

The Core Content of Medical Toxicology

Medical Toxicology Core Content Task Force

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P R E A M B L E

In December 2002, the Medical Toxicology Subboard, composed of representatives from emergency medicine, pediatrics, and preventive medicine, approved a new Core Content of Medical Toxicology. The Core Content encompasses the specialty of medical toxicology and outlines the areas of knowledge considered essential for the practice of medical toxicology. Functionally, the Core Content provides the organizational framework for the development of the medical toxicology certification and recertification examinations and details the knowledge to be tested on those examinations. In addition, the Core Content may serve as a template for the development of medical toxicology fellowship curricula.

In 1992, the American Board of Medical Specialties granted subspecialty approval to medical toxicology. Soon thereafter, a subboard of representatives from the 3 sponsoring boards, the American Board of Emergency Medicine, American Board of Pediatrics, and American Board of Preventive Medicine, was organized to develop the articles of agreement for the boards of certification in medical toxicology, Program Requirements for Residency Education in Medical Toxicology, and the medical toxicology certification examination. The first examination was offered in 1994, and subsequent examinations have been offered biannually. The first 5 examination cycles yielded a total of 245 diplomates in medical toxicology. Of the current diplomates, 73% are from emergency medicine, 11% are from pediatrics, 11% are from preventive medicine, and 5% are diplomates from other American Board of Medical Specialties member boards.

The first Medical Toxicology Core Content was developed to assist in the construction of the first examination in 1994. This document consisted of 22 major content areas and was organized, in part, by toxicant classification. Listed under most of these major content areas were exhaustive lists of drugs and toxicants that a medical toxicologist was expected to master. The development of succeeding examinations has continued to use this Core Content, with minor modifications.

In 2000, the Medical Toxicology Subboard embarked on a major revision of the original Core Content outline. This undertaking was initiated to update the Core Content, as well as to improve the framework that conceptualizes the expanding breadth of medical toxicology. In addition, the subboard wanted to devise a concep-

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tual document that would accommodate future discoveries and changes. A task force of Medical Toxicology Subboard members was convened to develop and draft the revised Core Content. During the process, input was solicited from interested stakeholders including medical toxicology fellowship directors, the American College of Medical Toxicology, and the Committee of Medical Directors of the American Association of Poison Control Centers.

The Core Content task force organized the new Core Content into 5 distinct subject areas: (1) principles of toxicology; (2) toxins and toxicants; (3) therapeutics; (4) assessment and population health; and (5) analytical and forensic toxicology. The rationale for this major revision was the need to encompass the breadth and heterogeneity of medical toxicology. Although the initial foray into medical toxicology for some practitioners may have been caring for overdose patients in the emergency department, other areas such as surveillance, public health, workplace issues, diagnostic services, legal issues, regulatory affairs, and issues pertaining to biochemical terrorism have become core components of the field. Accordingly, basic toxicologic mechanisms, risk and public health issues, and analytic and forensic topics assume greater emphasis in the new Core Content.

One of the more contentious issues the Medical Toxicology Task Force grappled with in revising the Core Content was the level of detail to include in the document. The new Core Content lists drug and toxicant classes but departs from the previous approach of providing an encyclopedic listing of drugs and toxins. The rationale for this departure is pragmatic. Given the ongoing introduction of new pharmaceuticals and chemicals, yearly updating of the document to include a definitive list of all toxins and toxicants becomes increasingly unwieldy. A few representative examples are included in many of the drug and toxicant classes for clarity, but the scope of medical toxicology and the examination is not limited to these examples. The subboard believes it is reasonable that test items can be developed on any agent that could be classified either under a broader category (eg, drugs that affect the cardiovascular system) or a narrower category (eg, antihypertensives).

The Medical Toxicology Subboard appreciates that the Core Content of Medical Toxicology will undoubtedly evolve in the years ahead. This revised document reflects the consensus of representatives from emergency medicine, pediatrics, and preventive medicine in

2003. Periodic reevaluation of this document is encouraged as the field of medical toxicology advances and responds to our changing times.

