American Osteopathic College of Occupational and Preventive Medicine

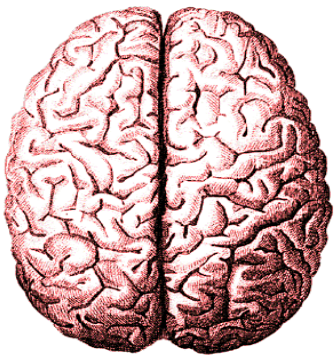
Basic Course in Occupational Medicine, Part II

Sunday, October 7, 2012

Heather Gjorgjievski, DO and P. Lance Walker, DO, MPH
Program Co-Chairs

Basic Course Lecture Handouts

A. 7:30 am Overview of the CAQ in Occupational and Environmental Medicine, Heather Gjorgjievski, DO
B. 8:00 am Infectious Disease & Biological Hazards, Charles Werntz, DO, MPH, FAOCOPM
C. 9:15 am Occupational Metals, P. Lance Walker, DO, MPH
D. 10:30 am ADA and Regulatory Issues, Charles Werntz, DO, MPH, FAOCOPM
E. 11:45 am Physical Hazards, Elizabeth P. Clark, DO, MPH&TM, FAOCOPM
F. 1:00 pm Plastics and Pesticides, Mike Carson, DO, MPH
G. 2:15 pm Occupational Dermatology, Elizabeth P. Clark, DO, MPH&TM, FAOCOPM
H. 3:15 pm Solvents and Organics, Vikas Kapil, DO, MPH, FACOEM
I. 4:30 pm Conclusions, Questions and Answers, Posttest, P. Lance Walker, DO, MPH
5:00 Adjourn



Grievance Procedure

Please let Jeffrey LeBoeuf, CAE or one of the AOCOPM Officers know immediately if you have any problems with facilities, hand-outs, program content, or any other issue with this conference. Concerns about the CME program's compliance with the AOA "Uniform Guidelines" may be expressed to the accredited sponsor—American Osteopathic College of Occupational and Preventive Medicine (AOCOPM) during the conference or after by calling AOCOPM at (800) 558-8686. Copies of these guidelines are available upon request. Unresolved issues regarding compliance with the AOA "Uniform Guidelines" can be brought to the attention of the AOA Division of CME. They can be contacted at (800) 621-1773 x 8053 or (312) 202-8053 or via mail at 142 East Ontario Street; Chicago, IL 60611-2864.

About the CAQ

The Certificate of Added Qualifications (CAQ) in Occupational/ Environmental Medicine represents credentialing in the field of medicine. The CAQ is approved by the American Osteopathic Association (AOA) through established criteria and a written exam administered by the American Osteopathic Board of Preventive Medicine (AOBPM).

The AOBPM is the AOA-approved examining entity, which administers exams for:
(1) Full Board certification in occupational/environmental medicine, aerospace medicine, and public health/general preventive medicine for the osteopathic profession.

(2) A Certificate of Added Qualification (CAQ) in occupational/environmental medicine.

The AOCOPM CME Conferences offer didactics designed to provide the most up-to-date information for doctors who practice in occupational/environmental medicine, disability/impairment evaluations, public health/general preventive medicine, and aerospace medicine.

In addition, the College sponsor a basic course in occupational and environmental medicine designed to provide a basic understanding and expertise in the areas of occupational and environmental medicine while preparing participants to take a written examination qualifying for an AOA-approved, Certificate of Added Qualification (CAQ).

The Course is presented in three (3) parts; physicians *do not* need to take the parts in sequence. For the convenience of the faculty and participants, one part is provided at each of the two (2) conferences presented by the AOCOPM each year (usually in March and October). Each part is a full day didactic program, requires separate registration to the AOCOPM, and provides seven to nine (7 - 9) hours of 1-A CME credits (Attendance at the AOCOPM conferences in the spring and fall will provide a total of approximately fifty (50) hours of AOA Category 1 CME credits each year).

Study Text: It is suggested that study include such volumes as: "The National Medical Series for Independent Study of Preventive Medicine and Public Health," by Brett J. Cassens, Harvard Publishing; "Occupational and Environmental Medicine," 2nd Edition, Lange Series, by Joseph LaDou; "A Practical Approach to Occupational and Environmental Medicine," 2nd Edition, by Robert J. McCunney, Little, Brown and Company, and "Occupational Medicine" the 3rd Edition by Carl Zenz.

AOCOPM Membership

Membership: For information on membership in the American Osteopathic College of Occupational & Preventive Medicine, please call 800-558-8686 or email jeffrey@aocopm.org. Please visit www.aocopm.org for further information or to see about future conferences.

Eligibility Requirements

- Must be Board Certified by the AOA in an AOA- approved primary certification;
- Hold a valid, unrestricted license to practice medicine in a state or territory of the United States or a province of Canada;
- Show evidence of completion of a basic review course comparable to the one provided through the AOCOPM or document an initial 100 hours of postgraduate training within the past five (5) years in the area of special interest. At a minimum, 50 hours must be in Category 1 and 50 hours in Category II.
- Submit practice documents verifying current practice in area of special interest (i.e., letters of agreement from companies, schools, hospitals and/or clinics contracted with or performing service for).
- Submit two (2) letters of recommendations from persons competent in the area of special interest.
- Submit the required application, fees, and supporting documents to the Executive Secretary of the AOBPM by January 1 prior to sitting for the CAQ examination.
- Pass appropriate examination designed to evaluate applicant's understanding of the scientific bases of the problems involved in the field of interest and demonstrate current knowledge, sound judgment and a high degree of skill. An oral interview and a written multiple choice examination will be personally conducted, supervised and reviewed by members of the AOBPM.

The application to take the CAQ exam must be obtained from the Executive Secretary of the AOBPM - not from the College. You may contact the AOBPM Executive Secretary:

Michael Shelden, D.O, MPH
Executive Secretary
American Osteopathic Board of Preventive Medicine
142 East Ontario Street, Floor 4
Chicago, Illinois 60611
Phone 800-621-1773, Ext 8103 - Fax 312-202-8224
email aobpm@osteopathic.org
web page http://www.aobpm.org

The Certificate of Added Qualification (CAQ) is valid from the date of issuance, provided a minimum of 50 hours of Category 1-A in occupational / environmental / preventive medicine is documented every three years.

To prepare for the CAQ examination, it is recommended that in addition to completing a basic review course in occupational medicine, the applicant contact the AOBPM for a list of study materials.

The AOCOPM presents a three-part basic course designed to educate primary care physicians to deal with occupational and environmental medicine issues as they occur in the course of their practices and to assist in the preparation for the CAQ exam.

For more information on the basic course, contact the AOCOPM at 800.558.8686 or e-mail to: jeffrey@aocopm.org.

Michael Carson, DO, MPH, FACPM

Dr. Michael Carson is the Global Director for Health Services Consulting for The Dow Chemical Company, responsible for leading the medical support to Dow in product safety, business development, external advocacy, government affairs, medical outreach, and issue management. In addition, he leads Dow's Epidemiology department for human health research.

During his 23 years with Dow, Dr. Carson has participated in and published numerous studies assessing Dow employee health in Ohio, Texas, California, and Michigan, and several clinical trials of product health and safety impacts. Dr. Carson has also served as Dow's health focal point regarding dioxin since 1997.

Prior to his current responsibilities, Dr. Carson served as an Occupational Health Physician and Regional Medical Director for Dow in numerous regions, including California, Texas, and Midland, MI, from 1989 to 2011. He has been in clinical medical practice for over 20 years, including a Family Medicine practice in Michigan prior to working in Dow.

After graduating with a Bachelor of Science (BS) from Duke University, Dr. Carson earned his D.O. degree from Michigan State University. He completed his residency in Family Practice with Saginaw Cooperative Hospitals from 1978-1980. Dr. Carson obtained a Masters in Public Health (MPH) in Occupational Medicine from the University of Michigan in 1991.

Dr. Carson is a Diplomate with the American Board of Family Practice, a Diplomate with the American Board of Preventive Medicine in Occupational and Environmental Medicine, and a Fellow of the American College of Preventive Medicine.

Elizabeth Clark, DO, MPH&TM, FAOCOPM

Dr. Elizabeth Clark recently retired from the USAF where she was COL, MC, CFS, and Chief, International Education &Training Division. She is currently employed in New Braunfels, TX in a weight loss and cosmetic clinic.

Dr. Clark earned her medical degree at the University of Health Sciences, Kansas City followed by the MPH & TM from Tulane's School of Public Health and Tropical Medicine. She completed Flexible Internship at Orlando General Hospital and her residency in Aerospace and Preventive Medicine through the USAFSAM program.

Dr. Clark is board certified by AOBPM in Aerospace Medicine, Occupational Medicine, and Preventive Medicine, by AOBFP in Family Practice, and holds a Certificate of Additional Knowledge in Tropical and Travel Medicine. She is a fellow of the college and of the Academy of International Medical Acupuncture.

Vikas Kapil, DO, MPH, FACOEM

Dr. Kapil is Chief Medical Officer and Associate Director for Science at the National Center for Environmental Health and the Agency for Toxic Substances and Disease Registry at the Centers for Disease Control and Prevention in Atlanta, Georgia.

He received his D.O. at the Michigan State University College of Osteopathic Medicine in East Lansing, Michigan and a Masters in Public Health (M.P.H.) from The University of Michigan. He completed residency training in Emergency Medicine at POH Medical Center in Pontiac, Michigan and in Occupational and Environmental Medicine at the University of Michigan Medical Center in Ann Arbor, Michigan.

He is Board Certified in Emergency Medicine and in Occupational Medicine. Dr. Kapil is a Fellow of the American College of Occupational and Environmental Medicine and Associate Professor of Environmental Health at the University of Cincinnati Medical Center in Cincinnati, Ohio. His primary areas of clinical and research interest include environmental emergencies, environmental exposures in communities, mass casualty events preparedness and response, and non-communicable disease and injury in low income countries.

P. Lance Walker, DO, MPH

Dr. Walker is currently a partner in SiteMed North America, LLC, which provides on-site occupational medical services to industry. He is the Associate Medical Director of Georgia Power Corporation. He is also a partner in PointMed, Inc.,which provides MRO and IME services.

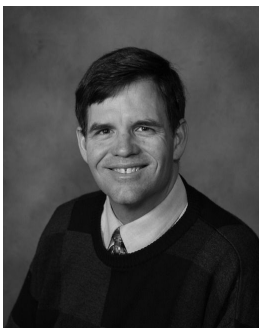
Dr. Walker completed undergraduate training in Biology at William Jewell College in Liberty, Missouri. He received a Doctorate Degree in Osteopathic Medicine from the Oklahoma State University College of Osteopathic Medicine. His residency was completed in Family Medicine at Floyd Medical Center in Rome, Georgia where he served as Chief Resident.

After residency he entered private practice in North Carolina where he co-founded and managed three successful practices in the Raleigh-Durham area. He received a Masters Degree in Public Health from the University of North Carolina in 2005. Dr. Walker relocated to the Atlanta area to be closer to family in 2006. He is board certified in Family and Osteopathic Medicine. He is an Aviation Medical Examiner and a Certified Medical Review Officer.

His practice interests include wellness and occupational medicine. His treatment philosophy is to emphasize disease prevention through early intervention and lifestyle modification before utilization of pharmacologic interventions.

Dr. Walker is married, has two young children and resides in Kennesaw, Georgia. His personal interests include running, reading and travel.

Charles Livingston Werntz, III, DO, MPH, FACOEM



Dr. Carl Werntz currently serves as An Associate Professor of West Virginia University and is the Program Director of the Osteopathic Occupational Medicine Residency program in Morgantown West Virginia. Dr. Werntz is a 1996 graduate of the Kirksville College of Osteopathic Medicine and received his Master's of Public Health from West Virginia University in 2002. He completed his Residency in Occupational Medicine at the West Virginia University in 2002. Dr. Werntz has provided numerous professional lectures throughout his career. He is a fellow of the American College of Occupational and Environmental Medicine.

Basic Course in Occupational and Environmental Medicine

Needs Assessment

The American Osteopathic Board of Preventive Medicine provides the most recent Table of Specificity for the Occupational Medicine – Certificate of Added Qualification (CAQ) Examination. This provides the core of our needs assessment. Based upon this table of specificity the lectures were chosen and learning objectives developed.

Domain Distribution
Epidemiology and Statistics 3%
Acute Disease Prevention 12%
Chronic Disease Prevention 5%
Impairment and Disability Evaluation 5%
Toxicology 15%
Injury Prevention 7%
Mental Health and Retardation 2%
Industrial Hygiene and Safety 16%
Substance Abuse 2%
Clinical Occupational and Environmental Medicine 13%
Legal and Regulatory Requirements 10%
Physical Hazards 5%
Biological Hazards 3%
Reproductive Hazards 2%

Total 100%

Learning Objectives

Part I

A. Overview

At the end of the presentation the attendee will be able to:

- Introduce participants to the College, the CAQ and the Board of Preventive Medicine
- Preview the Basic Course in Occupational and Preventive Medicine
- Discuss Occupational Medicine as a Career
- Provide a pre-test to participants

B. Introduction to Occupational Medicine

At the end of this lecture, the student will be able to:

- Understand the scope and practice of OM
- Name 2 historical OM figures
- Identify significant laws
- Name one major preventive health initiative in which OM plays an important role
- Enumerate OM services delivery methods
- Explain the essential and elective components of an OM practice

C. Ergonomics

At the end of this lecture, the student will be able to:

- Define Ergonomics & Work Related Musculoskeletal Disorder
- Identify the Elements of an Ergonomics Process
- Explain Ergonomic Risk Factors
- Describe Causation issues
- Outline Intervention Strategies

D. Medical Surveillance

At the end of the presentation the attendee will be able to:

- Define Medical Surveillance
- Discuss the purpose of Medical Surveillance
- Describe the phases of a Medical Surveillance Program
- Identify and understand the significance of Occupational Sentinel Health Events
- Recognize the distinction between well-established Medical Surveillance protocols and nascent protocols for new substances

E. Biostatistics and Epidemiology

At the end of this lecture, the student will be able to:

- Define Epidemiology and how it explains disease patterns.
- Explain the differences between epidemiology and clinical medicine.
- Identify the types of epidemiologic studies.
- Describe the measures of association between a factor and an outcome.

F. Occupational Safety & Health Regulations

At the end of this lecture, the student will be able to:

- Evaluate the impact that various governmental and private sector organizations have upon employers in their management of environmental issues.
- Determine the degree to which a broad range of occupational health laws and regulations directly impact clinical practice in occupational medicine
- Apply new changes to existing laws which affect occupational medicine practice
- Implement an effective clinical program in the Worker Compensation environment
- Employ the use of the internet as a valuable resource in the practice of occupational medicine

G. Clinical Toxicology

At the end of this lecture, the student will be able to:

- Understand the definition of TOX
- Identify Various Aspects of Chemical Exposure
- Identify methods, common applications of TOX in Chemical induced illness
- Understand the routes and degree of exposure, absorption and metabolism
- Understand Exposure - Dose Response Relationship, Duration, Frequency, Distribution, affect on Target Organ, Metabolism and Routes of Excretion

H. Facility Walk-Though Survey

At the end of this lecture, the student will be able to:

- Develop a strategy for conducting a workplace walk-through survey.
- Organize a format for recording essential observations.
- Consider unique characteristics of various industries in evaluating worksites.
- Consider applicable governmental regulations in their assessments.
- Effectively utilize information resources.

Part II

A. Overview

At the end of the presentation the attendee will be able to:

- Introduce participants to the College, the CAQ and the Board of Preventive Medicine
- Preview the Basic Course in Occupational and Preventive Medicine
- Discuss Occupational Medicine as a Career
- Provide a pre-test to participants

B. Occupational Metals

At the end of the presentation the attendee will be able to:

- Discuss the physical and chemical properties of common occupational metals
- Identify common objects containing occupational metals
- Identify risks and methods of absorption and exposure
- Discuss illnesses and injuries caused by metallic exposure
- Learn proper evaluation and management of exposure cases
- Identify preventive measures

C. Occupational Dermatology

At the end of the presentation the attendee will be able to:

- Review medical definitions and terminology to describe Occupational Dermatoses
- Better understand the epidemiology and economic impact of Occupational Dermatology
- Review proper skin examination to effectively assess Occupational Dermatoses
- Review effective history taking techniques to effectively diagnose Occupational Dermatoses
- Review common clinical morphologic patterns of Occupational Skin Disease and their etiology
- Review Occupational Skin disorder prevention strategies

D. ADA Regulatory Issues

At the end of the presentation the attendee will be able to:

- Become familiar with a major law which dramatically impacts the practice of Occupational Medicine.
- Determine which individuals have protection under the ADA.
- Understand the meaning of “qualified individual with a disability.”
- Determine who are “exempted employers”
- Understand the role of medical examinations, drug testing and return to work evaluations.
- Determine what is “reasonable accommodation”

E. Physical Hazards

At the end of the presentation the attendee will be able to:

- Describe the various types of physical hazards associated with occupational exposures.
- Describe the health effects associated with those hazards.
- Describe the appropriate prevention measures to minimize health effects from physical hazards.

F. Infectious Disease/Biological Hazards

At the end of the presentation the attendee will be able to:

- Identify potential biologic hazards commonly encountered in occupational settings.
- Identify protective strategies that are available.
- Identify the relevant legal/regulatory controls
- Review the Bloodborne Pathogens Standard (OSHA)
- Review guidance on preparing workplaces for an Influenza Pandemic (OSHA)

G. Solvents and Organics

At the end of the presentation the attendee will be able to:

- Provide an overview of the toxic effects of organic solvents.
- Examine the range of toxicities and the target organs.
- Review the basic chemical structures of the categories of organic solvents.
- Identify the common organic solvents and their metabolites.
- Understand the principles of prevention of toxicity.

