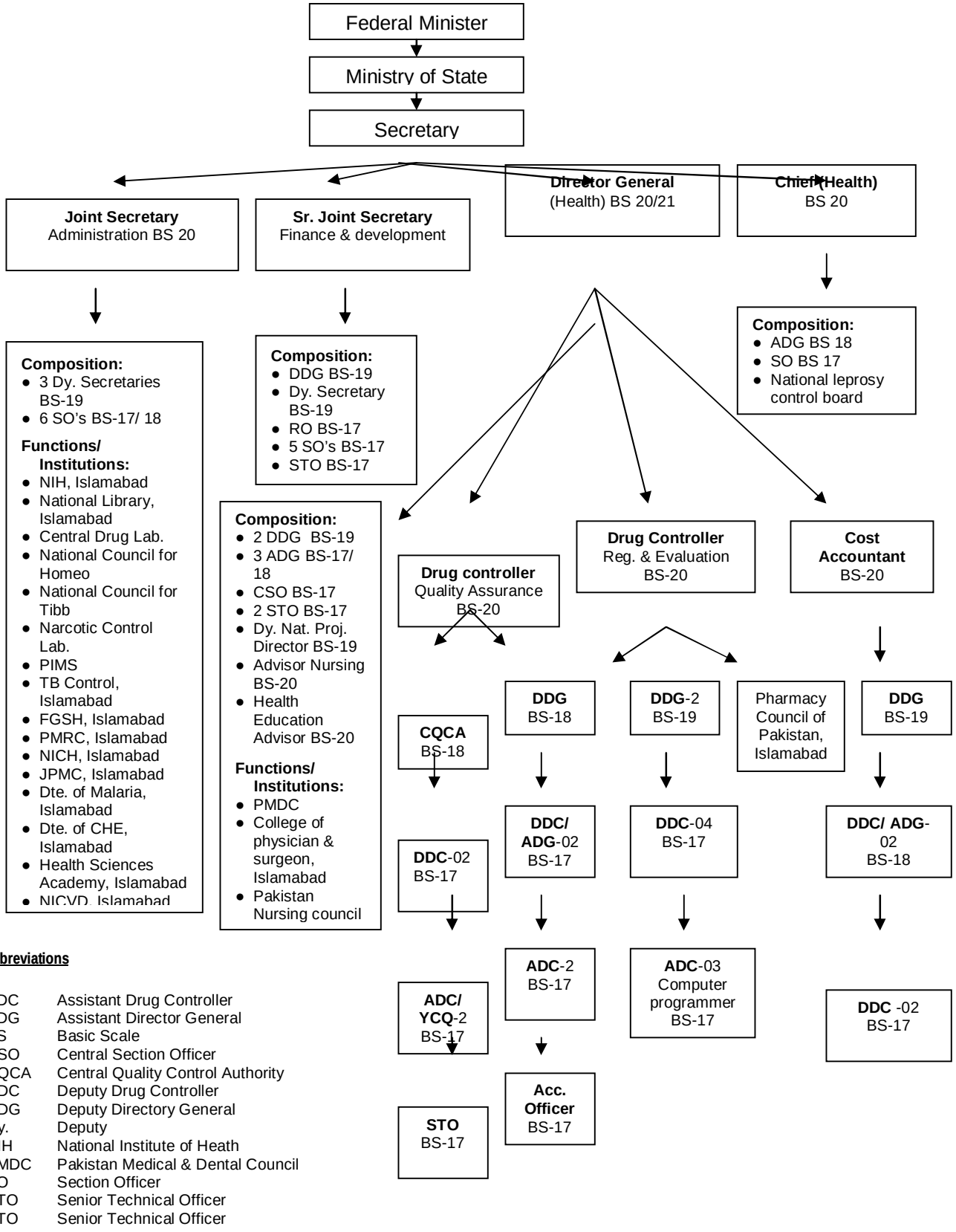
DRUGS LABORATORIES

Central and Provincial Drugs Laboratories established under Section 14 of Drug Act. Federal Drugs Testing/ Research Laboratory and institutes may set up, for the purposes of this Act as may be prescribed.
Central Drugs Laboratories
Building No. 4. Block 'B', S.M.C.H.S.
Phone No. 92-21-4382979
92-21-4383079

NATIONAL DRUG POLICY

Pakistan is committed to the goal of Health for all by the year 2000 which was inspired by the principle of social equity. To achieve this, the Government is taking all possible measures in the field of health services at large and drugs in particular. Formulation of the national drug policy thus forms an integral component of its national health policy, purpose of which is to ensure regular availability of essential drugs of acceptable efficacy, safety and quality at affordable prices to all irrespective of their socio-economic status or place of living. Essential Drugs are those which meet the health care needs of the majority of the population. Hence they will help in combating disease and maintaining and improving the health of population. The goal in nutshell is to develop, within the resources of the country potential through the availability of drugs to control common diseases and to alleviate pain and suffering.