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MEDICAL TOXICOLOGY CORE CONTENT 2003

Medical Toxicology Major Core Content Categories

- 1.0 Principles of Toxicology
- 2.0 Toxins and Toxicants
 - 2.1 Drugs
 - 2.2 Industrial, Household, and Environmental Toxicants
 - 2.3 Natural Products
 - 2.4 Warfare, Terrorism, and Riot Control Agents
- 3.0 Therapeutics
- 4.0 Assessment and Population Health
- 5.0 Analytical and Forensic Toxicology

MEDICAL TOXICOLOGY CORE CONTENT

Part 1: Principles of Toxicology

- 1.1 Pharmacology/Toxicology
 - 1.1.1 Pharmacokinetics/Toxicokinetics
 - 1.1.1.1 Bioavailability and Absorption
 - 1.1.1.2 Distribution
 - 1.1.1.3 Metabolism
 - 1.1.1.4 Elimination
 - 1.1.1.5 Clearance
 - 1.1.1.6 Models (eg, compartmental, physiologic)
 - 1.1.2 Pharmacodynamics/Toxicodynamics
 - 1.1.2.1 Dose/Concentration Relationship to Effect
 - 1.1.2.2 Structure-Activity Relationship
 - 1.1.2.3 Receptor Agonism/Antagonism
 - 1.1.2.4 Receptor Regulation
 - 1.1.3 Adverse Effects
 - 1.1.3.1 Mechanistic (predictable)
 - 1.1.3.2 Idiosyncratic
 - 1.1.4 Interactions
 - 1.1.4.1 Xenobiotic-Environment
 - 1.1.4.2 Xenobiotic-Food
 - 1.1.4.3 Xenobiotic-Xenobiotic (eg, drug-drug)
 - 1.1.5 Proteomics
 - 1.1.6 Tolerance and Withdrawal
 - 1.1.6.1 Behavioral Tolerance
 - 1.1.6.2 Biologic Tolerance
 - 1.1.7 Immunologic Response (eg, antibodies, cytokines)
 - 1.1.8 Pharmacogenomics/Toxicogenomics (eg, xenobiotic response, gene expression profiling)
- 1.2 Molecular Components/Mechanisms
 - 1.2.1 Glycolysis and Oxidative Phosphorylation
 - 1.2.2 Other Metabolic Pathways (eg, amino acids and urea cycle)
 - 1.2.3 Membranes
 - 1.2.4 Enzymes and Transport Proteins (eg, methemoglobin, G6PD)
 - 1.2.5 Channels and Pumps
 - 1.2.6 Signal Transduction
 - 1.2.6.1 Receptor Isoforms and Subtypes
 - 1.2.6.2 Regulation and Messengers
 - 1.2.6.3 Neurotransmitters

- 1.3 Cytotoxic Mechanisms (eg, apoptosis, microtubular dysfunction)
- 1.4 Mutagenesis and Carcinogenesis
 - 1.4.1 Mutagenesis
 - 1.4.1.1 Chromosome Aberrations (structural, numeric)
 - 1.4.1.2 Gene Mutation (oncogenes, tumor suppressor genes)
 - 1.4.2 Development of Neoplasia
 - 1.4.2.1 Initiation (eg, genotoxic mechanisms)
 - 1.4.2.2 Procarcinogens and Conversion to Carcinogens (eg, biotransformation)
 - 1.4.2.3 Progression (eg, growth, invasiveness)
 - 1.4.2.4 Promotion (eg, nongenotoxic mechanisms)
 - 1.4.3 Inhibition of Carcinogenesis-Modulating Factors
 - 1.4.3.1 Endogenous Factors (eg, age, sex, immune status, hormones)
 - 1.4.3.2 Exogenous Factors (eg, diet, radiation)
 - 1.4.4 Interactive Carcinogenesis
 - 1.4.4.1 Xenobiotic: Gene Interactions
 - 1.4.4.2 Xenobiotic: Physical Interactions
 - 1.4.4.3 Xenobiotic: Radiation Interactions
 - 1.4.4.4 Xenobiotic: Viral Interactions
- 1.5 Adverse Reproductive and Developmental Outcomes
 - 1.5.1 Conception Impairment, Mutagenesis, and Teratogenesis
 - 1.5.1.1 Chromosomal and Gene Abnormalities
 - 1.5.1.2 Effects on Gametogenesis and Gametes
 - 1.5.1.3 Effects on Gonads
 - 1.5.1.4 Spontaneous Abortion and Perinatal Death
 - 1.5.2 Factors Determining Fetal or Infant Exposure to Agents
 - 1.5.2.1 Breast Milk Transfer
 - 1.5.2.2 Placental Transfer
 - 1.5.2.3 Xenobiotic Disposition (eg, maternal xenobiotic disposition, fetal pharmacokinetics)
 - 1.5.3 Offspring Effects
 - 1.5.3.1 Cancer
 - 1.5.3.2 Congenital Anomalies and Malformations
 - 1.5.3.3 Development of Infant/Child
 - 1.5.3.4 Genetic Mutations