H. Plastics & Pesticides

Regarding Plastics, at the end of the presentation the attendee will be able to:

- Identify the major plastics.
- Basic understanding of toxicities.
- Learn to recognize exposure opportunities.
- Develop knowledge of specialized tests.
- Gain an appreciation of the deficiency in current scientific data.

Regarding Pesticides, At the end of the presentation the attendee will be able to:

- Become familiar with the importance of these compounds
- Understand the common routes of exposure
- Learn to recognize the common clinical symptoms and signs
- Understand the implications for treatment of toxicities
- Develop strategies for prevention and surveillance

PART III

A. Overview

At the end of the presentation the attendee will be able to:

- Introduce participants to the College, the CAQ and the Board of Preventive Medicine
- Preview the Basic Course in Occupational and Preventive Medicine
- Discuss Occupational Medicine as a Career
- Provide a pre-test to participants

B. Noise Induced Hearing Loss

At the end of the presentation the attendee will be able to:

- Discuss the costs of hearing loss
- Describe the basics of hearing
- Identify the Types of hearing loss
- Develop the essentials of a good hearing conservation program
    - Noise Monitoring
    - Periodic Audiometric evaluation
    - Engineering Controls
    - Worker Education
    - Selection of appropriate HPDs
    - Administrative Controls

C. Occupational Cancer Risk

At the end of the presentation the attendee will be able to:

- Discuss potential causes of occupational related cancers
- Discuss estimates of rates of occupational exposures causing human cancers
- Identify the Initiation, Promotion, and Progression of occupational related cancers

D. Psychiatric Aspects of Occupational Medicine

At the end of the presentation the attendee will be able to:

- Relate the biopsychosocial model of psychiatric disease to occupational medicine.
- Discuss the epidemiological implications of the work environment, industrial organization, and cultural relationships.
- Examine the spectrum of occupational psychiatric disease
- Identify areas of controversy in occupational psychiatric disorders
- Offer relevant management/treatment strategies

E. Ionizing and Non-Ionizing Radiation

At the end of the presentation the attendee will be able to:

- Apply epidemiological principles in the approach to assessing exposures to radiation.
- Understand the concepts & definitions of various types of ionizing radiation (IR) and non-ionizing radiation (NIR) and distinguish the differences between the various types of exposure.
- Diagnose the biologic effects of IR in man.
- Diagnose the biologic effects of NIR in man.
- Utilize therapeutics strategies for radiation exposures

F. Disability/Impairment Evaluations

At the end of the presentation the attendee will be able to:

- Compare and contrast three types of disability or income replacement programs
- Review the Physician's role in the disability process
- Effectively participate in the three different programs
- Appropriately utilize Independent Medical Examiner (IME)
- Recognize the characteristics of a good IME

G. Reproductive Issues in the Workplace

At the end of the presentation the attendee will be able to:

- Be able to cite some important court decisions regarding reproductive health issues in the workplace
- Be able to describe the difference between reproductive hazards and teratogens
- Be able to describe background rates of infertility and sub-fertility, miscarriage and stillbirths, birth defects, low birth weight and premature birth, developmental disorders, and childhood cancers
- Be able to list some suspected reproductive hazards and the suspected consequences of their exposures
- Be able to describe some prevention strategies to minimize exposure to workplace reproductive hazards

H. Occupational Pulmonary Disorders

At the end of the presentation the attendee will be able to:

- Define key terms, phrases and exposures relevant to Occupational induced Pulmonary disorders
- Discuss the health impact and the major causes of morbidity and mortality due to Cardiopulmonary Occupational diseases
- Describe the features of Cardiopulmonary diseases: burden of illness, risk factors/etiology, prevention strategies
- Discuss the key components of an occupation evaluation and demonstrate the ability to utilize screening, diagnostic and monitoring modalities

I. Occupational Cardiovascular Disorders

At the end of the presentation the attendee will be able to:

- Define key terms, phrases and exposures relevant to occupational induced Cardiovascular disorders
- Discuss the health impact and the major causes of morbidity and mortality due to Cardiovascular occupational diseases
- Describe the features of Cardiovascular diseases: burden of illness, risk factors/etiology, prevention strategies
- Discuss the key components of an occupation evaluation and demonstrate the ability to utilize screening, diagnostic and monitoring modalities

Evidence Basis:

Core References

1. A Practical Approach to Occupational and Environmental Medicine. Robert J. McCunney; Third Edition, 2003, 952 pg, Lippincott Williams and Wilkins. Includes NIOSH CD-ROM Pocket Guide to Chemical Hazards.
2. Current Occupational & Environmental Medicine. Joseph LaDou; Fourth Edition, 2007, 846 pg, McGraw-Hill Companies Inc.
3. Textbook of Clinical Occupational and Environmental Medicine. Rosenstock, Cullen, Brodkin, Redlich; Second Edition, 2005, 1328 pg, Saunders.

Recommended Supplemental Resources:

1. Instant Medical Surveillance: The Evaluation of Biological and Chemical Dangers, Frank Mitchell, DO, MPH; 2nd Edition 2007, 424 pg, OEM Press.
2. Occupational Medicine Board Essentials. Les Folio; Second Edition, 2002, 100 pg, WordBytes Publications. $30.00. Available at the AOCOPM webstore, www.aocopm.org
3. Preventive Medicine Board Essentials. Folio, Yao, Clark; Second Edition, 2003, 100 pg, WordBytes Publications. $30.00. Available at the AOCOPM webstore, www.aocopm.org
4. AOCOPM Basic Course Review CD. $45. Available at the AOCOPM webstore, www.aocopm.org

Other Resources

1. Environmental and Occupational Medicine, 4th Edition, 2006. William N Rom, 1904 Pages. Lippincott, Williams & Wilkins
2. The Workplace Walk-Through. James P. Kornberg, MD, ScD; 1992, 165 pg, Lewis Publishers
3. Guide to the Medical Evaluation of Respirator Use. Robert McLellan, Kathleen Schusler; 2000, 324 pg, OEM Press.
4. Clinical Environmental Health and Toxic Exposures. John B. Sullivan, Jr, MD, Gary R. Krieger, MD, MPH; Second Edition, 2001, 1344 pg, Lippincott Williams and Wilkins.
5. Occupational Medicine Practice Guidelines: Evaluation and Management of Common Health Problems and Functional Recovery in Workers. American College of Occupational and Environmental Medicine; 3rd Edition, 2009, 3500 pgs, ACOEM.
6. The DOT Medical Examination. Natalie Hartenbaum, MD, MPH; 2008, 4th Edition, 275 pg, OEM Press.
7. Reproductive Hazards in the Workplace. Linda Frazier, MD, MPH, Marvin Hage, MD; 1998, 600 pg, John Wiley & Sons, Inc.
8. Chronic Musculoskeletal Injuries in the Workplace. Don Ranney; 1997, 352 pg, W. B. Saunders Co.

Periodicals

1. Journal of Occupational and Environmental Medicine: American College of Occupational and Environmental Medicine, http://www.joem.org , (847) 818-1800; monthly.

Other Study Aids

1. Occupational Medicine Secrets. Rosemary Bowler, Ph.D., MPH, James Cone, MD, MPH; 1999, 353 pg, Hanley & Belfus, Available from OEM Press.
2. Clinical Occupational and Environmental Medicine: a Pretest and Self-Assessment Guide. Renata Bluhm; 2000, 101 pg, OEM Press.

Major Suppliers of Occupational Medicine Texts

AOCOPM Website, **www.aocopm.org** Click on "AOCOPM Store"

Elsevier is a parent company for numerous publishers of core and subspecialty texts in occupational and environmental medicine, as well as the **Clinics** series of periodicals in many specialty areas. Publishers found at the Elsevier website include Saunders, Mosby, Churchill Livingstone, Butterworth-Heinemann, and Hanley-Belfus. http://us.elsevierhealth.com , (800) 545-2522

Lippincott, Wilkins and Williams is a unit of Wolters Kluwer Health, a group of leading information companies offering specialized publications and software for physicians, nurses, students and specialized clinicians. Products include drug guides, medical journals, nursing journals, medical textbooks and medical pda software. www.LWW.com (800) 638-3030

OEM Press publishes a catalog for many occupational and environmental medicine subspecialty texts. www.oempress.com , (800) 533-8046.

Occupational Medicine Websites and Phone Numbers:

Occupational Medicine

1. American Osteopathic College of Occupational and Preventive Medicine (AOCOPM) www.aocopm.org
2. American College of Occupational and Environmental Medicine (ACOEM) www.acoem.org
3. NIOSH: 1-800-35-NIOSH www.cdc.gov/niosh/homepage.html
4. Chemical Protective Clothing http://www.cdc.gov//niosh/docs/87-108/
5. American Society for Testing and Materials (ASTM) http://www.astm.org/
6. National Fire Protection Association http://www.nfpa.org
7. University of Vermont MSDS Collection http://hazard.com; http://siri.uvm.edu/msds
8. Equal Employment Opportunity Commission; www.eeoc.gov
9. Mine Safety and Health Administration; www.msha.gov
10. Food and Drug Adminstration; www.fda.gov
11. Substance Abuse and Mental Health Services Administration; www.samhsa.gov

12. Regional Poison Control (800) 222-1222
13. Environmental Protection Agency – Indoor Air Quality; www.epa.gov/iaq
14. National Agriculture Safety Database; www.cdc.gov/nasd
15. Advanced OSHA Search; www.osha.gov/pls/oshaweb/owasrch.full_site_search
16. Americans with Disabilities Act; http://janweb.icdi.wvu.edu/
17. Code of Federal Regulations; www.dol.gov/esa/regs/cfr/main.htm
18. NIOSH homepage; www.cdc.gov/niosh/homepage.html
19. Haz Map: Information Hazardous Chemicals and Occupational Disease; http://hazmap.nlm.nih.gov/
20. NIOSH Elements of Ergonomic Program; www.cdc.gov/niosh/ephome2.html
21. Frequently cited OSHA Standards; www.osha.gov/pls/imis/citedstandard.html
22. OSHA Respiratory Advisor Page; www.osha.gov/SLTC/etools/respiratory/contents.html
23. OSHA Compliance etools page; www.osha.gov/SLTC/etooldownloads/downloads.html
24. OSHA Fact Sheets; www.safetyinfocur.com/OSHAfactindex.html
25. American Association of Medical Review Officers; www.aamro.com/
26. Department of Transportation; www.dot.gov
27. Federal Motor Carrier Safety Administration; www.fmcsa.dot.gov/

Hazardous Substances Databases

1. ATSDR (Agency for Toxic Substances and Disease Registry) toxicological Profiles; www.atsdr.cdc.gov/
2. TOXNET databases; http://toxnet.nlm.nih.gov
    a. HSDB (Hazardous Substance Data Bank
    b. IRIS (Integrated Risk Information System)
    c. ITER (International Toxicity Estimate for Risk)
    d. Gene-Tox (Genetic Toxicology)
    e. CCRIS (Chemical Carcinogenic Research Information System)
    f. Toxline (Toxicology Bibliographic Information)
    g. DART/ETIC (Developmental and Reproductive Toxicology)
    h. Chem ID Plus (Chemical Synonyms and Structures)
    i. TRI (Toxic Release Inventory)
3. Registry of Toxic Effects of Chemical Substances (RTECS); www.cdc.gov/niosh/rtecs/default.html
4. Toxic Release Inventory; www.epa.gov/tri/
5. Toxicology, Occupational Medicine, and Environmental Series (TOMES) Plus System; www.micromedex.com/products/tomesplus/
6. Biennial Reporting System (BRS) for large quantity generators; www.epa.gov
7. Comprehensive, Environmental Response, Compensation, and Liability Inventory System (CERCLIS); www.epa.gov
8. Nuclear Reactor List; www.nrc.gov
9. Hazardous Substance Release Effects Database (HazDat); www.atsdr.cdc.gov
10. NTP (National Toxicology Program); http://ntp-server.niehs.nih.gov/
11. CHEMTREC HazMat Communication Center (800) 424-9300; www.chemtrec.org
12. National Pesticide Information Center; http://npic.orst.edu/
13. National Pesticide Telecommunications Network: 1-800-858-7377/7378

Literature Search Databases and Library Resources

1. Medline via PubMed; www.ncbi.nlm.nih.gov/entrez/query.fcgi
2. PubMed; www.pubmedcentral.nih.gov

3. UC at Berkeley Toxicology and Occupational Medicine; www.lib.berkeley.edu/PUBL/tox.html
4. National Libraries of Medicine Homepage; www.nlm.nih.gov
5. Free Medical Journals; www.freemedicaljournals.com
6. CDC Wonder: Public Health Databases; http://wonder.cdc.gov/
7. Bureau of Labor Statistics homepage; http://stats.bls.gov/

Reproductive Toxicity Databases

1. Organization of Teratology Information Services (OTIS); http://www.otispregnancy.org/
2. Reproductive Toxicology Center (REPROTOX); www.reprotox.org/
3. REPRORISK and TERIS (fee based); www.micromedex.com/products/reprorisk/

Preventive Medicine

1. Poison Control; www.aapcc.org/
2. Hepatitis B (CDC Guides); www.cdc.gov/ncidod/diseases/hepatitis/b/Bserology.htm
3. National Institute of Environmental Health Sciences (NIH); www.niehs.nih.gov
4. NIEHS Reports on Carcinogens; www.niehs.nih.gov (Advanced Search)
5. CDC Post Exposure HIV Prophylaxis; www.cdc.gov/mmwr/preview/mmwrhtml/rr5409a1.htm

Environmental Medicine and Disaster Response

1. Calif. State Hazard Education and Information System (HESIS); www.dhs.ca.gov/ohb/HESIS
2. Environmental Toxicology: California Office of Environmental Health Hazard Assessment (OEHHA); www.oehha.ca.gov
3. First Responder Chemical Hotline; 1-800-424-8802
4. National Domestic Preparedness Office; http://www.virtualref.com/govagency/492.htm
5. DOT Hazardous Materials Safety; http://hazmat.dot.gov
6. Terrorism Self-Assessment; http://www.emsrb.state.mn.us/**terrorism**.asp
7. Chemical Hazard Response Information System (CHRIS): USCG; www.chrismanual.com
8. CDC Emergency Preparedness and Response; www.bt.cdc.gov
9. Required Reporting Information for spills (800) 424-8802; www.nrc.uscg.mil/nrchp.html
10. Managing Hazardous Materials Incidents. Volumes I-III; www.atsdr.cdc.gov/MHMI

Travel

1. CDC Travel; http://wwwn.cdc.gov/travel/default.aspx

Clinical Guidelines

1. Hydrogen Cyanide; www.emedicine.com/emerg/topic118.htm
2. Hydrogen Sulfide; www.emedicine.com/EMERG/topic258.htm
3. Other guidelines; www.emedicine.com

Biologic Hazards

AOCOPM
Basic Course
in
Occupational Medicine

Carl Werntz, D.O., MPH
March 2, 2011

Objectives

- Identify potential biologic hazards
- Describe protective measures
- Describe OSHA Bloodborne Pathogen Standard (OSHA)
- Describe a TB prevention program for a healthcare facility
- Craft a training and vaccination program for work-related illnesses

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Introduction

- Biologic hazards are Ubiquitous
- Only workplace hazards considered
- Impacts many workplaces
  - Healthcare
  - Public Safety
  - Grounds Maintenance
  - Research

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Biologic Hazards

- Infections
  - Viral
  - Bacterial
  - Fungal
- Allergies
- Critter-related
  - Bites
  - Envenomations
  - Zoonoses
- Plants

Risk Classification

- Biological Safety Level (BSL)
- Parallel system for animal health aBSL
- Classifies risk from an agent
- Outlines precautions for working with the agent and access control measures

Risk Classification

- BSL-1 – No Human Health Effects
- BSL-2 – No human health effects from aerosol exposure (does not readily aerosolize)
- BSL-3 – Human Health Risk from aerosol
- BSL-4 – Definite Human Health Risk, Weaponization Potential

BSL-2 – No human health effects from aerosol exposure (does not readily aerosolize)

- Think: There is little risk if I take the top off of a Petri dish
- Examples: HIV, HBV, HAV, Lyme, Dengue, salmonella
- General lab precautions are enough
  - Gloves, Lab Coats, splash hazards
  - Autoclave before disposal

BSL-3 – Pathogen with significant Human Health risk (Readily Aerosolizes)

- Think: Clear health risk when top taken off Petri dish
- Examples: TB, West Nile, Anthrax, Yellow Fever
- Respiratory & Clothing protection
  - Respirators, scrubs, & shower out
  - May also have security concerns

BSL-4 – Severe Human health effect or risk for spread

- Think: Release of agent could cause severe human or animal population health issues
- Examples: Smallpox, Ebola, various hemorrhagic fevers
- PPE: Respirators, Moon Suits, etc
- Few facilities in US

Protective Measures Hierarchy

Ordering of controls to protect workers (Most to Least Desirable):

- Elimination
- Substitution
- Engineering Controls
- Administrative Measures
- Personal Protective Equipment (PPE)

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Bloodborne Pathogens

- Origins in response to HIV
- OSHA 1910.1030
- Covers all exposures to human tissues or fluids
  - Healthcare Workers
  - Emergency Responders
  - Janitorial Workers
  - Lab Workers

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Bloodborne Pathogen Risk Control Measures

- ~~Elimination~~
- ~~Substitution~~
- Engineering Controls
- Administrative Measures
- Personal Protective Equipment

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Bloodborne Pathogen Risk Control Measures

- Engineering Controls
  - Self-capping needles
  - Needleless IV systems
  - Automate lab manipulations
  - Sharps Controls
    - Sharps Containers
    - Specific disposal systems
    - Surgical neutral field

Bloodborne Pathogens Administrative

- Training
  - Risk Communication
  - Material Handling/Labeling
  - Response to Exposures
  - End needle recapping
- Material Handling
  - Biohazard bags – distinctive color
  - Sharps Containers

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Bloodborne Pathogens Administrative (part 2)

- Vaccination program
- Post-Exposure response system
- Recordability (OSHA 300 Log)
  - Special "Needlestick" provisions
    - All needlesticks are recordable
    - Names excluded from log
    - Sharps log shall contain the type and brand of device involved; the work area and the explanation of the incident.