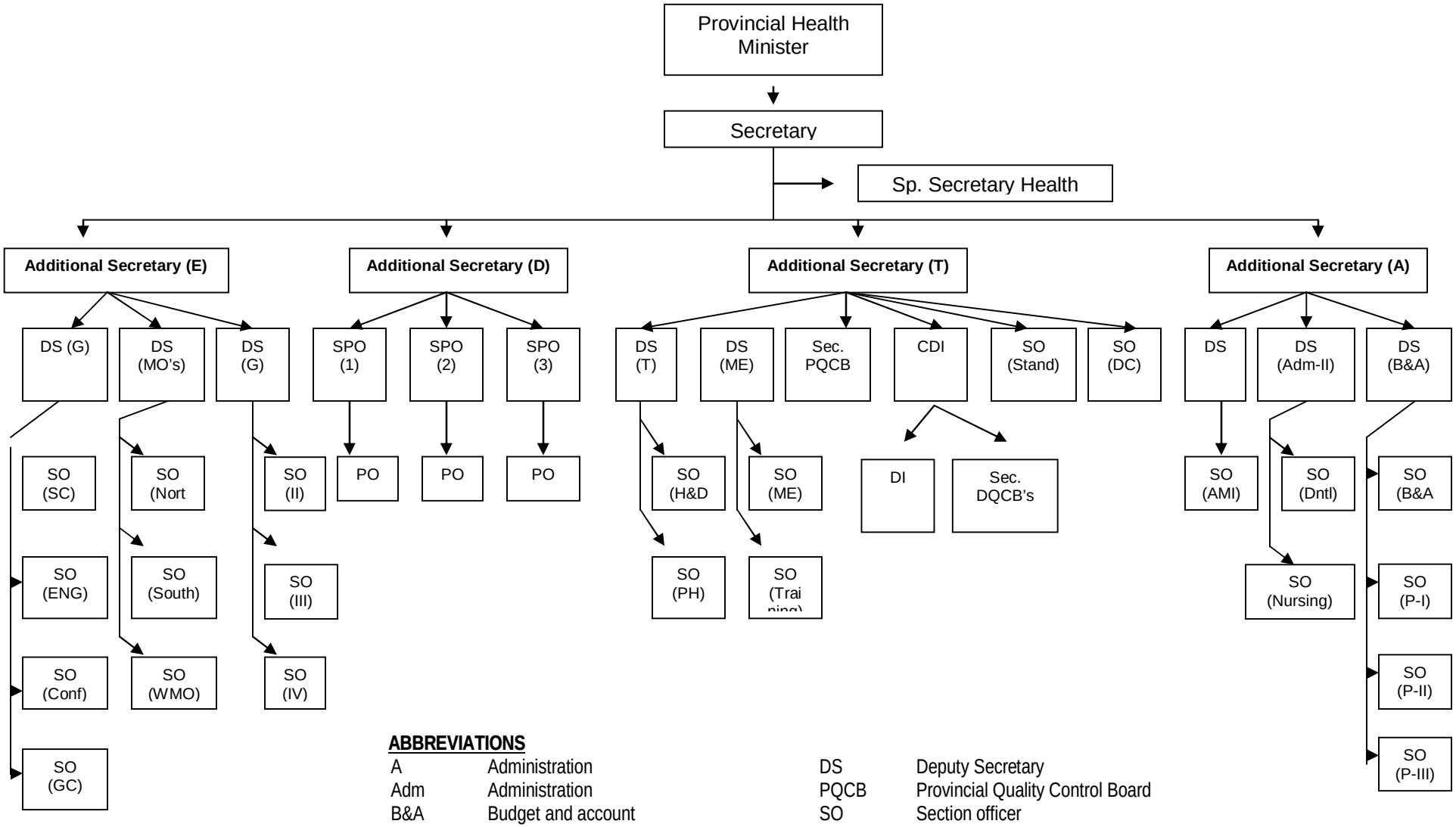
Old Organization Chart of Ministry of Health, Islamabad, Pakistan



Abbreviations

ADC	Assistant Drug Controller
ADG	Assistant Director General
BS	Basic Scale
CSO	Central Section Officer
CQCA	Central Quality Control Authority
DDC	Deputy Drug Controller
DDG	Deputy Directory General
Dy.	Deputy
NIH	National Institute of Heath
PMDC	Pakistan Medical & Dental Council
SO	Section Officer
STO	Senior Technical Officer
STO	Senior Technical Officer

Old Organization of Provincial Health Department, Pakistan



ABBREVIATIONS

A	Administration	DS	Deputy Secretary
Adm	Administration	PQCB	Provincial Quality Control Board
B&A	Budget and account	SO	Section officer
CDI	Chief Drug Inspector	SPO	Senior Purchase Officer
DC	drug controller	T	Technical
E	Establishmen	Sec.	Secretary
D	Development	DI	Drug Inspectors

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