Part 2: Toxins and Toxicants

- 2.1 Drugs
 - 2.1.1 Analgesics, Anti-inflammatory Drugs
 - 2.1.1.1 Acetaminophen
 - 2.1.1.2 Nonsteroidal Anti-inflammatory Drugs
 - 2.1.1.3 Opioids
 - 2.1.1.4 Salicylates
 - 2.1.1.5 Others (eg, antigout drugs, gold)
 - 2.1.2 Antimicrobials
 - 2.1.2.1 Antibiotics
 - 2.1.2.2 Antifungals
 - 2.1.2.3 Antimycobacterials
 - 2.1.2.4 Antiparasitics
 - 2.1.2.5 Antiprotozoals
 - 2.1.2.6 Antiretrovirals
 - 2.1.2.7 Antiseptics
 - 2.1.2.8 Antivirals
 - 2.1.3 Chemotherapeutic Drugs
 - 2.1.3.1 Alkylators
 - 2.1.3.2 Antimetabolites
 - 2.1.3.3 Hormones
 - 2.1.3.4 Natural Drugs, (eg, vinca alkaloids, antibiotics)
 - 2.1.3.5 Miscellaneous (eg, platinum, hydroxyurea)
 - 2.1.4 Diagnostic Drugs (eg, radionuclides)
 - 2.1.5 Drugs That Affect Cholesterol and Lipids
 - 2.1.6 Drugs That Affect the Cardiovascular System
 - 2.1.6.1 Antidysrhythmics
 - 2.1.6.1.1 Calcium channel blockers
 - 2.1.6.1.2 Cardiac glycosides
 - 2.1.6.1.3 Potassium channel blockers
 - 2.1.6.1.4 Sodium channel blockers
 - 2.1.6.2 Antihypertensives
 - 2.1.6.2.1 Angiotensin system modulators
 - 2.1.6.2.2 β -Adrenergic (and mixed α , β) antagonists

- 2.1.6.2.3 Centrally acting α receptor agonists
 - 2.1.6.2.4 Diuretics
 - 2.1.6.2.5 Vasodilators (eg, nitrates, nitrites)
 - 2.1.6.3 Inotropes
 - 2.1.7 Drugs That Affect the Endocrine System
 - 2.1.7.1 Antidiabetic Drugs
 - 2.1.7.1.1 Insulin
 - 2.1.7.1.2 Oral hypoglycemics
 - 2.1.7.1.3 Others (eg, metformin, glitazones)
 - 2.1.7.2 Bone Active Drugs (eg, calcitonin, bisphosphonates)
 - 2.1.7.3 Electrolytes and Minerals
 - 2.1.7.4 Glucocorticoids
 - 2.1.7.5 Sex Hormones, Growth Hormones, and Anabolic Steroids
 - 2.1.7.6 Thyroid Drugs
 - 2.1.7.7 Vasopressin and Somatostatin Analogues
 - 2.1.8 Drugs That Affect the Gastrointestinal System
 - 2.1.8.1 Antidiarrheals
 - 2.1.8.2 Antiemetics
 - 2.1.8.3 Drugs Used for Biliary and Pancreatic Diseases (eg, bile salts, pancreatic enzymes)
 - 2.1.8.4 Drugs Used for Inflammatory Bowel Disease
 - 2.1.8.5 Drugs Used to Treat Acid-Peptic Diseases
 - 2.1.8.6 Laxatives
 - 2.1.8.7 Protonic inhibitors
 - 2.1.9 Drugs That Affect the Hematologic System
 - 2.1.9.1 Anticoagulants
 - 2.1.9.2 Antifibrinolytics
 - 2.1.9.3 Antiplatelet Drugs
 - 2.1.9.4 Blood-Stimulating Drugs (eg, erythropoietin)
 - 2.1.9.5 Drugs Used to Treat Bleeding (eg, clotting factors, antiplasmin drugs)
 - 2.1.9.6 Iron
 - 2.1.9.7 Thrombolytics
 - 2.1.10 Drugs That Affect the Immune System (eg, interferon, cyclophosphamide)
 - 2.1.11 Drugs That Affect the Nervous System
 - 2.1.11.1 Anesthetics
 - 2.1.11.1.1 Inhalational and sedative anesthetics (eg, nitrous oxide, propofol)
 - 2.1.11.1.2 Local anesthetics
 - 2.1.11.2 Anticonvulsants
 - 2.1.11.3 Antiparkinsonism Drugs
 - 2.1.11.4 Drugs That Affect Autonomic Homeostasis
 - 2.1.11.4.1 Anticholinergics
 - 2.1.11.4.2 Antihistamines
 - 2.1.11.4.3 Antiserotonergics
 - 2.1.11.4.4 Cholinergics (eg, nicotine)
 - 2.1.11.4.5 Ergot and derivatives
 - 2.1.11.4.6 Methylxanthines
 - 2.1.11.4.7 Serotonin agonists and other proserotonergics (eg, dextromethorphan)
 - 2.1.11.4.8 Sympathomimetics (eg, amphetamines, cocaine)
 - 2.1.11.5 Ethanol
 - 2.1.11.6 Muscle Relaxants
 - 2.1.11.7 Neuromuscular Blockers
 - 2.1.11.8 Psychoactive Drugs and Hallucinogens (eg, marijuana, lysergic acid diethylamide [LSD])
 - 2.1.11.9 Psychotropics
 - 2.1.11.9.1 Anxiolytics and sedative-hypnotics
 - 2.1.11.9.2 Antidepressants
 - 2.1.11.9.3 Antipsychotics
 - 2.1.11.9.4 Mood stabilizers
 - 2.1.12 Pharmaceutical Additives (eg, excipients)
 - 2.1.13 Veterinary Products
 - 2.1.14 Vitamins
- 2.2 Industrial, Household, and Environmental Toxicants
 - 2.2.1 Airborne Solids
 - 2.2.1.1 Asbestos
 - 2.2.1.2 Coal Dust
 - 2.2.1.3 Organic Dust