Bloodborne Pathogens Post-Exposure Response

- Fast (< 1 Hour)
- Immediately Irrigate and Clean Site
- Assess riskiness of exposure
  - Source Testing (law varies by state)
  - Hollow (high risk) vs Solid (lower risk) needle
- Anti-Virals
  - National Clinicians' Post-Exposure Prophylaxis Hotline
  - Call 888-448-4911 (www.ucsf.edu/hivcntr)
  - Testing (immediate and follow-up)

Bloodborne Pathogens Vaccination – Hepatitis B

- Offered upon employment
- 3 shot series – Usual CDC schedule
- Post-series titer (Anti-HBs)
  - Positive – No further titers
  - Negative – Repeat Series (once)

- Do we need to repeat titers over time ?
  - NO!
  - Per CDC, once titer + lifelong protection

→

Bloodborne Pathogens Vaccination – Hepatitis B

- What about workers with prior HBV vaccination?
  - If ever titer positive, document this and no further action
  - If never titered
    - Check titer – if positive, then no action
    - If Negative – either:
      - Single dose vaccine, recheck titer
        - » Positive – no further action
        - » Negative – repeat series
      - Repeat series and draw titer

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Bloodborne Pathogen Program

- Information and Training
  - Training within 90 days of initial assignment
  - Annual refresher training
  - Includes Standard and Exposure Control Plan
  - Must have opportunity for questions
  - Trainer must be knowledgeable

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Bloodborne Pathogen Program

- Recordkeeping
  - Medical Records on all exposed employees
    - must remain confidential
    - must be maintained for duration of employment plus 30 years
    - include name, SSN, HepB status, medical evaluations and treatment, follow-up procedures

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Record Keeping

- Training records
  - include names, job titles , date, contents of training and trainer info
  - maintained for 3 years

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Sharps Injury Log

- Employer shall maintain a sharps injury log for percutaneous injuries from contaminated sharps.
- Confidentiality of the injured employee should be maintained.
- The sharps log shall contain the type and brand of device involved; the work area and the explanation of the incident.

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Example Workp The Hospita

- Bloodborne Pathogens
- Tuberculosis
- Varicella
- Measles
- Meningococcus
- Outbreak du jour
  - H_1N_1, SARS, Rubella, etc.

Hospital Isolation "Levels"

(In addition to "universal precautions")

- Standard
  - – Gloves (add mask, faceshield & gown for splash)
- Airborne
  - – N-95 Respirator
- Droplet
  - – N-95 Respirator + Gown
- Contact
  - – Gown

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Tuberculosis: General Information

- Symptoms for pulmonary TB include cough, fever, night sweats, weight loss and pleuritic pain.
- Problem: Many are asymptomatic

Tuberculosis: Asymptomatic TB

- Common with competent immune systems
- Reactivation a risk with any change in immune status
- Risk for transmitting disease if reactivated
- Transmission usually airborne, rarely via ingestion or physical contact.

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Tuberculosis: Control

- Communicability depends upon the closeness and duration of exposure.
- Suspected TB should be reported to local health authorities who conduct investigation.
- Positive PPD
  - – prior infection
  - – +/- active disease.

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Example Workplace – Tuberculosis Airborne Hazard

- Engineering
  - – Negative Pressure Rooms
- Administrative
  - – Cohorting Patients
- PPE
  - – N-95 respirators

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Tuberculosis: Control

- Screening healthcare workers
  - – PPD
  - – X-ray
  - – Alt: Quantiferon Gold
    - Plus: Single blood draw
    - Minus: Only MTB (misses other mycobacterium)
  - – Treat latent disease
    - To prevent reactivation

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Example Workplace – Varicella (Airborne Hazard)

- Engineering
- Administrative
- PPE

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Example Workplace – Outbreak du jour

- Engineering
- Administrative
- PPE

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Critters

- Local fauna varies
- Folks working outside are at risk (and if they have problems it is a work-related condition)
- Insects
- Mammals
- Snakes

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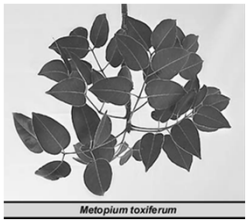
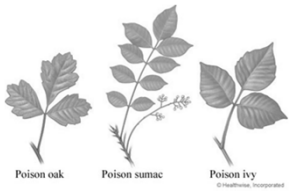
Rabies

- Education
- Post-Exposure Response
- Vaccination
  - Wild mammal exposure
  - Veterinarians
  - Vet Techs
  - Farm Workers
  - Usually NOT lab animal contact

Plants – Contact Dermati

- Know local risks





Plants – Tree of Heaven

- Cardiomyopathy
- Quassinoids in sap
- Risk to tree surgeons

Pandemic Flu Planning

- Employers are responsible for providing a safe and healthful workplace.
- An influenza pandemic occurs when a new influenza virus emerges where there is little immunity in the human population, causes serious illness and spreads easily from person to person.

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How a Severe Pandemic Influenza Affects the Workplace

- Absenteeism – could affect 40% of the workforce and unpredictable
- Change in patterns of commerce- online shopping, online meetings
- Social Distancing – no meetings, not shaking hands

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How Employers Can Maintain Operations During a Pandemic

- Develop a disaster plan
- Protect employees and customers (cough etiquette)
- Human Resource policies:
  - Sick employees to stay home;
  - Pay?
  - Telecommuting?
  - Limiting Travel

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Questions ?

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Thank you

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Occupational Metals

Basic Course In Occupational Medicine

Part II

Lance Walker, DO MPH

American Osteopathic College of Occupational and Preventive Medicine

- Learning Objectives
  - Identify exposures for the most important metals in the occupational setting
  - Learn absorption routes for metals
  - Know toxic effects of metals on humans
  - Discuss basic treatments for metals exposures
  - Highlight applicable standards regarding metals
  - Discuss surveillance procedures for various metals
  - Have some fun!!

Occupational Metals

- Metals Used Extensively in Industry
  - Construction
  - Automotive
  - Aerospace
  - Electronics
  - Glass
  - Plastics
- By Products of Activities
  - Power Generation
  - Catalysts

Occupational Metals

- Biological Activity
  - Form Stable Complexes with Sulfhydryl Groups
  - Alters Structure and Function of Proteins and Enzyme Systems
    - Several essential for normal metabolism
      - Zinc, Chromium, Manganese

Occupational Metals

- Background Exposure
  - General population exposed due to air water and food contamination
  - Levels of naturally occurring metals in soil and groundwater that influences biological levels
  - Environmental exposures in general population automotive exhaust, power generation, proximity to industrial operations

Exposure Routes

- Generally Ingested
- May be Inhaled as Fine Dust
- Fumes may be Inhaled
- Percutaneous Absorption

- Metals Lectures = Boring List
- Tried to think of this in a way that made sense to me and in a manner that would keep me awake

- While my occupational medical knowledge may be limited.....

- My football knowledge is profound and in football everything is ranked so.....

Occupational Metals

- I found a list
- What is the CERCLA List?
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) section 104 (i), as amended by the Superfund Amendments and Reauthorization Act (SARA), requires ATSDR and the EPA to prepare a list, in order of priority, of substances that are most commonly found at facilities on the National Priorities List (NPL) and which are determined to pose the most significant potential threat to human health due to their known or suspected toxicity and potential for human exposure at these NPL sites. CERCLA also requires this list to be revised periodically to reflect additional information on hazardous substances.

Arsenic

- # 1
- Arsenic really is a big number one as it is tops on the CERCLA list
- Notorious Homicidal and Suicidal Agent
  - Why? It works! Odorless, Tasteless and mixes easily with your husbands dinner

Arsenic

- Still in active use today:
- Raleigh, N.C. — A UNC pediatric AIDS researcher's poisoning death that went unsolved for years before Raleigh police charged his wife with murder is the focus of an upcoming TV segment on CBS News' "48 Hours Mystery."

  Ann Miller Kontz pleaded guilty in November 2005 to second-degree murder and conspiracy to commit first-degree murder, acknowledging she poisoned her then-husband, Eric Miller, with arsenic before his death on Dec. 2, 2000.

Arsenic

- Naturally occurring element comes from the earth.
- Inorganic Arsenic is used to preserve wood, Copper Chromated Arsenic no longer used residentially since 2003
- Organic Arsenic Compounds used as pesticides. (cotton, tobacco) Used in ceramics and electronics LEDs (arsine gas), Lead Acid Batteries

Arsenic

- Occupational Exposures
  - Agricultural Workers
  - Lumber workers with pressure treated lumber, sawing or sanding arsenic treated wood (why you shouldn't burn pressure treated wood!!)
  - Battery Workers
  - Electronics Workers
  - Copper or Lead Smelting

Arsenic

- Exposure Routes
  - Oral, Skin, Inhalation
  - Predominant route is oral
  - Taken up by RBCs
  - Distributed to liver, kidney, muscle, bone, skin and hair
  - Renal Excretion (half life of ten hours)

Arsenic

- Effects
  - Acute high dose oral exposure to inorganic arsenic may cause nausea, vomiting, diarrhea, cardiovascular effects and encephalopathy.
  - Long term oral exposure to low levels of inorganic arsenic may cause dermal effects (such as hyperpigmentation and hyperkeratosis, corns and warts) and peripheral neuropathy characterized by a numbness in the hands and feet that may progress to a painful "pins and needles" sensation. There may also be an increased risk of skin cancer, bladder cancer, and lung cancer

Arsenic

- Effects
- Dermatologic- Dermatitis, hyperkeratosis (palms and soles), bronze hyperpigmentation, Squamous cell cancer, mees lines on nails, alopecia
- Inhalation of inorganic arsenic may cause respiratory irritation, nausea, skin effects, and increased risk of lung cancer

Arsenic

- Monitoring
- Urine Arsenic Levels good indicator of acute exposure dimethylarsenic acid (DMA) and monomethylarsonic acid (MMA) AS (III) AS (V)
- Other lab findings- anemia, leucopenia, hyperbilirubenemia, hematuria, proteinuria, ecg changes, elevated liver enzymes

Arsenic

- Treatment
- Treatment- Acute oral ingestion induce emesis, activated charcoal, cathartic
- -Dimercaprol (BAL) Developed at Oxford as antidote to lewsite arsenic based chemical warfare agent
- Narrow therapeutic range, painful IM injection, nephrotoxicity and hypertension
- Enhances toxicity of Selenium and concentrates cadmium in the kidneys

Arsenic

- Applicable Standard
  - 29 CFR 1910.1018 Inorganic Arsenic Standard

Arsine

- ARSINE (ASH_3)
  - Branch of the Arsenic Family Tree
  - Gas formed in electronics production
  - Causes Intravascular Hemolysis
  - Clinical Triad Abdominal Pain, Jaundice and Oliguria
  - Treatment- Alkaline diuresis, exchange transfusion/hemodialysis

Lead

- NUMBER 2 LEAD
- LEAD #2 on CERCLA Priority List and #2 amongst the metals
- Naturally occurring element found in the earth's crust. Useful properties including corrosion resistance, density, and low melting point make it useful in many products and processes.
- One of the first metals used by people, evidence dating back to 6000 years ago
- Occupational Hazards Documented by the Physicians of the Day
  - Hippocrates (370 BC) Lead Colic
  - Ramazzini (1713) Potters demonstrated sx of hand tremors and paralysis
- Relatively Recent Historic Uses- Lead Pipes, Lead Paint, Leaded Gasoline (still in limited use)

The Lead Brick

- Neighborhood Lead Brick Games
  - Lead Brick Shot Put
  - Lead Brick Smash Toys
  - Lead Brick BB gun target
  - Lead Brick Show and Tell at School
  - May explain a lot of things

Lead

- Occupational Exposures
- Lead smelting and refining, battery manufacturing, steel welding and cutting operations, construction, rubber products and plastics industries, printing, firing ranges, radiator repair shops

Lead

- Exposure Routes
- Inhalation is primary route for Occupational Exposure- Larger particles deposited in ciliated airways, transported out of airways by mucociliary transport and swallowed
- Oral- primary route of exposure for general population in children up to 50% ingested is absorbed
- Dermal- Organic lead well absorbed through skin in animal studies
- Organic Lead may be absorbed through skin, oral or inhaled, Tetraethyl Lead (TEL), Tetramethyl Lead (TML) lipid soluble, crosses blood brain barrier, may see neurologic toxicity without hematologic toxicity

Lead

- Distribution: Body burden =Total body content of lead
- Blood, primarily bound to RBC $t_{1/2}$, 35 days
- Soft Tissue and boney trabeculae $t_{1/2,}$ 40 days
- Bone Cortex $t_{1/2,}$ 20 years, 90% of body burden

Lead

- Health Effects
- Hematological- Decrease in Heme synthesis, shortened lifespan of circulating RBC's
  - Leads to Anemia
  - Basophilic stippling seen on peripheral smear
-
- Neurologic-
  - Lead Encephalopathy
  - Lead Palsy- Foot Drop/ Wrist Drop

Lead

- Health Effects Continued
- Gastrointestinal-
  - Lead Colic- sharp onset abdominal spasms, Constipation
- Renal-
  - Lead Nephropathy decreased GFR, Saturine Gout- Lead interferes with excretion of Urates
- Reproductive-
  - Reduced Fertility
- Cardiovascular- Hypertension

Lead

- Monitoring
- BLL-blood lead levels
- ZPP- Zinc protoporphyrin (story of the chelators)

Mercury

- Mercury #3 on CERCLA List and our #3 metal
  - Naturally Occurring Metal Combines with other elements to form mercury compounds
  - Categories
    - Elemental Metal, Inorganic Compounds, Organic Mercury
  - Historic Occupational Exposure
    - Miners - cinnabar (HgS)
    - Jewelers - amalgamates
    - Mirror production
    - Felt hat industry – mad hatter
    - Medicinal - mercurous chloride

Mercury

- Modern Occupational Exposures
  - Miners
  - Smelters
  - Manufacture of medicinals containing Hg
  - Dental Workers (declining)
  - Manufacture of other mercury containing products (thermometers, light bulbs)
  - Spill clean up operators

Mercury

- Absorbtion
  - Inhalation of dust or vapors
  - Effects
    - Classic Syndrome Triad
      - Stomatitis
      - Intention (cerebellar) tremors
      - Psychic irritability - erethism, timid, anxious, easily embarrassed, irritable - anger outbursts

Mercury

- Biologic Monitoring
  - Urine (24 hr): Normal <10 μg/L
    Hazardous >200 μg/L
    Poisoning Sx >300 μg/L
  - Blood: Reflects methyl mercury as well as inorganic and other organic forms
- Treatment
  - British Anti-Lewisite (BAL) 5 mg/kg I.M., followed by 2.5 mg/kg qd or BID for 10 days. Most effect in acute poisoning.

Cadmium

- Number 4 of our Metals but drops to #7 on CERCLA list
  - Naturally occurring usually combined with other elements
  - Produced as the result of extraction of zinc, lead and copper ores
  - Used in batteries, pigments, metal coatings and plastics
  - Smokers get 2μg/d of cadmium

Cadmium

- Absorption: Inhalation major route in industry, ingestion major route in general population
- 10-40% absorbed from inhalation, GI 5%
- Distribution: Liver initially, then to kidney
- Excretion: Very slow, half-life 8-30 years

Cadmium

- Acute Toxicity: Metal fume fever-like initially progressing to chemical pneumonitis
- Chronic Toxicity
  - Renal Proximal Tubular Dysfunction
    - Initially ↑ β1 and β2-microglobins
    - Progress to Fanconi syndrome, with aminoaciduria, glycosuria, hypercalciuria, phosphaturia
  - Nephrolithiasis
  - Osteomalacia
- Carcinogenicity - suspected prostate & lung remember things that cause cancer!!

Cadmium

- Lab
  - Acute: ABGs, CXR, PFT (↓ FEV-1 and FVC), renal and hepatic function
    - NL blood Cd – 1 µg/L
    - NL urine Cd – 1 µg/g creatinine
  - Chronic (workers): periodic medical surveillance exams and bio-monitoring
    - Exam:
      - Hx: Smoking, renal, CV, MS, Resp, reproductive, nephrotoxic meds, febrile illnesses, physical exercise
      - PE: BP, Resp, GU, prostate (over 40)
      - Dx: PFT, CXR, CBC, BUN, Cr, UA w/ protein (β2-microglobin)

Cadmium

- Prevention
  - Prohibit smoking
  - Enclosures/exhaust
  - PPE
  - Prevent proteinuria
- Treatment
  - Admit if acute inhalation
  - Severe: chelation w/ calcium disodium EDTA
  - No dimercaprol (BAL) remember it concentrates cadmium in the kidneys

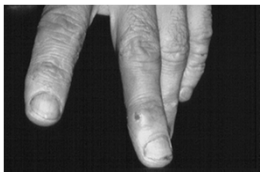
Chromium

- Naturally Occurring found in rocks, animals, plants, soil, volcanic dusts
- Uses: Alloying, metal plating, dyeing, leather tanning, steel production
- Valence: Hexavalent more toxic than trivalent form and carcinogenic

Chromium

- Exposure occurs from ingestion or inhalation
- Excretion: renal
- Clinical Toxicology
  - Skin: Contact and allergic dermatitis, irritant dermatitis (chrome holes, painless)
  - Respiratory tract and mucous membrane irritant
  - Asthma
  - Nasal septum perforation
  - Carcinogenicity: lung cancer causally linked with hexavalent form

Chromium



Chromium

- Lab:
  - Renal (proteinuria, hematuria)
  - Hepatic
  - PFT: FEV-1:FVC ratio decreased
  - Patch testing
  - CXR
- Prevention:
  - Avoid smoking
  - Biologic monitoring: Urinary chromium
- Treatment: No antidote for chromium poisoning

Beryllium

- Our #6 Metal but falls to #42 on CERCLA
- Naturally Occurring, found in rocks, coal, soil and volcanic dust
- Mined and used in nuclear weapons, reactors, aircraft and space vehicles, instruments, xray machines and mirrors, alloys used in cars, computers and golf clubs

Beryllium

- Exposure risk: purification processes, ultrafine particles highest risk
- Poorly absorbed: skin, inhalation or ingestion
- Lung, bone, liver, spleen, skin, lymph nodes (systemic disease)
- Excretion: urinary (not found in nonexposed)

Beryllium

- Acute exposure:
  - Irritant: eyes, mucous membranes, respiratory tract
  - Severe: chemical pneumonitis, pulmonary edema
- Chronic exposure:
  - Months to years
  - Exertional dyspnea
  - Interstitial Lung Disease-Crackles, HSM, lymphadenopathy, clubbing, May be misdiagnosed as Sarcoidosis
  - Pulmonary hypertension
  - Allergic dermatitis, granulomas
- Osteogenic sarcomas and lung cancer in animals

Beryllium

- Prevention
  - Medical surveillance
    - PFT and diffusing capacity
    - CXR
    - BeLPT
    - Patch Testing
- Treatment
  - Removal
  - Oxygen, corticosteroids
- Prognosis: may persist and progress after exposure ceases

Cobalt

- Cobalt #7 CERCLA #49
- Naturally Occurring
- Used to produce alloys used for the manufacture of aircraft engines, magnets, grinding and cutting tools, artificial hip and knee joints, also used to color glass ceramics and paint, medical uses for radiation therapy, sterilizing equipment

Cobalt

Cobalt

- 1966 Dow Brewery had large market share in Quebec
- Known for abundance and consistency of head, cobalt salt additive well within "safe" limits
- 25 deaths from cobalt related cardiomyopthy
- Those that died drank an average of 12 quarts of beer a day
- Never regained market share ceased production 1992

Cobalt

- Exposure
  - Cobalt dust inhalation, ingestion
    - Iron deficiency enhances uptake
    - Effects
      - Respiratory- pneumonitis, asthma
      - Dermatologic- rashes
      - Vascular- Cardiomyopathy
      - Radioactive Cobalt- radiation syndrome, cancer
      - Urine Monitoring

Nickel

- Number 8 and Number 53 on CERCLA list
- Natural element
- Uses: Stainless steel, nickel alloys, electroplating, alkaline batteries
- Exposure- skin, ingestion, inhalation
- Clinical Toxicology
  - Skin: contact dermatitis (nickel itch)
  - Pulmonary: delayed-type asthma
  - Carcinogenicity: lung and paranasal sinuses
  - Nickel carbonyl: highly toxic, fulminant pneumonitis
- Medical surveillance: skin and respiratory system

Zinc

- ZINC #9 #74 on CERCLA List
- Use: galvanizing steel and other metals, pigment, welding, wood preservative, batteries, dental cement, alloys (brass)
- Ingestion: 30% absorbed, inhalation (fumes), distributed widely in tissues
- Excretion: pancreatic fluid, bile, sweat, 20% in urine
- Clinical: metal fume fever - headache, fever and chills, metallic taste, muscle and joint pain, fatigue, sweats, cough, chest pain
  - Complete spontaneous resolution in 24-48 hours

Zinc

- Lab
  - ↓ lung volumes and diffusing capacity
  - leukocytosis
  - NI CXR
  - Possible ↑ urine and plasma zinc
  - Patch test: zinc chloride
- Surveillance: derm, resp
- Treatment: non-specific
  - Removal if sensitized

Manganese

- #10 and #117 on CERCLA List
- Use: Steel, batteries, matches, paint, pesticide, antiknock agent in fuel (MMT), welding rods
- Exposure: Mining, smelting, refining, welding, battery, chemical and fuel production

Manganese

- Absorption: Inhalation, ingestion, skin (MMT)
- Excretion: Primarily in bile; biological half-life: 30 hours
- Toxic effects variable among individuals
- Clinical toxicology:
  - Acute (MMT): burning of skin, metallic taste, nausea, dyspnea, chemical pneumonitis, hepatic and renal toxicity.
  - Chronic: nervous system damage
    - Parkinsonism
    - Manganese psychosis (excitability, sexual arousal, garrulousness)
    - Fatigue, headache, apathy, mood changes
    - Gait problems
    - Slow speech
- Lab: Blood and urine Mn (others usually normal)

Manganese

- Prevention:
  - Respiratory protection
  - Closed systems
  - Exhaust ventilation
  - Medical surveillance: respiratory and nervous system
    - Liver and kidney function (MMT)
    - Whole Blood Levels
- Treatment:
  - Neurotoxicity: Chelation w/ Calcium disodium EDTA

Manganese

Battery Plant

83 Manganese Levels

47 of 83 above reference range

Site inspection revealed black residue throughout plant

On eating surfaces

Asked kindly by company lawyers to ignore

Company solution?????

Stop testing

Selenium

- #11 and #147 on CERCLA List
- Use: glass, plastic, photoelectric cells, steel, rubber, shampoo, antifungals, animal feed
- Ingestion, inhalation, damaged skin - metabolized in liver to organic forms
- Excreted: lungs (dimethyl) or urine (trimethyl)

Sellenium

- Severe respiratory irritation
- Neuro, hepatic and renal damage
- Skin burns
- Garlic odor of breath
- Liver tumors: animals
- Lab: urine level (NL < 150 µg/L) - keep below 100 µg/L
- Surveillance: resp, GI, derm
- Chelation contraindicated

Vanadium

- #12 #198 on CERCLA List
- Steel and alloys, ceramics; found in fossil fuel
- Absorption: Inhalation, ingestion
- Excretion: renal; some bioaccumulation
- Eye & respiratory irritant - asthma, allergic dermatitis
- Green tongue (chronic exposure), PFT (obstructive pattern)
- Surveillance: resp, derm
- Remove from exposure permanently if sensitized

ALUMINUM

- #13 and #187 on CERCLA List
- Cans, foil, auto bodies, aircraft, military, ceramics, pigments, antacids, antiperspirants
- Absorption: inhalation, ingestion
- Excretion: urinary
- Exposure: welding and oxide dust

ALUMINUM

- Respiratory: irritant, pulmonary fibrosis, COPD, asthma
- Neuro:
  - "Dialysis dementia": excess of aluminum compound intake causing encelphalopathy during uremia
  - Exposure still questionably associated with Alzheimer's disease
  - Dose-dependent neurotoxicity (aluminum hydroxide)
- Lab
  - PFT (obstructive or restrictive pattern)
  - Chest x-ray/CT: nodules, granulomas, diffuse interstitial markings
  - Bio monitoring of blood or urine: results variable, risk of toxicity without correlation
- Treatment: removal
- Prevention: Respirator, ventilation, dust control
- Surveillance: Resp sx, PFTs, chest x-ray (periodic)

Antimony

- #14 and #219
- Mined and smelted from stibnite (Sb_2S_3)
  - Often alloyed with lead and arsenic
- Battery grids, semiconductors, bearings, cable sheaths, munitions, glass, pottery, fire retardant, paint, rubber, solder; treatment for leishmaniasis, shistosomiasis and filariasis; grain fumigant (Stibine)
- Absorption: Inhalation (rapid uptake: soluble forms) or ingestion
- Excretion: Renal is major means of elimination
  - Pentavalent form excreted more rapidly than trivalent form due to red cell uptake.
  - Insoluble forms excreted slowly: detected years later in urine after exposure ceases
- Toxicity:
  - Pustular dermatitis
  - Eye irritant
  - Respiratory tract irritant, pneumoconiosis
  - Cardiac: Antimony trisulfide ("sudden death")
  - Hemolysis, altered liver functions (medicinals)
  - Reproductive disorders
  - Suspected carcinogen (lung, bladder)
- Stibine gas (SbH_3) – Hemotoxin, anuria (hemolysis)

Antimony

- Lab:
  - Low RBC
  - Hemoglobinuria
  - ECG: prolonged QT, T wave changes
  - PFT changes
  - Chest x-ray/CT
  - Urine Sb: diagnostic for past exposure not severity
    - Unexposed: 0.001 mg/L
    - Occ exposure: 0.1-0.3 mg/L
- Treatment:
  - Removal
  - Chelation: Dimercaprol or penicilamine
  - Stibine hemolysis: Exchange transfusion
- Prevention: Respirator, biologic monitoring for urine Sb

Tin

- Rounding out the Bottom
  - Primary use: plating
- Organotin: plastics, oils, silicone rubber, leather preservative, marine paint biocide
- Miners: silica risk high
- Poorly absorbed, primarily excreted in feces; inhaled remains in lungs
- Organotin: skin, inhalation, ingestion; excretion: biliary, kidney

Tin

- Clinical
  - Mucous membrane, eye, respiratory irritant
  - CXR: interstitial opacities = "stannosis"
  - Memory defects, seizures, disorientation, encephalopathy
  - Skin rash, folliculitis
- Medical surveillance
  - Respiratory system (inorganic)
  - Nervous system and skin (organotin)

Thallium

- 1800's medicinals then abandoned for toxicity
- Banned as rodenticide in 1972
- Currently: electronics, jewelry and pigments, medical procedures
- Smelting operations

- Inhalation, ingestion, skin
  - 0.5-1 g ingested may be lethal

- Excretion (slow): GI, renal

- Clinical: GI, cardio, neuro, alopecia

- Lab: urine thallium

Questions

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Legal Issues in Occupational Medicine

The Americans With Disabilities Act (ADA)

Carl Werntz, D.O., M.P.H.

Learning Objectives

- After this session the learner will:
  - Describe the intent of the ADA
  - Determine which individuals have protection under the ADA.
  - Understand the meaning of "Qualified individual with a disability."
  - Determine who are "exempted employers"

Learning Objectives

- Understand the role of medical examinations, drug testing and return to work evaluations.
- Define "Essential Job Functions"
- Determine what is "reasonable accommodation"

The Americans with Disabilities Act

- Signed into law July 26, 1990 by President George W. Bush
- Guarantees fair employment practices and accessibility to a range of services for an estimated 40 to 43 million individuals with disabilities.
- *"Bill of Rights"* for persons with disabilities

The Americans with Disabilities Act

- ADA Amendments Act of 2008 (Effective 01/01/2009)
- Increased protection to the "disabled" and passed in response to decisions of the Supreme Court.
- Broadened definition to include personal and other's perception of disability
- Definition of Disability should be construed in favor of broad coverage of individuals.

The Americans with Disabilities Act

- Five major sections, or *Titles*
  - Title I
    - Prohibits discrimination in Employment
  - Title II
    - Prohibits discrimination in Public Services
  - Title III
    - Prohibits discrimination in Public Accommodations
  - Title IV
    - Prohibits discrimination in Telecommunications
  - Title V
    - Miscellaneous issues

The Americans with Disabilities Act

- Title I: Employment
  - Prohibits discrimination against "qualified" individuals in job application procedures, promotion, hiring, discharge, job training and other conditions of employment.
  - Many concepts taken directly from the rehabilitation act of 1973.
  - Effective date
    - >25 employees – July 26, 1992
    - 15 to 24 employees – July 26, 1994
    - < 15 employees not required to provide accommodation

The Americans with Disabilities Act

- Enforcement
  - Equal Employment Opportunity Commission (EEOC)
  - Final Regulations for employment provisions issued on July 26, 1991
  - Technical Assistance Manual Available
  - EEOC is revising that portion of its regulations that define "substantially limits".

The Americans with Disabilities Act

- Persons Protected under the ADA
  - "Disability" = "Handicap"
  - Qualified Individual with a disability.

The Americans with Disabilities Act

- Persons Protected under the ADA
  - Qualified Individual with a Disability.
    - Has a physical or mental *impairment* that *substantially limits one or more major life activities.*
    - Has *a record of such an impairment.*
    - Is *regarded by others as having such an impairment*

The Americans with Disabilities Act

- Definitions
  - "Impairment"
  - "Substantially Limits"
  - "Major Life Activities"

The Americans with Disabilities Act

- Definitions
  - *"Impairment"*
    - The EEOC defines impairment as any physiological disorder or condition, cosmetic disfigurement, or anatomical loss affecting one or more body systems, or any mental or psychological disorder.

The Americans with Disabilities Act

- Impairment *does not* include:
  - Physical Characteristics, such as right-handedness, weight or height.
  - Personality Traits, for example a quick temper.
  - Economic, cultural or environmental disadvantages.
  - Age
  - Current drug/alcohol abuse

The Americans with Disabilities Act

- Definitions
  - "Impairment"
  - "Major Life Activities"
  - "Substantially Limits"

- Definitions
  - 2008 ADA Amendment now defines *"Major Life Activities"* to include, but not limited to:

- Caring for oneself
- Manual tasks
- Seeing
- Hearing
- Eating
- Sleeping
- Walking
- Standing
- Lifting
- Bending
- Speaking
- Breathing
- Learning
- Reading
- Concentrating
- Thinking
- Communicating
- Working

BUT WAIT !

- MAJOR LIFE ACTIVITIES ALSO INCLUDE OPERATION OF A MAJOR BODILY FUNCTION:
- Immune system
- Normal cell growth
- Digestive, bowel, bladder, neurological, brain, respiratory, circulatory, endocrine and reproductive functions

The Americans with Disabilities Act

- Definitions
  - "Impairment"
  - "Major Life Activities"
  - "Substantially Limits"

The Americans with Disabilities Act

- *Substantially Limits"- Old Stuff*
  - Nature and Severity of the impairment.
  - Duration or expected duration of the impairment.
  - Permanent or long-term impact resulting from the impairment. (All of this may be gone!)

  Congress finds that current EEOC ADA regulations defining the term "substantially limits" as "significantly restricted" expressed too high a standard. STANDBY FOR NEW REGULATIONS ON THIS!

The Americans with Disabilities Act

- The determination of substantially limiting impairments must be made on a case by case basis, without regard to mitigating measures, such as medicines or assistive devices. (THIS HAS FLIP-FLOPPED BACK AND FORTH TWICE.) But now: "Ordinary eyeglasses or contact lenses" shall not be considered as a disability.

The Americans with Disabilities Act

- Having a "Record of a Disability"
- Generally includes two groups of people
  - Those who have *"Recovered"* from a limitation
  - Those who were *"Misclassified"* as having an impairment

The Americans with Disabilities Act

- Being "Regarded as Having a Disability"

  Individual establishes that he or she has been subjected to an action prohibited under the 2008 ACT because of an actual or perceived physical or mental impairment whether or not the impairment limits or is perceived to limit a major life activity.

The Americans with Disabilities Act

- The *"Regarded As"* inclusion is meant to acknowledge the fact that myths, untruths, old wives' tales and fears about disabilities can be just as much a barrier to employment as physical limitations caused by an actual impairment.

The Americans with Disabilities Act

- Exclusions to the Act
  - Behavior disorders such as transvestism, gender identity disorders not resulting from physical impairments, pedophilia, transsexualism, exhibitionism, voyeurism, compulsive gambling, kleptomania and pyromania

The Americans with Disabilities Act

- Exclusions to the Act
  - Controlled Substances Act, 21 USC 812
    - The ADA specifically excludes any individual who is currently using illegal drugs or who has a psychoactive substance use disorder resulting from current use.

The Americans with Disabilities Act

- Persons Protected under the ADA
  - *Qualified* Individual with a Disability.
    - Has a physical or mental *impairment* that *substantially limits one or more major life activities.*
    - Has *a record of such an impairment.*
    - Is *regarded by others as having such an impairment*

The Americans with Disabilities Act

- An individual with a disability is considered *qualified,* if the have the ability to perform the *essential functions* of the job in question, *with or without reasonable accommodation.*

The Americans with Disabilities Act

- Determination of Qualified Individual
  - Must satisfy the prerequisites for the position
    - Appropriate education, experience, licenses and so forth.
  - Individual must be able to perform the "essential functions' of the job, with or without reasonable accommodation.

The Americans with Disabilities Act

- Essential Functions
  - The essential functions of a job are those integral tasks that an individual must be able to perform unaided or with the assistance of a reasonable accommodation.

The Americans with Disabilities Act

- Essential Functions
  - The position exists to perform the function in question.
  - The employer has a limited number of employees among whom the various functions can be distributed
  - The function is highly specialized

The Americans with Disabilities Act

- Evidence of Essential Function
  - The employer's judgment as to which functions are essential
  - Written job descriptions
  - Amount of time spent on the job performing the particular function.

The Americans with Disabilities Act

- Essential Functions Continued.
  - consequences of not requiring an employee to be able to perform the function
  - Work experience of current and former employees.

The Americans with Disabilities Act

- Job Descriptions
  - Not required by the ADA
  - Some employers may unwisely decide not to develop them
  - Use the term Essential Functions.
  - Make sure the job description focuses on *what* is to be accomplished not *how* it is to be done.

The Americans with Disabilities Act

- Discriminatory Employment Practices Prohibited under Title I
  - General Provisions of section 102
    - Section 102(a) – defines the general rule prohibiting discrimination in job application procedures, hiring, discharge, training and promotion
    - Section 102(b) – describes more specific forms of discrimination encompassed by the general rule
    - Section 102 (c) – Limits an employers use of pre-employment inquires and medical examinations.