- 2.2.1.4 Silica
- 2.2.1.5 Other Minerals (eg, man-made mineral fibers)
- 2.2.2 Cleansers and Caustics
 - 2.2.2.1 Acids
 - 2.2.2.2 Alkali
 - 2.2.2.3 Bleach
 - 2.2.2.4 Detergents and Soaps
 - 2.2.2.5 Disinfectants and Topical Anti-infectives
 - 2.2.2.6 Swimming Pool Products
- 2.2.3 Food Additives (eg, monosodium glutamate, sulfites)
- 2.2.4 Household Products
 - 2.2.4.1 Aquarium Products
 - 2.2.4.2 Art Products
 - 2.2.4.3 Batteries
 - 2.2.4.4 Cosmetics
 - 2.2.4.5 Dental Products
 - 2.2.4.6 Hair Products
 - 2.2.4.7 Personal Hygiene Products
- 2.2.5 Hydrocarbons/Solvents/Fuels
 - 2.2.5.1 Aldehydes
 - 2.2.5.2 Alcohols and Glycols
 - 2.2.5.2.1 Diethylene glycol
 - 2.2.5.2.2 Ethylene glycol
 - 2.2.5.2.3 Glycol ethers
 - 2.2.5.2.4 Isopropanol
 - 2.2.5.2.5 Methanol
 - 2.2.5.3 Aliphatic Hydrocarbons
 - 2.2.5.3.1 Hexane and congeners
 - 2.2.5.3.2 Mixtures (eg, gasoline, kerosene)
 - 2.2.5.4 Aromatic Hydrocarbons
 - 2.2.5.4.1 Benzene
 - 2.2.5.4.2 Polycyclic aromatic hydrocarbons
 - 2.2.5.4.3 Toluene
 - 2.2.5.5 Halogenated Hydrocarbons
 - 2.2.5.5.1 Carbon tetrachloride
 - 2.2.5.5.2 Chloroform
 - 2.2.5.5.3 Methylene chloride
 - 2.2.5.5.4 Perchloroethylene
 - 2.2.5.5.5 Trichloroethylene
 - 2.2.5.5.6 Vinyl chloride
 - 2.2.5.6 Hydrazines
 - 2.2.5.7 Ketones
 - 2.2.5.8 Peroxides
 - 2.2.5.9 Terpenes
- 2.2.6 Metals/Metalloids
 - 2.2.6.1 Arsenic (including arsine)
 - 2.2.6.2 Barium
 - 2.2.6.3 Beryllium
 - 2.2.6.4 Cadmium
 - 2.2.6.5 Chromium
 - 2.2.6.6 Cobalt
 - 2.2.6.7 Copper
 - 2.2.6.8 Lead
 - 2.2.6.9 Manganese
 - 2.2.6.10 Mercury
 - 2.2.6.11 Nickel
 - 2.2.6.12 Thallium
- 2.2.7 Pesticides
 - 2.2.7.1 Fumigants and Sterilants
 - 2.2.7.2 Fungicides
 - 2.2.7.3 Herbicides
 - 2.2.7.4 Insecticides and Repellents
 - 2.2.7.4.1 Carbamates
 - 2.2.7.4.2 DEET
 - 2.2.7.4.3 Moth balls
 - 2.2.7.4.4 Organochlorines
 - 2.2.7.4.5 Organophosphates
 - 2.2.7.4.6 Pyrethrins and pyrethroids
 - 2.2.7.5 Rodenticides
 - 2.2.7.5.1 Anticoagulant
 - 2.2.7.5.2 Nonanticoagulant
 - 2.2.7.6 Other (eg, molluscides)
- 2.2.8 Pollutants
 - 2.2.8.1 Air Pollutants (eg, respirable particulates)
 - 2.2.8.2 Persistent Organic Pollutants (eg, polychlorinated biphenyls, dibenzodioxins)
 - 2.2.8.3 Water Pollutants (eg, trihalomethanes)
- 2.2.9 Toxic Gases
 - 2.2.9.1 Cellular Asphyxiant Gases
 - 2.2.9.1.1 Carbon monoxide
 - 2.2.9.1.2 Cyanide
 - 2.2.9.1.3 Hydrogen sulfide
 - 2.2.9.2 Irritant Gases
 - 2.2.9.2.1 Chlorine
 - 2.2.9.2.2 Nitrogen oxides
 - 2.2.9.2.3 Ozone
 - 2.2.9.2.4 Phosgene
 - 2.2.9.2.5 Sulfur oxides
 - 2.2.9.3 Radon
 - 2.2.9.4 Simple Asphyxiants (eg, methane, nitrogen)
 - 2.2.9.5 Smoke Inhalation
- 2.2.10 Miscellaneous Toxicants
 - 2.2.10.1 Acrolein
 - 2.2.10.2 Acrylamides
 - 2.2.10.3 Acrylates
 - 2.2.10.4 Amines
 - 2.2.10.5 Aniline Compounds
 - 2.2.10.6 Azides
 - 2.2.10.7 Bromide Compounds
 - 2.2.10.8 Butadienes
 - 2.2.10.9 Carbon Disulfide
 - 2.2.10.10 Chlorates
 - 2.2.10.11 Coal Tar Products
 - 2.2.10.12 Diamines
 - 2.2.10.13 Dibromochloropropane (DBCP)
 - 2.2.10.14 Dimethylacetamide (DMAC)
 - 2.2.10.15 Dimethylformamide (DMF)
 - 2.2.10.16 Dinitrobenzene
 - 2.2.10.17 Dinitrotoluene (DNT)
 - 2.2.10.18 Epichlorohydrin
 - 2.2.10.19 Ethylene Dibromide (EDB)
 - 2.2.10.20 Ethylenediamine (EDA)
 - 2.2.10.21 Fluoride Compounds
 - 2.2.10.22 Fuels
 - 2.2.10.23 Hexachloro-1,3-Butadiene (HCBD)
 - 2.2.10.24 Isocyanates (eg, toluene diisocyanate)
 - 2.2.10.25 Maleic Anhydride
 - 2.2.10.26 Mercaptans
 - 2.2.10.27 Methylene Diamine (MDA)
 - 2.2.10.28 Nitriles
 - 2.2.10.29 O-Phenylenediamine (OPD)
 - 2.2.10.30 Phosphorus/phosphides
 - 2.2.10.31 Phthalates
 - 2.2.10.32 Polymers
 - 2.2.10.33 Resins
 - 2.2.10.34 Styrene
 - 2.2.10.35 Trimellitic Anhydride
 - 2.2.10.36 Triorthocresylphosphate (TOCP)
 - 2.2.10.37 Xylidine
- 2.2.11 Syndromes Attributed to the Environment, Not Specified Elsewhere
 - 2.2.11.1 Event-Specific Syndromes (eg, Gulf War syndrome, World Trade Center cough)
 - 2.2.11.2 Mold
 - 2.2.11.3 Multiple Chemical Sensitivity Syndrome
 - 2.2.11.4 Tight Building Syndrome
- 2.3 Natural Products
 - 2.3.1 Food Poisoning
 - 2.3.1.1 Bacterial
 - 2.3.1.2 Marine
 - 2.3.2 Fungi
 - 2.3.2.1 Mushrooms
 - 2.3.2.2 Other Fungal Toxins (eg, aflatoxins, trichothecene mycotoxins)
 - 2.3.3 Herbal and Dietary Supplements
 - 2.3.4 Plants

- 2.3.4.1 Cardiovascular Toxic Plants (eg, *Aconitum napellus*, *Nerium oleander*)
- 2.3.4.2 Cutaneous/Mucus Membrane Toxic Plants (eg, *Toxicodendron* sp, *Dieffenbachia* sp)
- 2.3.4.3 Gastrointestinal Toxic Plants (eg, *Phytolacca Americana*, *Solanum* sp)
- 2.3.4.4 Hepatotoxic Plants (eg, *Bilghia sapida*, *Symphatum* sp)
- 2.3.4.5 Multisystem Toxic Plants (eg, *Prunus* sp, *Ricinus communis*)
- 2.3.4.6 Neurotoxic Plants (eg, *Datura* sp, *Nicotiana tabacum*)
- 2.3.5 Toxic Envenomations
 - 2.3.5.1 Arthropods
 - 2.3.5.2 Marine Creatures
 - 2.3.5.3 Reptiles/Amphibians
- 2.4 Warfare, Terrorism, and Other
 - 2.4.1 Biological
 - 2.4.1.1 Bacteria (eg, anthrax, plague)
 - 2.4.1.2 Toxins (eg, botulinum, staphylococcus B)
 - 2.4.1.3 Viruses (eg, smallpox)
 - 2.4.2 Chemical
 - 2.4.2.1 Acetylcholinesterase Inhibitors (eg, sarin, soman, VX)
 - 2.4.2.2 Blister Agents (eg, mustard)
 - 2.4.2.3 Incapacitating Agents (eg, calmatives, BZ [3-quinuclidinyl benzilate])
 - 2.4.2.4 Tear Gases (eg, pepper spray)
 - 2.4.3 Nuclear/Radiological