The Americans with Disabilities Act

- Exempted employers:
  - Federal Government
  - Native American Tribes
  - Bona fide Tax-exempt private membership clubs
  - Small employers (< 15 employees)

The Americans with Disabilities Act

- Pre-Employment Inquires
  - Specifically prohibits any pre-employment inquiries about an applicant's disability.
  - Implies may not ask about medical conditions

The Americans with Disabilities Act

- Before making a job offer:
  - May ask questions about an applicant's ability to perform specific job functions
  - Must not ask about disabilities (or medical conditions)
  - May ask about an applicant's qualifications (education, training, degrees and so on)

The Americans with Disabilities Act

- After making a conditional offer of employment and before an individual actually starts work an employer may require a Medical Examination.
  - Should be job specific, should not involve medical systems which have no bearing on the specific position

The Americans with Disabilities Act

- Medical Examinations:
  - Cannot require a medical examination to determine whether a job applicant has a disability.
  - Must be made post-offer of employment.
  - Any information collected must be kept in separate confidential medical files
  - Physician must have knowledge of "essential" Functions and the ADA requirements

The Americans with Disabilities Act

- Medical Examinations
  - Decisions must be made on solid data not mere speculation of possible future injury.
  - Applicant can be rejected if there is a high probability of substantial harm and cannot be accommodated. (BE CAREFULL NOW).
  - ADA is not meant to override medical exam requirement under state, local or Federal Law.

The Americans with Disabilities Act

- Drug Testing
  - ADA does not prohibit testing for illegal drugs and making employment decisions based on the results.
  - Drug tests are not considered Medical Examinations under the ADA.
  - Can be required pre-offer.

The Americans with Disabilities Act

- Return-to-work examinations.
  - Must be a job related medical exam, not a full physical exam.
  - Employer must allow a worker with a disability return to work, if not fully recovered unless:
  - Cannot perform essential function with or without accommodation
  - Would pose a significant risk of substantial harm that cannot be reduced to acceptable level, with or without accommodation.

The Americans with Disabilities Act

- Alcohol and Substance Abuse
- Current use of illegal substances is not considered a disability.
- Alcoholism is considered a disability.
  - Employer may hold an alcoholic employee to same standards and qualifications as other employees.

The Americans with Disabilities Act

- Reasonable Accommodation under Title I
  - Individual with a disability must be "Otherwise Qualified"
- This requirement is a duty to remove or alleviate barriers to employment.

The Americans with Disabilities Act

- Reasonable Accommodations
  - Making existing facilities accessible
  - Restructuring jobs
  - Providing part-time or modifies work schedu
  - Acquiring or modifying equipment or devices
  - Modifying policies
  - Providing qualified readers or interpreters
  - Reassigning individuals with disabilities to vacant positions

The Americans with Disabilities Act

- Who must be accommodated?
  - Employer's *are* required to accommodate "known" physical or mental disabilities
  - Employer's *are not* required to accommodate disabilities of which they are unaware

The Americans with Disabilities Act

- Undue Hardship
  - An employer is not required to reasonably accommodate an individual with a disability if doing so would pose an undue hardship, significant expense or difficulty

The Americans with Disabilities Act

- Determining Undue Hardship
  - The nature and cost of accommodation.
  - The overall financial resources of the site or sites involved, number of employees at each site and the effect of expenses.
  - The overall financial resources of the covered entity(all the various sites together)
  - The nature of the covered entity's operation
  - The accommodations impact on the site

The Americans with Disabilities Act - Amended January 1, 2009

- Definition of "Substantially Limits"
- Broaden definition of "Major Life Activities"
- Most mitigating measures not relevant
- Expand definition of "Regarded As Disabled"
- Impairments that are episodic or in remission
  - A condition regarded as being disabling when active is still considered a disability if inactive

Course Test Questions

- Which of the following is false regarding the Americans with Disabilities Act?
  - A. Is considered a *Bill of Rights* for persons with disabilities.
  - B. Contains five major sections or *Titles*
  - C. Requires all employers to comply with the regulations.
  - D. Was amended in 2008.

Course Test Questions

- A person protected under the act has all of the following except?
  - A. Has a physical or mental impairment that substantially limits one or more minor life activities.
  - B. Has a record of such an impairment.
  - C. Is regarded by others as having such an impairment.

Course Test Questions

- True or False, Impairment does not include:
  - Physical Characteristics, such as right-handedness, weight or height.
  - Personality Traits, for example a quick temper.
  - Economic, cultural or environmental disadvantages.
  - Age

Course Test Questions

- True or False, To be a "Qualified Individual" the person must meet the following criteria.
  - Must satisfy the prerequisites for the position
    - Appropriate education, experience, licenses and so forth.
  - Individual must be able to perform the "essential functions' of the job, with or without reasonable accommodation

Course Test Questions

- True or False, Current use of Illegal Substances is considered a disability under the Americans with Disabilities Act?

PHYSICAL HAZARDS

Basic Course in Occupational Medicine
Part II
Liz Clark, D.O., MPH & TM, FAOCOPM

American Osteopathic College of
Occupational and Preventive Medicine

Common Types

- Thermal
- Radiation
- Noise
- Vibration
- Barometric
- Physical Trauma

Occupational Deaths

- 2008 - 5,071
- 2009 – 4,551

- Currently 12 workers per day die on the job

Occupational Deaths 2008

- Transportation – 40%
- Contact with objects or equipment – 18%
- Violence – 16%
- Falls – 13%
- Harmful substance or environment – 9%
- Fires / Explosions – 3%

http://www.bls.gov/news.release/cfoi.t01.htm

Thermal Hazards - Heat

- Integral part of many industrial operations and processes
- Waste byproduct in other operations
- Can be an environmental hazard, especially accompanied by personal protective garments
- Can result in either localized injuries (burns) or systemic problems

Fig. 6-14. Improved Chemical Agent Monitor (I-CAM). The I-CAM detects vapors of chemical agents by sensing molecular ions of specific mobilities and uses timing and microprocessor techniques to reject common battlefield interferences. It consists of a drift tube, signal processor, molecular sieve, membrane, and expendable items such as batteries, confidence testers, and dust filters.

Role of Evaporation

- The most important source of heat loss. It depends on relative humidity.
  - The higher the humidity, the less efficient the heat loss.
  - Therefore, high ambient humidity (which decreases the cooling effect of sweating) and prolonged strenuous exertion (which increases heat production by muscle) increase the risk of developing heat disorders.

Thermal Regulation

- Age, obesity, chronic alcoholism, debility, and many drugs (e.g., anticholinergics, antihistamines, phenothiazines, numerous psychoactive drugs, alcohol, cocaine) increase susceptibility to heat disorders, particularly heatstroke.

THERMAL HAZARD

Skin Disorders

Heat Cramps

Heat Exhaustion

Heat Stroke

Heat-Related Skin Disorders

- Miliaria (heat rash)
  - Caused by sweat retention resulting from obstruction of the sweat gland duct.
  - 3 forms (in order of increasing severity)
  1. Miliaria crystallina: barely perceptible vesicles
  2. Miliaria rubra: firm papulovesicular lesions
  3. Miliaria profunda: vesiculonodular lesions

Heat Cramps

- *Exercise-induced cramps of striated muscle resulting from excessive fluid intake without sodium replacement.*
- Skin is moist and cool
- Characterized by slow painful contractions lasting 1-3 minutes
- Treatment: cool environment, balanced salt solution or oral saline solution of 4 tsp salt per gallon of water. Rest 1-3 days.

Heat Exhaustion

- *Excessive fluid and electrolyte loss due to sweating, resulting in hypovolemia and electrolyte imbalance.*
- Excessive sweating without concomitant fluid replacement causes heat exhaustion with increasing fatigue, weakness, and anxiety.
- Circulatory collapse ensues, with a slow, thready pulse; low or imperceptible BP; cold, pale, clammy skin; and disordered mentation followed by a shock-like unconsciousness.
- Core temperature ranges from 38.3 to 40.6° C (101 to 105° F).
- Mild heat exhaustion, precipitated by prolonged standing in a hot environment (because blood pools in heat-dilated vessels in the legs), is manifested by a subnormal body temperature and simple syncope.

Heat Stroke

- *Inadequacy or failure of heat loss mechanisms resulting in dangerous hyperpyrexia.*
- An abrupt onset is sometimes preceded by headache, vertigo, and fatigue. Sweating is usually decreased, and the skin is hot, flushed, and usually dry. The pulse rate increases rapidly and may reach 160 to 180 beats/min; respirations usually increase. Disorientation may briefly precede unconsciousness or convulsions. The temperature climbs rapidly to 40 to 41° C (104 to 106° F), causing a feeling of burning up. Circulatory collapse may precede death; after hours of extreme hyperpyrexia, survivors are likely to have permanent brain damage.

OSHA educational resources:
http://www.osha.gov/SLTC/heatillness/edresources.html

Thermal Hazard - Burns

- Do to any external heat source capable of raising the temperature of skin and deeper tissues to a level that causes cell death and protein coagulation or charring.
- Most common causes are flame, scalding liquids, and hot objects or gases contacting the skin. The extent and depth of the damage depends on the amount of energy transferred from the source.

Thermal Burns

- 1st Degree
  - Tissue blanches with pressure, damage is minimal, usually no blistering or scarring
- 2nd Degree
  - Partial thickness, associated pain, blistering, sensation is intact
- 3rd Degree
  - Completely through skin to subcutaneous tissue, skin charred or transluscent white. Pain often from surrounding 2nd degree burns but burn is painless to touch.

THERMAL HAZARD HEAT PREVENTION

Engineering

Administrative

Personal/Safe Work Practices

Personal Protective Equipment

Hazard Prevention and Control
http://www.osha.gov/SLTC/etools/safetyhealth/comp3.html

Permissible Heat Exposure Limits

Table 51-1. Examples of permissible heat exposure threshold limit values (values are given in °C and [°F] WBGT)*

Work-rest regimen	Workload Light	Moderate	Heavy
Continuous work	30.0(86)	26.7(80)	25.0(77)
75% work—25% rest, each hour	30.6(87)	28.0(82)	25.9(78)
50% work—50% rest, each hour	31.4(89)	29.4(85)	27.9(82)
25% work—75% rest, each hour	32.2(90)	31.1(88)	30.0(86)

Adapted from American Conference of Governmental Industrial Hygienists. *"Threshold limit values for chemical and physical agents and biological exposure indices, 1992–1993."* Cincinnati, 1992, The Conference.
*As workload increases, the heat stress impact on an unacclimated worker is exacerbated (see Fig. 51-1). For unacclimatized workers performing a moderate level of work, the permissible heat exposure TLV should be reduced by approximately 2.5°C.

Table 51-2. TLV WBGT correction factors in °C for clothing

Clothing type	Clo value*	WBGT correction
Summer work uniform	0.6	0
Cotton overalls	1.0	−2
Winter work uniform	1.4	−4
Water barrier, permeable	1.2	−6

Adapted from American Conference of Governmental Industrial Hygienists: *"Threshold limit values for chemical and physical agents and biological exposure indices, 1992–1993,"* Cincinnati, 1992, The Conference.
Clo, Insulation value of clothing.
*One clo unit = 5.55 kcal/m²/hr of heat exchange by radiation and convection for each °C of temperature difference between the skin and adjusted dry-bulb temperature [DB_{ad} = (DB + MRT)/2].

Fig. 12-12. Cumbersome protective gear (including a respirator, hooded chemical-resistant suit, gloves, and boots), worn for prolonged periods of time in sandblasting operations, imposes both physiological and psychological demands on the worker. Excessive physiological demands often manifest as heat stress. The inability to tolerate the psychological demands may manifest as anxiety or claustrophobia. Source: US Army, Anniston Army Depot, Anniston, Ala.

THERMAL HAZARD - COLD

Generated in some chemical processes

Commonly used in storage and product life extension

Common environmental hazard

Has localized and systemic effects

THERMAL HAZARD - COLD INJURIES

Frostnip

Frostbite

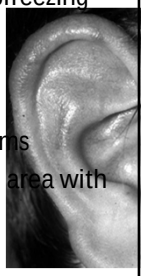
Immersion Foot

Chilblains (Pernio)

Hypothermia

Frostnip

- *Reversible* injury due to exposure to subfreezing conditions.
- First stage of frostbite
- Skin turns red and feels very cold
- May feel pain and tingling as skin rewarms
- Can be treated by warming the affected area with an unaffected hand or a warm object.

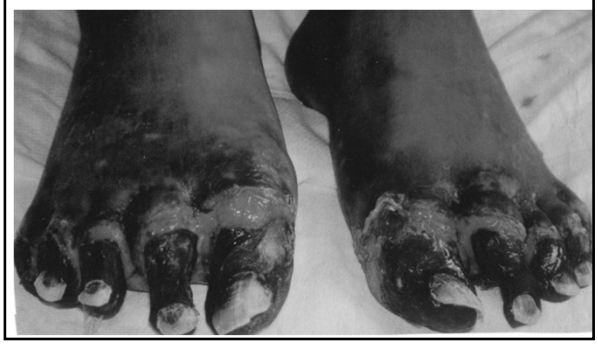


Frostbite

- *Injury due to freezing of tissue cells.*
- Frostbite of extremities occurs in extreme cold, especially at high altitude, and is aggravated if core temperature is subnormal, even though hypothermia may not be apparent.
- Ice crystals form within or between tissue cells. Vasoconstriction occurs to reduce heat loss from skin and peripheral tissues. Much of the damage occurs during rewarming (reperfusion injury).
- The affected area is cold, hard, white, and anesthetic; when warmed, it becomes blotchy red, swollen, and painful. Blisters form within 4 to 6 h. If filled with clear serum and located distally on the digits, blisters indicate superficial damage; if blood-filled and proximal, they indicate deep damage and tissue loss. Freezing of deeper tissue causes dry gangrene and less commonly wet gangrene. All degrees of frostbite may produce long-term symptoms--sensitivity to cold, excessive sweating, faulty nail growth, and numbness.

Frostbite

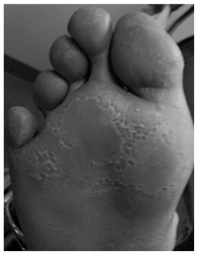
Gangrene



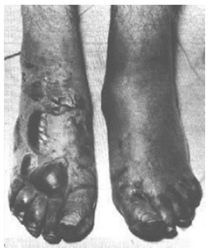
Immersion Foot (Trench Foot)

- *Injury due to prolonged exposure to wet cold at temperatures above freezing.*
- Immersion (trench) foot causes soggy edema, blotchy cyanosis, paresthesias, and pain due to autonomic dysfunction.
- 3 clinical stages
  1. Ischemic
  2. Hyperemic
  3. Posthyperemic (recovery)
- Hyperhydrosis may persist for years

Immersion Foot



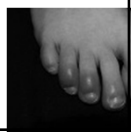
Mild



Severe

Chilblains (Acute Pernio)

- Result of exposure to cold or dampness
- Painful erythematous, pruritic skin lesions caused by inflammation
- Prolonged exposure can lead to chronic pernio or "blue toes"
- Scarring, fibrosis and atrophy can follow



Hypothermia

- *A generalized lowering of body temperature.*
- Hypothermia results from prolonged exposure to any temperature when body heat loss is greater than heat production. Hypothermia is most common during cold weather or immersion in water, but it may occur on a summer day or in warm climates if metabolic and exertional heat (shivering) cannot sustain core temperature.
- Hypothermia causes physiologic deceleration of all functions.
- The falling core temperature leads to lethargy; clumsiness; mental confusion; irritability; hallucinations; slowed or arrested respiration; and slowed, irregular, and, finally, arrested heartbeat. However, a victim should not be considered dead until he has been warmed. Ordinary clinical thermometers cannot measure the very low core temperature of hypothermia; a special low-temperature thermometer must be used. If only a standard clinical thermometer is available, failure of the mercury to rise above 34° C (93.2° F) indicates hypothermia.

THERMAL HAZARD - COLD

Engineering

Administrative

Personal/Safe Work Practices

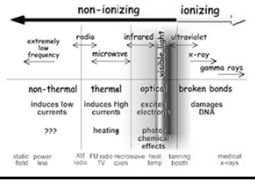
Personal Protective Equipment

	Actual Temperature (°F)											
	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
Wind Speed (mph)	Equivalent Chill Temperature (°F)											
Calm	50	40	30	20	10	0	−10	−20	−30	−40	−50	−60
5	48	37	27	16	6	−5	−15	−26	−36	−47	−57	−68
10	40	28	16	3	−9	−21	−33	−46	−58	−70	−83	−95
15	36	22	9	−5	−18	−32	−45	−58	−72	−85	−99	−112
20	32	18	4	−10	−25	−39	−53	−67	−82	−96	−110	−124
25	30	15	0	−15	−29	−44	−59	−74	−89	−104	−118	−133
30	28	13	−2	−18	−33	−48	−63	−79	−94	−109	−125	−140
35	27	11	−4	−20	−35	−51	−67	−82	−988	−113	−129	−145
40	26	10	−6	−22	−37	−53	−69	−85	−101	−117	−132	−148
Wind speeds > 40 mph have little additional effect	Little Danger (in < 5 h with dry skin; greatest hazard is from false sense of security)				Increasing Danger (exposed flesh may freeze within 1 min)				Great Danger (exposed flesh may freeze within 30 sec)			

Fig. 4-5. Potential heat loss, skin cooling, and lower internal temperature can be increased by air movement. The wind-chill index integrates windspeed and air temperature to estimate associated risk of cold injury. The wind-chill temperature index is the equivalent still-air (no wind) temperature that would produce the same heat loss on bare skin. A full description of the medical aspects of military operations in the cold is the subject of US Army Research Institute of Environmental Medicine (USARIEM) Technical Note 92-2, *Sustaining Health and Performance in the Cold*. Source of chart: US Army Research Institute of Environmental Medicine Technical Note 92-2. *Sustaining Health and Performance in the Cold: Environmental Medicine Guidance for Cold-Weather Operations*. Natick, Mass: USARIEM; July 1992: 37.