Part 3: Therapeutics

- 3.1 ABCs: Resuscitation
- 3.2 Initial Management
 - 3.2.1 Assessment Skills
 - 3.2.1.1 Differential Diagnosis
 - 3.2.1.2 Signs and Symptoms
 - 3.2.1.3 Toxidromes
 - 3.2.2 Decontamination Strategies
 - 3.2.2.1 Dermal
 - 3.2.2.2 Gastrointestinal
 - 3.2.2.3 Ocular
 - 3.2.3 Enhance Elimination Techniques
 - 3.2.3.1 Extracorporeal Removal
 - 3.2.3.2 Gastrointestinal Dialysis
 - 3.2.3.3 Urinary Approaches
- 3.3 Pharmacological Basis of Antidote Use
 - 3.3.1 Antagonize Effects of Poison
 - 3.3.1.1 Enzyme Inhibitors (eg, physostigmine)
 - 3.3.1.2 Enzyme Reactivators (eg, pralidoxime)
 - 3.3.1.3 Physiological Antagonists (eg, calcium, glucagon)
 - 3.3.1.4 Receptor Antagonists (eg, atropine, flumazenil, naloxone)
 - 3.3.1.5 Reducing Agent (eg, methylene blue, *N*-acetylcysteine)
 - 3.3.2 Dispositional Agents
 - 3.3.2.1 Alcohol Dehydrogenase Antagonists
 - 3.3.2.2 Antivenoms/Antibodies
 - 3.3.2.3 Chelators
 - 3.3.2.4 Cyanide Antidotes
 - 3.3.2.5 Enzyme/Cofactor Replacement (eg, folic acid, pyridoxine)
 - 3.3.2.6 Oxygen/Hyperbaric Oxygen
 - 3.3.3 Other Antidotes
- 3.4 Supportive and Other Care
 - 3.4.1 Adjunctive Therapy (eg, granulocyte colony-stimulating factor)
 - 3.4.2 Anticonvulsants
 - 3.4.3 Antidysrhythmics
 - 3.4.4 Control of Agitation
 - 3.4.5 Control of Temperature
 - 3.4.6 Correct Electrolyte and Acid-Base Disturbances
 - 3.4.7 Critical Care Procedures (eg, arterial catheter and central line placement)
 - 3.4.8 Fluid Resuscitation
 - 3.4.9 Patient Monitoring
 - 3.4.10 Pressor Agents and Control of Blood Pressure
 - 3.4.11 Protect Airway/Ventilation/Manage Airway Injury
 - 3.4.12 Psychiatric Issues
 - 3.4.13 Social Issues
 - 3.4.14 Transplantation
- 3.5 Withdrawal Syndrome Management

- 3.5.1 Alcohol
- 3.5.2 Opioid
- 3.5.3 Sedative-Hypnotic
- 3.5.4 Stimulant and Nicotine
- 3.5.5 Mixed Pattern

Part 4: Assessment and Population Health

- 4.1 Criteria for Causal Inference
 - 4.1.1 Biological Plausibility
 - 4.1.2 Consistency
 - 4.1.3 Dose-Response Relationship (biological gradient)
 - 4.1.4 Specificity (of exposure or outcome)
 - 4.1.5 Strength of Association
 - 4.1.6 Temporal Relationship
- 4.2 Information
 - 4.2.1 Consultation Resources (eg, databases, National Library of Medicine)
 - 4.2.2 Surveys/Surveillance (eg, poison center data, National Report on Human Exposures)
- 4.3 Monitoring
 - 4.3.1 Biological Monitoring and Biomarkers (eg, population norms, indicators of excessive exposure)
 - 4.3.2 Environmental Sampling/Exposure Monitoring
- 4.4 Occupational Assessment/Prevention
 - 4.4.1 Medical Surveillance
 - 4.4.2 Personal Protective Equipment
 - 4.4.3 Preemployment Screening
 - 4.4.4 Workplace Safety Engineering
- 4.5 Principles of Epidemiology and Statistics
 - 4.5.1 Statistical Concepts (eg, interpretation of *P* value, power calculation)
 - 4.5.2 Study Design
 - 4.5.2.1 Basic Types (eg, case series, randomized controlled trial)
 - 4.5.2.2 Basics of Validity/Generalizability (eg, bias, confounding, randomization)
 - 4.5.2.3 Measurements (eg, sensitivity, predictive value, limits of detection)
 - 4.5.2.4 Measures of Association (eg, odds ratios)
- 4.6 Regional Poison Centers
 - 4.6.1 Administration/Organization
 - 4.6.2 Consultation at a Distance
 - 4.6.3 Education
 - 4.6.4 Prevention
 - 4.6.5 Surveillance/Interaction With Other Professional Health Organizations
 - 4.6.6 Triage
- 4.7 Response to Hazardous Materials (Hazmat) Incidents, Including Terrorism
 - 4.7.1 Chemical Weapons Convention and Other Treaties
 - 4.7.2 Decontamination (eg, patients and responders)
 - 4.7.3 Incident Command System, Site Safety, and Control Zones
 - 4.7.4 Incident Response Planning and Emergency Preparedness
 - 4.7.5 National Pharmaceutical Stockpile: Deployment
 - 4.7.6 National Response Team: Federal Agency Coordination
 - 4.7.7 Regulatory and Legal Background (eg, Hazardous Waste Operations and Emergency Response Standard, Superfund Amendments and Reauthorization Act, Comprehensive Environmental Response, Compensation and Liability Act, Resource Conservation and Recovery Act)
- 4.8 Risk
 - 4.8.1 Risk Assessment
 - 4.8.1.1 Carcinogenicity Testing
 - 4.8.1.2 Extrapolation From High to Low Dose
 - 4.8.1.3 Extrapolation of Animal Studies to Humans
 - 4.8.1.4 Human Epidemiological Studies in Risk Assessment
 - 4.8.1.5 Interpretation of Key Terms (eg, recommended exposure limit [REL])
 - 4.8.1.6 No Observed and Lowest Observed Adverse Effect Levels (NOAEL, LOAEL)
 - 4.8.1.7 Role of Risk Assessment in Formulating Regulations
 - 4.8.1.8 Target Risks (eg, 10⁻⁵ or 10⁻⁶)
 - 4.8.1.9 "Uncertainty Factors" (reasons for them, approximate values)
 - 4.8.2 Risk Perception and Risk Communication
- 4.9 Role of Federal and International Agencies in Toxicology
 - 4.9.1 Agency for Toxic Substances and Disease Registry (ATSDR)
 - 4.9.2 Centers for Disease Control and Prevention (CDC)
 - 4.9.3 Consumer Product Safety Commission (CPSC)
 - 4.9.4 Environmental Protection Agency (EPA)