Radiation

- Ionizing
  - Alpha
  - Beta
  - Gamma
- Nonionizing
  - Microwave
  - Radiofrequency
  - Ultraviolet
  - Laser



IONIZING RADIATION

- Multiple uses in industry, including medical
- Can be byproduct of certain processes
- Exposed workers include those in Nuclear Industry, Medicine, Uranium Miners and the Military
- NRC (Nuclear Regulatory Commission) develops regulations governing nuclear reactor and nuclear material safety
- EPA and OSHA also involved in standards

Ionizing Radiation

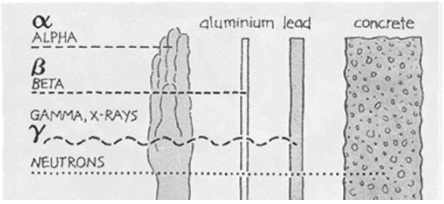
- Harmful sources of ionizing radiation include high-energy x-rays used for diagnosis and therapy, radium and other naturally occurring radioactive materials (e.g., radon), nuclear reactors, cyclotrons, linear accelerators, alternating gradient synchrotrons, sealed cobalt and cesium sources for cancer therapy, and numerous other artificially produced radioactive materials used in medicine and industry.
- Large amounts of radiation have accidentally escaped from reactors several times--e.g. the well-publicized accidents at Three Mile Island in Pennsylvania in 1979 and at Chernobyl in the Ukraine in 1986. The latter resulted in > 30 deaths and many radiation injuries; significant radiation was detected in most of Eastern Europe and in parts of Western Europe, Asia, and the USA. Most recently Japan.

Ionizing Radiation

- Ionizing radiation (e.g., x-rays, neutrons, protons, alpha or beta particles, gamma rays) damages tissue directly or by secondary reactions. High doses of radiation can produce observable somatic effects within days. Many years later, DNA changes due to smaller doses may lead to chronic disease in exposed persons or to a genetic defect in their offspring. Relationships between the degree of damage and the healing or death of a cell are complex.
- Commonly used units of measurement are the roentgen, gray, and sievert. The roentgen (R) is the amount of ionizing radiation in air. The gray (Gy) is the amount of energy absorbed by a tissue or substance and applies to all types of radiation (1 gray=100 rads).

Ionizing Radiation

- Alpha
- Beta
- Gamma



IONIZING RADIATION
Alpha

Highly active, short penetrating

Internal hazard only

Cell damage within 50 υm only

IONIZING RADIATION
BETA

Intermediate acting

External and Internal Hazard

Cell damage to few millimeters

IONIZING RADIATION GAMMA/XRAYS

Highly Penetrating

External and Internal Hazard

Cell damage measured in cms

Radiation Pearls

- Rad: "Radiation Absorbed Dose"
- 1 rad = 0.01 Gy
- Rem: "roentgen equivalent in man"
  - Unit of dose, taking into account biological effects
  - Rem = rads x QF (quality factory which takes into account type of radiation)
- Flight from LA-NY = 2mREM
- Skull X-ray = 8mREM
- Max Occupational Dose = 5 REM

IONIZING RADIATION

Engineering

Administrative

Personal Work Practices

Personal Protective Equipment

NON-IONIZING RADIATION

- Microwave and Radiofrequency
- Ultraviolet
- Lasers

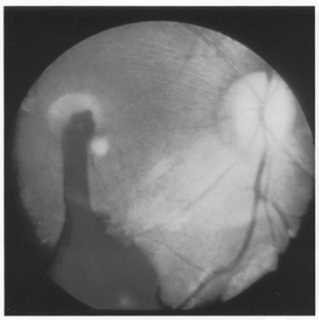


Fig. 8-18. Lasers, which destroy retinal tissue through to the vascular choroid, can cause hemorrhaging into the vitreous. Although the hemorrhage shown here will eventually be resorbed (albeit slowly), laser injuries involving the central macula usually do not have a good prognosis.

Noise

NOISE

Why is Noise Considered a Health Problem

- Hearing Loss
- Noise is generally viewed as being one of a number of general biological stressors.
- It is felt that excessive exposure to noise might be considered a health risk in that noise may contribute to the development and aggravation of stress related conditions such as high blood pressure, coronary disease, ulcers, colitis, and migraine headaches.
- There is also evidence suggesting that noise may be related to birth defects and low birth-weight babies.
- There are also some indications that noise exposure can increase susceptibility to viral infection and toxic substances.
- Used as a tactic in war: stressor

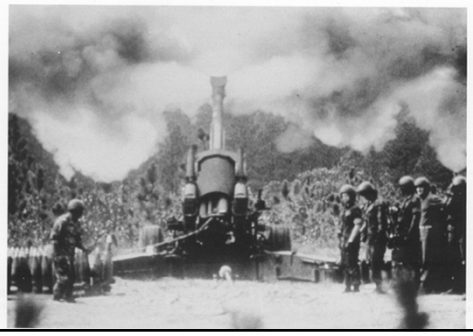
Noise and its Effects

Frequency (Db)	Effect
0	Threshold of Hearing
65	Average Human Conversation
85	Damage-Risk Limit
120	Threshold of Discomfort
140	Threshold of Pain
160	Eardrum Rupture

Impulse Noise

Weapon fire produces this type of noise. It is an explosive sound that builds rapidly to a high intensity and then falls off rapidly. Although the entire cycle usually lasts only milliseconds, this sound is detrimental to hearing when the intensity exceeds 140 decibels.

Impulse Noise



Noise - Auditory

- Noise induced hearing loss leading diagnosis for disability of occupationally related diseases
- Noise is ubiquitous in the work and outside environment
- Common exposures above acceptable levels (85dB on a 8 hour TWA; A scale)
- Hearing protection is least used form of personnel protective devices in workplace.

Noise - Auditory

- Caused by erosion of nerve hair sensors in inner ear
- Permanent
- Preventable in many cases
- OSHA requires ear protection and medical surveillance in work places with noise levels above 85dB (8 hour TWA)
- All permanent STS must be reported

Personal Protective Equipment

When worn alone, the SPH-4B Helmets reduce the noise exposure to safe limits for most aircraft in the Army inventory except for the UH-60 (Black Hawk) and CH-47 (Chinook).

Vibration Effects

- Vibration can cause short-term acute effects because of the biomechanical properties of the body.
- The human body acts like a series of objects connected by springs.
- The connective tissue that binds the major organs together reacts to vibration in the same way as springs do.
- When the body is subjected to certain frequencies, the tissue and organs will begin to resonate (increase in amplitude).
- When objects reach their resonant frequencies, they create a momentum, which increases in intensity with each oscillation.
- Without shock absorption, vibration will damage the mass or organ.

VIBRATION

Vibration-Induced White finger Disease (Hand-Arm vibration Syndrome)

- caused by segmental vibration of the hands
- usually frequencies of 125-300 Hz
- characterized by spasms of the digital artery caused by vibration
- Early symptoms: tingling followed by numbness
- Later: fingers turn white in the cold, followed by reactive hyperemia
- Advanced disease: degeneration of bone and cartilage

Anti-vibration Glove

Altitude

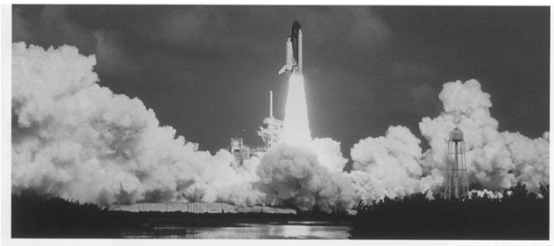


Fig. 10-9. The space shuttle Atlantis is shown being launched from the Kennedy Space Center, Florida, at 9:56 a.m. (EDT) on 31 July 1992. The large quantity of white smoke surrounding Launch Complex 39 is hydrogen chloride that was produced during combustion of the shuttle's perchlorate-based, solid rocket propellant. Photograph: Courtesy of National Aeronautics and Space Administration, Houston, Tex. 31 July 1991. Photograph STS046-(S)-082.

Altitude Hazards

- Humans readily adapt to changing pressures, however, we cannot respond quickly to these changes
- Biggest effect is on hollow organs and gas transport capability
- Issues in aviation and space industries
- Issues in diving, mining and tunnel industries

Decreased O_2 Tensions

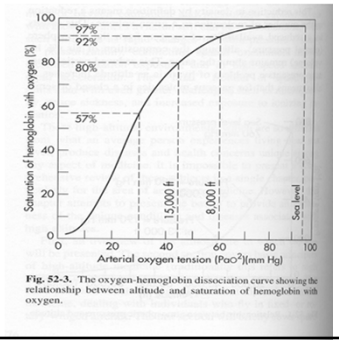
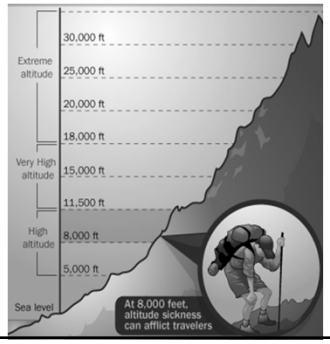


Fig. 52-3. The oxygen-hemoglobin dissociation curve showing the relationship between altitude and saturation of hemoglobin with oxygen.

Altitude



- 1500 – 3500m (4921 – 11483 ft) 'high altitude'
- 3500 – 5500m (11,483 – 18,045 ft) 'very high altitude'
- 5500 – 8850m (18,045 – 29,035 ft) 'extreme altitude'

Altitude Sickness -mountain sickness; soroche; puna; mareo.

- About 20% of persons ascending above 8000 ft (2500 m) in < 1 day develop some form of altitude sickness.
- Most persons acclimatize to altitudes of up to 10,000 ft (3000 m) in a few days. The higher the altitude, the longer full acclimatization takes. Above 17,000 ft (5100 m), deterioration is more rapid; no one can live at that altitude permanently
- Features of acclimatization include sustained hyperventilation with persistent partially compensated alkalosis, an initial increase in cardiac output (which is lower than normal maximum cardiac output), increased RBC mass, and increased tolerance for anaerobic work.
- HAPE and HACE are complications

HYPOXIA

- Hypoxia stimulates breathing, increasing tissue oxygenation but also causing respiratory alkalosis, which contributes to symptoms until loss of HCO_3 in urine partially compensates. The basic pathophysiology of altitude sickness is disturbance of water and electrolyte balance. Capillary permeability is increased, allowing fluid to accumulate in various locations; the cause is thought to be vascular endothelial damage. In susceptible persons, increased ADH secretion results in tissue fluid retention, and plasma volume is decreased, simulating an increase in Hct.

BAROTRAUMA

- In modern jet aircraft, the cabin pressure is equivalent to atmospheric pressure at 5000 to 8000 ft regardless of altitude.
- At such pressures, free air in body cavities expands by about 25%.
- Upper respiratory inflammation or allergy may result in obstructed eustachian tubes, and may result in barotitis media or barosinusitis. Facial pain of dental origin may occur when air pressure changes.

Increased Pressures

- A diver at 33 ft (10 m) in seawater is exposed to a pressure of 14.7 lb/sq in (760 mm Hg, 1 atm) higher than the barometric pressure at the surface. The total pressure at 33 ft is 2 atm, which is the weight of the water plus the barometric pressure at the surface. Every additional 33 ft of descent adds 1 atm. The pressure in a caisson or tunnel (in which compressed air is used to exclude water from the work site) reflects the pressure of the water outside.

Increased Pressures

- Deep-sea and scuba (self-contained underwater breathing apparatus) divers can develop medical problems due to high pressure, as can construction workers in tunnels or caissons (pressurized work areas). A patient with almost any disorder that develops during or especially after exposure to high pressure may have decompression illness (arterial gas embolism or decompression sickness) and urgently needs recompression. Physicians who see such patients must be alert for these problems and may seek advice from the Divers Alert Network (DAN), coordinated by the Duke University Medical Center, at any hour (919-684-8111).

Physical Trauma

- The workplace has many directly hazardous processes and operations
- Injuries due to falls, crushes, lacerations, lifting & contact with moving objects are by far the most common
- Foreign bodies most common eye problems in industry (e.g.: grinding, hammering)
- Ergonomic Injuries becoming more common
- Workplace violence

Personal Protective Equipment

Fig. 8-23. Face shields (secondary protectors) are designed to protect the entire face. They must be worn over industrial safety glasses, as pictured here, or chemical goggles (American National Standards Institute [ANSI] Z87.1–approved primary eye protectors).

Penetrating Eye Trauma

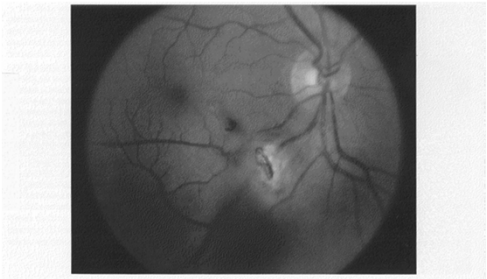


Fig. 8-8. Foreign bodies often have sufficient velocity to perforate the cornea or sclera—passing through internal structures such as the aqueous, iris, and vitreous—and can penetrate the lens or retina. Workers may not be fully aware that they have suffered an eye injury; the only visible signs may be some minor redness of the eye or an additional hole in the iris. These workers must be referred for evaluation and possible surgical treatment immediately. Industrial safety glasses might have precluded this injury.

Penetrating Eye Trauma

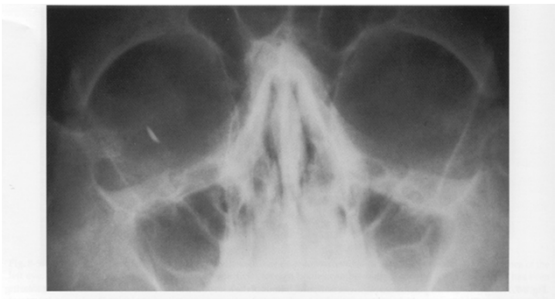


Fig. 8-9. Whenever a worker suspects that a penetrating eye injury has occurred, he or she should be referred for radiography and further evaluation. The penetrating metallic foreign body in the right eye is easily seen in this radiographic (Water's) view. Photograph: Courtesy of David Talley; formerly, Redstone Arsenal, Huntsville, Alabama.

WHY ARE ERGONOMICS IMPORTANT?

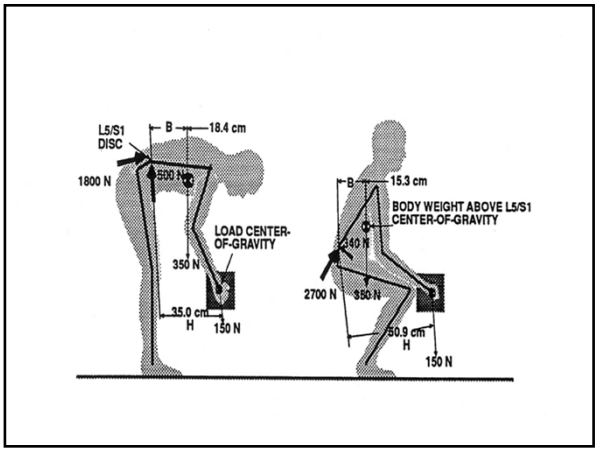
- Injury & Illness Prevention
- Quality of Life
  - Fully participating in favorite activities and sports
  - Picking up children/grandchildren
- Cost savings to the business
  - Direct costs - Medical treatments
  - Lost time pay
  - Indirect costs - Substitute workers

http://www.osha.gov/SLTC/ergonomics/guidelines.html

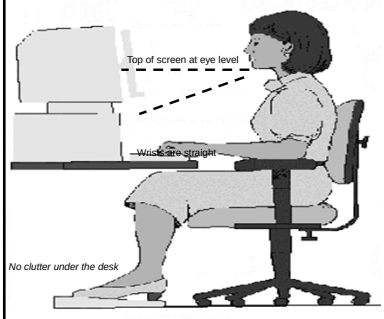
CURRENT ERGONOMIC GUIDELINES

Guidelines are voluntary but a company can be cited by OSHA under the General Duty clause if an ergonomic hazard exits without an attempt to correct it whether or not a standard exists for that industry

- Shipyards industry, February 28, 2008
- Poultry processing industry, September 2, 2004
- Retail grocery stores industry, May 28, 2004
- Nursing home industry on March 13, 2003



WORKSTATION INVENTORY: Example of Proper Positioning



Adjust workstation so that angles of body are approximately 90º

Neck not flexed

Arms supported

Seat back supports lazy "S "curve of spine

Adjust chair so that thighs are parallel to floor and feet are flat on floor or a footrest

Thighs fully supported, chair seat doesn 't hit back of legs

http://www.osha.gov/SLTC/etools/computerworkstations/index.html

Electrical Injuries

- Electrical burns result from the generation of heat, which may reach 5000° C (9032° F). Because most of the resistance to electric current occurs where the conductor contacts the skin, electrical burns usually affect the skin and subjacent tissues; they may be of almost any size and depth. Progressive necrosis and sloughing are usually greater and affect deeper tissues than the original lesion indicates. Electrical injury, particularly from alternating current, may cause immediate respiratory paralysis, ventricular fibrillation, or both

Electrical - Continued

- The type of current affects the severity of the injury. DC tends to cause a convulsive contraction, often forcing the victim away from the current's source. AC at 60 Hz (household current) produces muscle tetany, often freezing the hand to the current's source
- Generally, the higher the voltage and amperage, the greater the damage from either type of current.
- Body resistance - If skin resistance is low, few, if any, extensive burns occur. If skin resistance is high, much energy may be dissipated at the surface as current passes through the skin, and large surface burns can result at the entry and exit points, with charring of tissues in between

Thank YOU

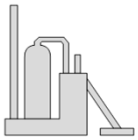
Thank You!

Dr. G

Dr. Clark Contact 210-289-8607

ENVIRONMENTAL HEALTH ISSUES…….PLASTICS

Mike Carson, D.O., MPH



American Osteopathic College of Occupational and Preventive Medicine

OBJECTIVES

By the end of the lecture the occupational physician will have:

Basic understanding of –
- approach to plastics.
- of exposure potential of plastics.
- toxicity of plastics.

Improved understanding of –
- major plastics.
- special testing, if available, to monitor for plastics exposure.