- 4.9.5 Food and Drug Administration (FDA)
- 4.9.6 Health Resources and Services Administration (HRSA)
- 4.9.7 National Institute of Occupational Safety and Health (NIOSH)
- 4.9.8 Occupational Safety and Health Administration (OSHA)
- 4.9.9 World Health Organization (WHO)
- 4.10 Toxic Outbreaks of Historical Significance (eg, yusho, toxic oil)

Part 5: Analytical and Forensic Toxicology

- 5.1 Assay Methods and Interpretation
 - 5.1.1 Clinical Drug Testing
 - 5.1.1.1 Confirmatory Tests
 - 5.1.1.1.1 Atomic Absorption
 - 5.1.1.1.2 Gas Chromatography/Mass Spectrometry (GC/MS)
 - 5.1.1.1.3 High-Pressure Liquid Chromatography (HPLC)
 - 5.1.1.2 Screening Tests
 - 5.1.1.2.1 Gas Chromatography (GC)
 - 5.1.1.2.2 Immunoassays (eg, enzyme-multiplied immunoassay technique [EMIT])
 - 5.1.1.2.3 Colorimetric Tests (eg, color tests, thin layer chromatography)
 - 5.1.1.3 Serum/Blood Drug Levels and Interpretation
 - 5.1.1.4 Urine Drug Testing
 - 5.1.1.4.1 Interpretive Challenges (eg, benzodiazepines, opioids)
 - 5.1.1.4.2 Adulteration Techniques
 - 5.1.1.4.3 Analytical Limitations and Interferences
 - 5.1.2 Hair Analysis
 - 5.1.3 Laboratory Issues
 - 5.1.3.1 Point of Care Testing
 - 5.1.3.2 Quality Assurance/Quality Control
 - 5.1.4 Special Toxicology Testing
 - 5.1.4.1 Heavy Metal Screens
 - 5.1.4.2 Cholinesterase Determinations
 - 5.1.5 Therapeutic Drug Monitoring
- 5.2 Laboratory and Other Diagnostic Assessments
 - 5.2.1 Anion Gap
 - 5.2.2 Blood Gases and Co-oximetry
 - 5.2.3 Electrolytes
 - 5.2.4 Hematologic and Coagulation Abnormalities
 - 5.2.5 Liver Function Tests
 - 5.2.6 Osmolality
 - 5.2.7 Renal Manifestations (eg, urine color, crystals)
 - 5.2.8 Other Supportive Testing
 - 5.2.8.1 Diagnostic Imaging
 - 5.2.8.2 Electroencephalography
 - 5.2.8.3 Electrocardiography
 - 5.2.8.4 Electromyography/Nerve Conduction Studies
- 5.3 Forensics
 - 5.3.1 Chain of Custody
 - 5.3.2 Clandestine Laboratories
 - 5.3.3 Definition and Scheduling of Controlled Substances
 - 5.3.4 Interpretation of Postmortem Drug Levels
 - 5.3.5 Necrokinetics
 - 5.3.6 Selection of Postmortem Specimens
 - 5.3.7 Special Issues
 - 5.3.7.1 Meconium
 - 5.3.7.2 Vitreous Humor
- 5.4 Legal Ethanol
 - 5.4.1 Alcohol and the Law
 - 5.4.2 Alcohol-Induced Psychomotor Impairment
 - 5.4.3 Blood and Urine Alcohol Analysis
 - 5.4.4 Breath Alcohol Analysis
 - 5.4.5 Collection and Storage of Alcohol Specimens
 - 5.4.6 Disposition of Alcohol
 - 5.4.7 Saliva and Other Media
- 5.5 Medical Legal Issues (eg, role of expert witness)
- 5.6 Workplace Drug Test Interpretation
 - 5.6.1 Cutoffs
 - 5.6.2 Guidelines for Federal Workplace Drug Testing Programs
 - 5.6.3 Role of Medical Review Officer (MRO)