INTRODUCTORY PRINCIPLES & CONCEPTS

- ROUTE INTO BODY (Portal of Entry)
  - Inhalation (Lung)
  - Dermal Contact (Skin Absorption)
  - Ingestion (Gastrointestinal Tract)

AGENT TYPES

- CHEMICAL
  - Metals
  - Solvents
  - Dusts
  - Pesticides
  - Irritant Gases
  - Asphyxiant Gases
  - Plastics

Approach to Plastics

- Basic understanding
- Recognition of exposure opportunities
- Knowledge of documented hazards
- Appreciation of deficiency in current scientific data

Plastics- Key Principles

- SYNTHESIS - commonly more toxic monomers, less toxic polymers
- COMPOUNDING with additives modify the toxicity profile
  - Organic & epoxy plasticizers/stabilizers & fillers/fibers
  - Flame retardants- e.g. PBDE
- FABRICATION
  - Heat/pressure, molding & blowing
  - Cutting & grinding
- COMBUSTION/DEGRADATION
  - All will decompose to new materials and by-products

MAJOR PLASTICS

Thermosets- 25% decompose when heated

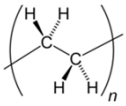
- Amino resins
- Polyurethane
- Polyesters
- Epoxy resins

Thermoplastics- resist heat

- Acrylics
- Polyamides (nylon)
- Fluoropolymers (Teflon)
- Polyethylene
- Polyvinyl chloride
- Polypropylene

Polyethylene

- What is it?- The most common basic plastic (80M metric tons / yr), ethylene addition polymer
- Exposure – Inhalation of Vapors during thermal processing
- Toxicity
  - Highly flammable
  - Thermal degradation produces CO (simple asphyxiant poison), formaldehyde & acrolein (occupational asthma & irritant)
- Special Tests - None

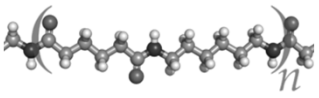


Acrylics

- What are they? Broad category of elastomers and polymers, resistant to breakage- elasticicity', made of acrylic acid esters,
- Exposure - Inhalation & Skin
- Toxicity
  - Allergic & sensitization dermatitis
  - Skin, respiratory & mucus membrane irritant
  - HA & finger parasthesia with methyl methacrylate
- Special Tests - Skin patch tests, neurological & respiratory exams

Polyamides (nylon)

- What is it? Copolymer of diamine and dicarboxylic acid, fiber applications in apparel, solid applications mechanical parts
- Exposure - Inhalation & Skin
- Toxicity
  - Allergic & irritant dermatitis (from azo dyes)
  - Respiratory sensitization & asthma (nylon flock)
  - Bladder cancer (1 study)
- Special Tests - None

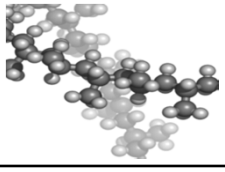


Fluoropolymers (Teflon)

- Exposure – Inhalation of vapors during thermal processing, environmental exposure- cookware?
- Toxicity
  - Solvent narcosis with fluoro-polymer resin "airing off"
  - Thermal degradation products of polytetra-fluoroethylene (PTFE) causes polymer fume fever (12-24 hr post-exposure chills, malaise, cough, SOB)
  - PFOA (perflourooctanoic acid), used in production, was detected in some PTFE products
- Special Tests - None

Polypropylene

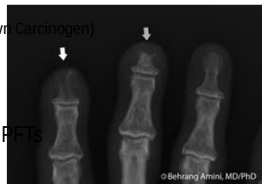
- Polymer- Propylene addition, resists solvents, acids
- Exposure - Inhalation
- Toxicity
  - Highly flammable
  - Thermal degradation products cause asphyxiation & respiratory irritation
  - Additives (biocides)
- Special Tests - None



Vinyl chloride (VC)

- Production: base for PVC- colorless gas

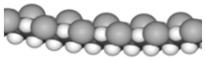
- Exposure - Inhalation
- Toxicity
  - Acute, massive (narcosis & hepatitis)
  - Chronic
    - IARC classification – group 1 (known Carcinogen)
    - Liver angiosarcoma
    - Acro-osteolysis of phalanges
    - Raynaud's phenomenon



- Special Tests - Liver functions, PFTs

Polyvinyl chloride (PVC)

- Long chain polymer of VC- solid hard plastic
- Plasticizers add flexibility
- Toxicity- Polyvinyl chloride
  - Meat wrappers asthma- possibly from Phthalic anhydride from heated labels
  - Irritant due to PVC thermal byproducts
  - Reports of scleroderma & pulmonary fibrosis with PVC dust



Amino resins

- What are they? Polymer resins of aldehyde and amines, adhesives and coatings for paper and textiles
- Exposure - Inhalation & Skin
- Toxicity
  - Allergic & sensitization dermatitis
  - Respiratory & mucus membrane irritant
  - Systemic HA, N&V, fatigue with urea-formaldehyde insulation
  - Thermal degradation products (CO, formaldehdye, ammonia & cyanide) cause irritation & asphyxia
- Special Tests - Skin & respiratory exams

Epoxy resins

- What is it? Polymer of epoxide 'resin' and polyamine ' hardener', wide application in adhesives, paint, circuit boards, coatings
- Exposure - Inhalation & Skin

- Toxicity
  - Allergic dermatitis
  - Asthma- respiratory sensitization
  - Bisphenol A- endocrine disruption?
- Special Tests - Skin & respiratory exams

Polyurethane

- What is it?- reaction polymer of isocyanate and hydroxyl , foam, insulation, apparel, many uses, chemically inert once reacted
- Exposure - Inhalation & Skin
- Toxicity- MDI, TDI
  - Respiratory sensitization & asthma
  - Corneal burns
  - Allergic & irritant dermatitis
  - Thermal degradation products (isocyanates, hydrogen cyanide, CO) cause pulmonary asphyxia
  - Irritation
  - COPD
- Special Tests - Skin patch tests; respiratory exams & PFTs

Polyesters

- What is it? Polymer with ester in main chain, polycarbonates, polyethylene terephthalate (PET), for fabrics, cushions, spray films, LCDs, filters
- Exposure - Inhalation & Skin
- Toxicity
  - Low toxicity
  - Limited respiratory & dermatological irritant & sensitization
  - Fibers in lung tissue
- Special Tests - None

Plastic additives

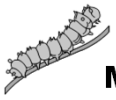
- Types
  - Plasticizers, colorants, fillers, foaming/blowing agents, flame retarders, stabilizers
- Exposure
  - Depends on agent (includes asthma, allergic contact dermatitis, skin & respiratory irritation)
- Toxicity - Depends on agent
- Special Tests - Depends on agent

Environmental Trends

Plastics: from environmental problems to environmental solutions

- Recycle
- Energy and Insulation applications
- Biodegradable plastics

ENVIRONMENTAL HEALTH ISSUES.....PESTICIDES



Mike Carson, D.O., MPH

OBJECTIVES

By the end of the lecture the occupational physician will have:

Basic understanding of –

- approach to pesticides.
- of exposure potential of pesticides.
- toxicity of pesticides.

Improved understanding of –

- major pesticides.
- special testing, if available, to monitor for pesticide exposure.

INTRODUCTORY PRINCIPLES & CONCEPTS

- ROUTE INTO BODY (Portal of Entry)
  - Inhalation (Lung)
  - Dermal Contact (Skin Absorption)
  - Ingestion (Gastrointestinal Tract)

AGENT TYPES

- CHEMICAL
  - Metals
  - Solvents
  - Dusts
  - Pesticides ✓
  - Irritant Gases
  - Asphyxiant Gases
  - Plastics

Pesticides- Key OH Principles

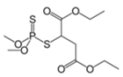
- Intended to be biologically active and 'hazardous' to a pest (think antibiotics)
- Species specific selective effects
- Highly researched, highly regulated (FIFRA)- US EPA authorized to suspend / cancel registration of any pesticide
- Acute toxicity may require advance planning (e.g. antidotes)

PESTICIDE TYPES

- Insecticides
- Fungicides
- Herbicides
- Rodenticides

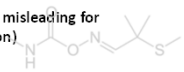
Insecticides

Organophosphates (#1): malathion, chlorpyrifos, many
- Exposure - Inhalation & Skin absorption & Ingestion
- Acute Toxicity –
  - Inhibits acetylcholinesterase- producing continuous stimulation of cholinergic fibers.
  - Produces muscarinic effects (saliva, lacrimation, urination, diarrhea, & respiratory secretions)
  - Nicotinic toxicity (muscle fasciculation, muscle weakness & paralysis)
  - CNS- headache, respiratory depression, incoordination
- OPIDN- Organophosphate Induced Delayed Neuropathy
  - Mainly afferent neuropathy in legs
  - Weeks to months or longer
- Intermediate Syndrome
  - Delayed 24-96 hours, respiratory and muscle paresis, cranial nerve palsies
- Special Tests –
  - Serum & RBC cholinesterase (do not delay treatment)



Insecticides

N-Methyl Carbamates : aldicarb, fenoxicarb, many, also effective nematocides- plant parasitic nematodes
- Exposure –
  - Inhalation, Skin absorption & Ingestion
- Toxicity –
  - short-acting acetylcholinesterase inhibitors.
  - Similar to organophosphates except: AchE inhibition is reversible, less bradycardia, less penetration of CNS
- Special Tests –
  - Serum & RBC cholinesterase (may be **misleading for** carbamates due to in vitro reactivation)



Insecticides

Organochlorines (e.g. DDT) : restricted by EPA due to persistence and bioaccumulation, remaining: lindane
- Exposure –
  - Inhalation, Skin absorption & Ingestion
- Toxicity –
  - Interfere with axionic transmission of nerve impulses- CNS effects, seizures
  - Fat-stored; slow half-life.
  - Kidney & liver disease.
  - Some carcinogenic, teratogenic & mutagenic.
- Special Tests –
  - Blood, serum & fats analysis

Insecticides

Pyrethrins : organic derivatives of chrysanthmum
- Exposure –
  - Inhalation, Skin absorption & Ingestion
- Toxicity – not neurotoxic in humans
  - Dermatitis
  - Pulmonary sensitization
  - Anaphylactoid reaction
- Special Tests –
  - Skin testing for sensitivities

Herbicides

Chlorophenoxy: most widely used commercial broadleaf control, hundreds of products, classic is 2,4-D

- Exposure –
  - Inhalation, skin absorption, ingestion
- Toxicity
  - Moderate skin irritation
  - Intentional ingestion has resulted in metabolic acidosis, vomiting, weight loss, and CNS, hepatorenal dysfunction
  - Extensive Chronic low level studies in farmers, manufacturers
- Special Tests –
  - Some compounds measured in blood & urine

Herbicides

Paraquat: non-selective, highly effective, but restricted in US due to toxicity

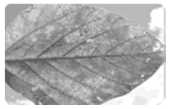
- Exposure - Inhalation, skin absorption, ingestion
- Toxicity- high acute toxicity
  - Ingestion associated with ARDS, in suicides
  - Severe myocardial, hepatic & renal dysfunction
  - Irritation of eyes, mucous membranes & skin
  - Parkinson's in farm workers (NIH study 2011)
- Special Tests
  - None

Fungicides

Fungicides protect seed and crop during storage and in field from mildews, spores- e.g. soybean rust destroyed 80% of LA crop in 2004

Older Fungicides- e.g. Organomercury- no longer registerd by EPA due to toxicity

- Exposure –
  - Inhalation, skin absorption, ingestion
- Toxicity –
  - Alkylmercury compounds cause CNS depression (paresthesias, ataxia, spasticity)
  - Irritation to skin, eyes and mucous membranes
  - Vision & hearing impairment
  - Emotional disturbances
  - Dermatitis



Fungicides

- Creosote: coal tar derivative, main use is wood preservative
  - Exposure –
    - Rapid skin absorption, inhalation, ingestion
  - Toxicity
    - Irritation to skin, eyes and upper respiratory system
    - CNS- confusion, seizures, hyperpyrexia
    - Probable Carcinogen per US EPA and IARC
  - Special Tests –
    - None

Fungicides

Strobilurin compounds: azoxystrobin- #1 fungicide worldwide

- Exposure –
  - Inhalation, skin absorption, ingestion
- Toxicity
  - Irritation of eyes, mucous membranes & skin
  - Skin sensitization is primary finding with modern fungicides
- Special Tests –
  - not readily available

Rodenticides

- Anticoagulants: warfarin, idandiones
  2nd gen: difencoum, difethialone 'superwarfarins'
  - Exposure –
    - Ingestion
  - Toxicity
    - Hypoprothrombinemia
    - Vascular injury resulting in hemorrhage
  - Special Tests –
    - Blood prothrombin time prolonged

Rodenticides

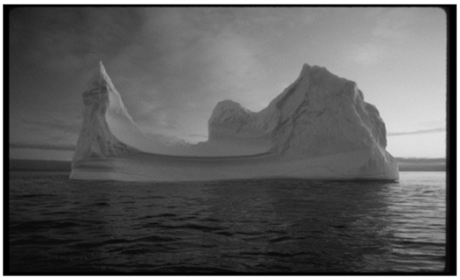
Metal Phosphides: cheaper and works for rodents resistant to anticoagulations, no risk of secondary kill

- Exposure –
  - Ingestion
- Toxicity
  - Deep thermal burns
  - Reaction with water in gut release phosphine gas- ventilate area
  - Ingestion causes severe gut injury & peripheral liver necrosis
- Special tests –
  - not useful

Environmental Trends

- Reduced toxicity
- Shorter ½ life before degradation
- Non bioaccumulative
- Natural pesticides
- Low level farm hand exposure studies
  - Primary workers
  - Secondary exposures- farm families

TIP OF THE ICEBERG



OCCUPATIONAL DERMATOSES

Basic Course in Occupational Medicine
Part II
Liz Clark, D.O., MPH & TM, FAOCOPM

American Osteopathic College of
Occupational and Preventive Medicine

Learning Objectives:

- To better understand the epidemiology and economic impact of Occupational Dermatoses
- To review medical definitions and terminology order to better describe Occupational Dermatoses
- To review the proper way to examine the skin in order to more effectively assess Occupational Dermatoses

Learning Objectives Cont'd

- To review effective history taking techniques in order to more effectively diagnose Occupational Dermatoses.
- To review the common clinical morphologic patterns of Occupational Skin Disease and their etiologic causes
- To review preventive strategies to prevent Occupational Skin disorders

Introduction

- Skin is the most prominent interface between the worker and the environment
- Largest organ of the body - 15% of the total body weight
- Marked size and exposure causes increase vulnerability to occupational injury and diseases

Definitions

- Occupational Skin Disease - any abnormality of the skin *induced* or *aggravated* by the work environment
- Dermatitis - describing a skin disease as having an inflammatory component involved in its pathogenesis
- Dermatosis - describes a skin disease from any cause including inflammatory and non-inflammatory causes

Epidemiology

- Occupational skin diseases and disorders are the most common non-trauma occupational illness
- Skin diseases account for approximately 30-45% of all occupational illnesses
- Bureau of Labor Statistics (BLS) data 2009 estimated that greater than 15% of occupational injury/illness was due to skin diseases (estimated that total number of occupational skin disorders may be 10-50 times greater than what BLS is able to estimate)

Epidemiology "Cont'd"

- Affects approximately one worker per thousand in private sector. Annual incidence rate in 1993 by the BLS was 76 cases per 100,000 workers
- Greatest number of cases of occupational skin disease are seen in manufacturing industry but the highest *incidence rate* is seen in the agriculture/forestry/fishing industry
- BLS data reveals that approximately 20% of all occupational skin disease result in days away from work with a median work absence of 3 days

Epidemiology Cont'd"

- Economic cost is a result of:
  - medical costs
  - lost work time
  - rehabilitation cost
  - worker's compensation litigation
  - re-hiring and training new workers

Epidemiology "Cont'd"

- Only 1/3 of U.S. workforce is employed in large place facilities which are more likely to have a comprehensive occupational health program
- 2/3 of U.S. workers employed by small companies employing less than 500 workers. Incidence rates of occupational diseases are higher in these facilities usually due to lack of comprehensive health programs.

Evaluation of Occupational Dermatoses

- Physicians engaged in evaluating occupational dermatoses should be familiar with:
  - importance of their appearance
  - causes
  - methods of evaluation
  - diagnosis
  - treatment
  - prevention

Evaluation of Occupational Dermatoses Cont'd"

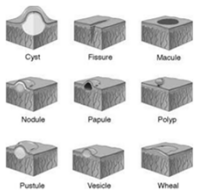
- It is crucial to evaluate a potential occupational skin disorder thoroughly
  - enables the worker to benefit from appropriate diagnosis and treatment
- Proper diagnosis is essential
  - may be difficult to change later
  - Wrong diagnosis may make the worker ineligible for many other positions in the same company or other industries

Types of Skin Lesions

- PRIMARY LESIONS
  - how skin diseases begin
  - key to accurate description and interpretation
- SECONDARY LESIONS
  - develop during the evolutionary process of the skin disease
  - may be created by scratching or infection

Primary vs Secondary

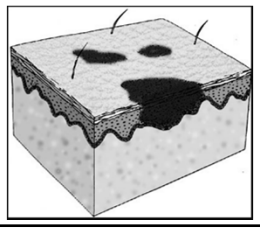
- Primary Lesions
  - Macule
  - Papule
  - Nodule
  - Vesicle
  - Petechiae
  - Patch
  - Plaque
  - Tumor
  - Bulla
  - Ecchymosis
  - Wheal
  - Pustule

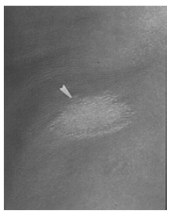


- Secondary Lesions
  - Atrophy
  - Crust
  - Erosion
  - Excoriation
  - Fissure
  - Lichenification
  - Scale
  - Scar
  - Telangestasia
  - Ulcer

Primary Lesions

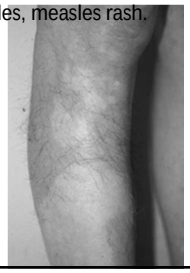
- Macule - up to 1 cm in size, circumscribed, flat discolorations of the skin.
  - Examples: freckles, flat nevi.





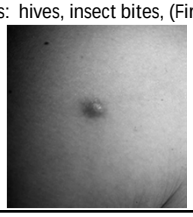
Primary Lesions

- Patch - larger than 1 cm, circumscribed, flat discolorations of the skin.
  - Examples: vitiligo, senile freckles, measles rash.



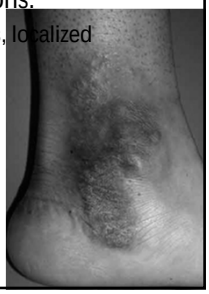
Primary Lesions

- Papule - up to 1 cm in size, circumscribed, elevated, superficial, solid lesions.
  - Examples: elevated nevi, warts, lichen planus
  - A wheal is a type of papule that is edematous and transitory.
  - Examples: hives, insect bites, (Fire Ant bite)



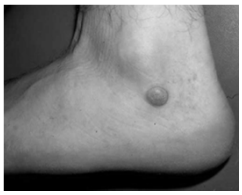
Primary Lesions

- Plaque - larger than 1 cm, circumscribed, elevated, superficial, solid lesions.
  - Examples: mycosis fungoides, localized neurodermatitis.



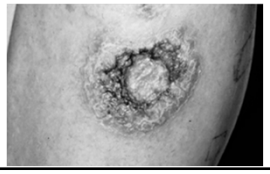
Primary Lesions "Cont'd"

- Nodule - range to 1 cm in size, solid lesions with depth; may be above, level with, or beneath the skin surface.
  - Examples: epitheliomas, xanthomas



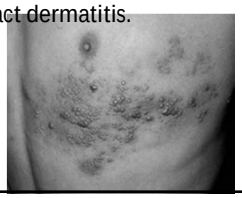
Primary Lesions "Cont'd"

- Tumor - larger than 1 cm, solid lesions with depth; may be above level with, or beneath the skin surface.
  - Examples: tumor stage of mycosis fungoids, larger epitheliomas



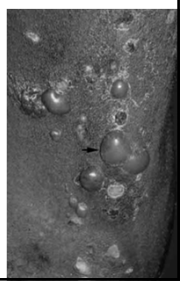
Primary Lesions Cont'd"

- Vesicle - range to 1 cm in size and are circumscribed elevations of the skin containing serous fluid.
  - Examples: early chickenpox, zoster, contact dermatitis.



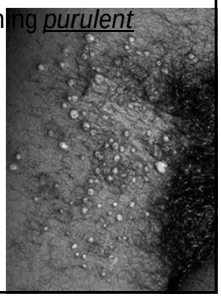
Primary Lesions

- Bullae - larger than 1 cm, circumscribed elevations of the skin containing serous fluid
  - Examples: pemphigus, *second-degree burns*



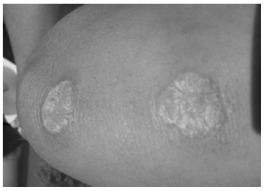
Primary Lesions "Cont'd"

- Pustule - vary in size, circumscribed elevations of the skin containing *purulent* fluid.
  - Examples: acne, impetigo



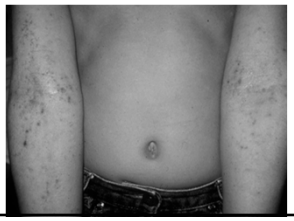
Secondary Lesions

- Scales - shedding, dead epidermal cells that may be dry or greasy
  - Examples: dandruff, psoriasis



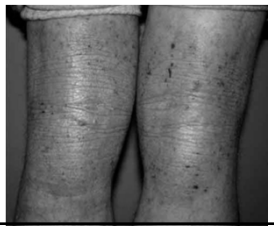
Secondary Lesions

- Excoriation - abrasions of the skin, usually superficial and traumatic
  - Examples: scratched insect bites, scabies



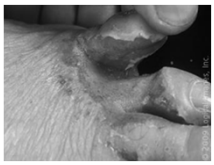
Secondary Lesions "Cont'd"

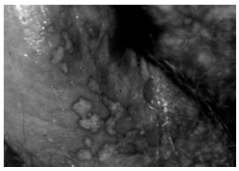
- Lichenification - diffuse area of thickening and scaling with resultant increase in skin lines and markings.



Secondary Lesions

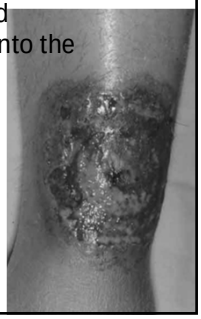
- Erosion - loss of all or part of the epidermis





Secondary Lesions

- Ulcer - irregularly sized and shaped excavations in the skin extending into the dermis as well as the epidermis
  - Examples: stasis ulcers of legs



History Taking in the Evaluation of Occupational Dermatoses

- When did lesions begin
- Where did lesion begin
- What do you do (occupation)
- Previous jobs held
- Current part-time jobs
- Changes in rash symptoms when away from work
- What does patient believe is the cause

History Taking in the Evaluation of Occupational Dermatoses "Cont'd"

- Any co-workers with similar complaints
- Any recent changes in the workplace

History Taking in the Evaluation of Occupational Dermatoses "Cont'd"

- Description of workplace and workplace activities
  - Any MSDS's available?
- Previous contact allergies
- Current self-treatments
- Hobbies
- Current medications

Skin Examination

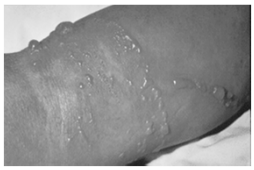
- Well-lighted room
- In order to understand the effects of various occupational agents on the skin, a concept of its barrier function is needed.
- The skin consists of three major units:
  - Epidermis
  - Dermis: includes follicle, sweat gland
  - Subcutaneous fat

Skin Examination

- Examine all of the skin surface
- Regional inspection
  - Begin at a distance
    - Distribution
    - Grouping
    - Stage of the lesions
- Lesion inspection

Clinical Morphologic Patterns of Skin Disease and Their Occupational Causes

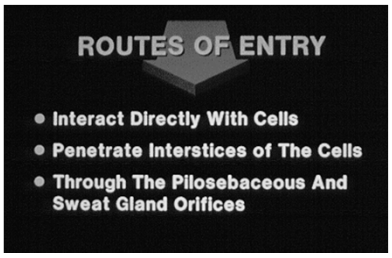
Acute Contact Dermatitis



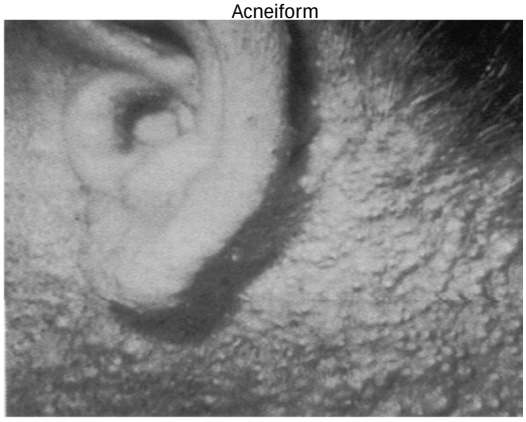
Contact Dermatitis

- Irritant or allergic contact dermatitis
  - Acute - blistering reactions
    - e.g. hydrofluoric acid (HF), ethylene oxide
  - Chronic - rough scaling and thickened skin
    - e.g. chronic turpentine exposure or solvent exposure, rubber compounds

Routes of Entry

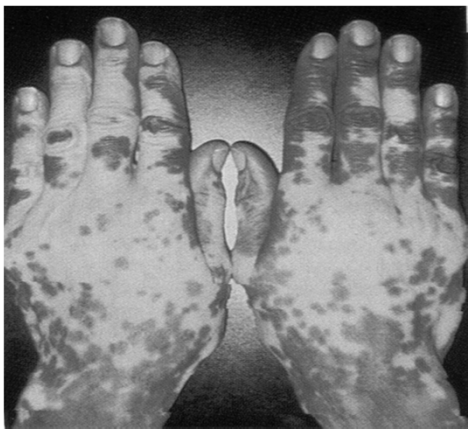


Acneiform



Acneiform

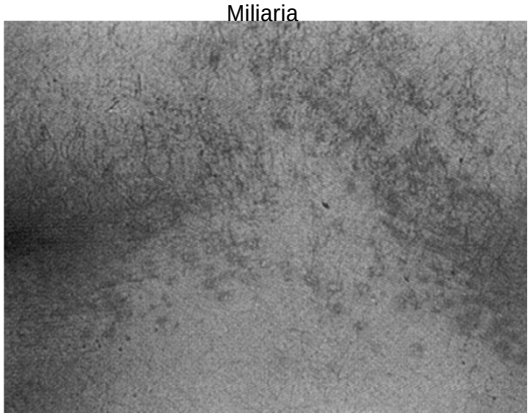
- Cosmetic Acne
  - Actors, models and cosmeteologists
- Oil Acne and Folliculitis
  - Machine operators, food service workers, roofers, pavers
- Ultraviolet Acne
  - Models and lifeguards
- Acne Mechanica
  - Truck drivers, those with frequent use of respirators
- Chloracne - characterized by straw-colored cysts on face (face and genitalia mostly affected)
  - Exposure to halogenated chemicals, especially dioxin, found in herbicides



Pigmentation Changes

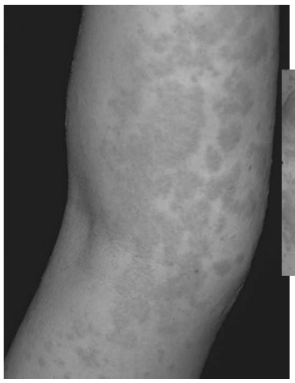
- Hypopigmentation
  - E.g. some phenolic compounds - especially hand involvement
- Hyperpigmentation
  - E.g. any inflammatory process, especially in dark-skinned individuals

Miliaria



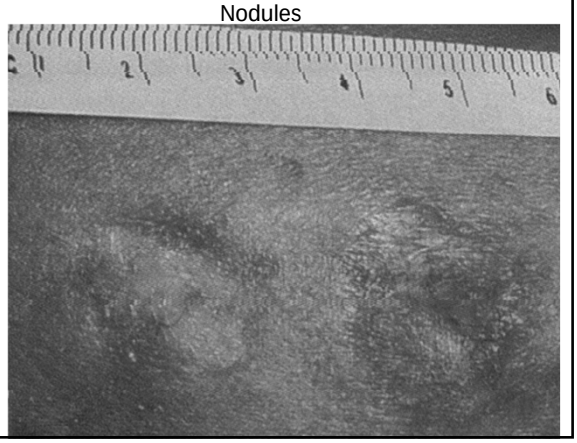
Miliaria

- Diffuse papulovesicular eruption
  - usually trunk and intertriginous areas
    - from excessive heat exposure


Urticaria

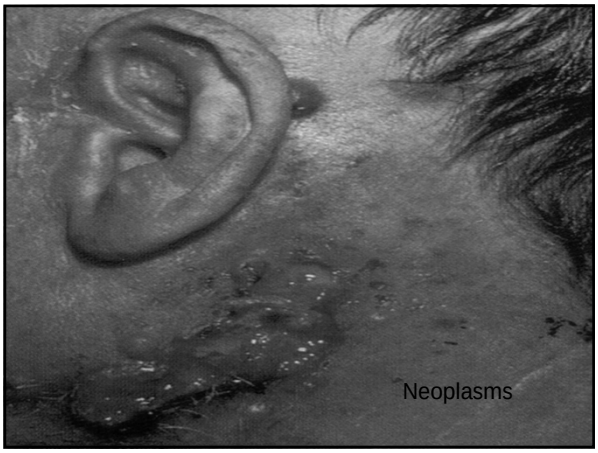
Urticaria

- Local or generalized hives
  - E.g. latex allergy


Nodules

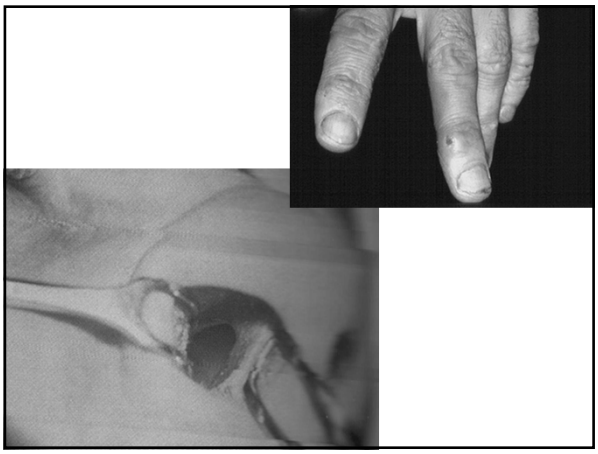
Nodules

- Foreign body (e.g. Silica, fibrous glass)
- Allergic (beryllium)
  - Predisposed workers will form granulomas in multiple tissues, similar to sarcoidosis
- Fibrous glass dermatitis
  - May form wart-like lesions. More common in newly exposed workers. May treat using cellophane tape. Tollerance will usually devolop.
- Infectious
  - Classic lesions of sporotrichosis are nodular


Neoplasms

Neoplasms (Tumors)

- Squamous cell carcinoma (SCC)
  - Ultraviolet light
  - Ionizing radiation
  - Arsenic (systemic or topical)
  - Polyaromatic Hydrocarbons
- Basal cell carcinoma (BCC)
  - Ultraviolet light and arsenic
- Malignant melanoma



Ulcerations

- Chromium (metal)
  - Exposure to fumes happens in the production of stainless steel
  - Chronic exposure may cause erosion of the nasal septum
  - Chrome holes are painless erosive ulcerations usually found on the fingers, knuckles and forearms

Direct Causes of Occupational Dermatoses

- 4 direct causes of occupational dermatoses, in order of frequency;
  - Chemical
  - Mechanical
  - Physical
  - Biological

Irritant Contact Dermatitis

- 80% of all occupationally caused contact dermatitis
- Caused by substances that damage the skin at the site of contact by non-immunologic mechanisms
- Many factors contribute to irritant reactions:

Irritant Contact Dermatitis "Cont'd"

- Potential Irritant(s):
  - Chemical properties
  - Physical properties
- Quantitative Aspects of Exposure
  - Concentration
  - Duration of exposure
  - Frequency and number of exposures
- Qualitative Aspects of Exposure
  - Occlusion of substance against skin
  - Temperature of substance on skin surface
  - Pre-existing skin damage to prevent skin barrier
  - Anatomic skin site

Irritant Contact Dermatitis "Cont'd"

- Host susceptibility
  - Atopic disease
  - Race (?)
  - Sex (?)
  - Age (?)
  - Allergies
  - Cleanliness
  - Season
- Most common predisposing factors in development of irritant dermatitis are atopy, dry skin, and advancing age.

Irritant Contact Dermatitis "Cont'd"

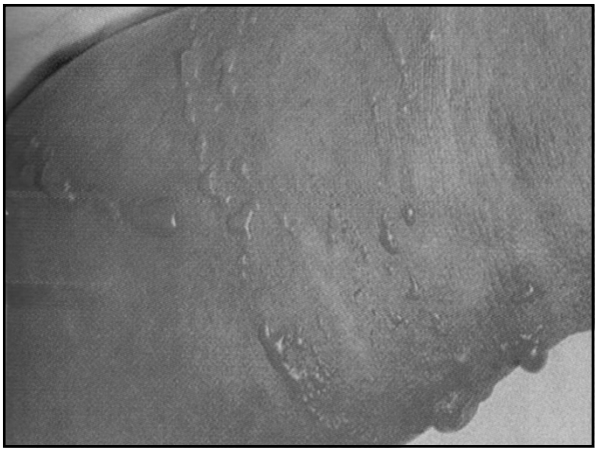
- Irritant Dermatitis is divided into two types:
  - Immediate (absolute)
  - Delayed

Immediate Irritant Dermatitis

- Single contact with a strong chemical substance causes acute, toxic reaction similar to burn.
- Erythema, blistering, and ulceration occur at site almost immediately after contact.
- Examples
  - Strong alkalis
  - Acids
  - Certain metallic substances and their salts
  - Many organic compounds

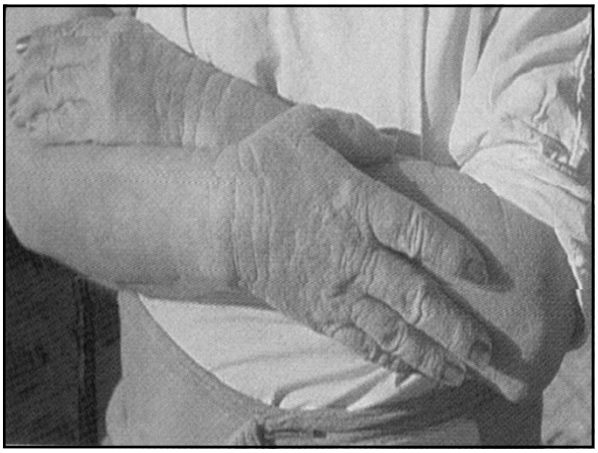
Immediate Irritant Dermatitis "Cont'd"

- Chief Determinants
  - Intrinsic nature of chemical
  - Concentration of the chemical
  - Duration of contact
- Almost everyone will respond the same way to these substances



Delayed Irritant Dermatitis

- Repeated or prolonged chemical contacts
- Clinical findings of erythema, increasing dryness and thickening, patchy hyperkeratosis with pruritus, and painful fissuring are characteristic



Delayed Irritant Dermatitis "Cont'd"

- Most Common Causes:
  - Soaps
  - Detergents
  - Mild acids and alkalis
- Most Common Contributing Factors:
  - Friction
  - Occlusion
  - Minor lacerations
  - Excessive environmental heat or cold
  - Low relative humidity
- *Often confused with allergic contact dermatitis*

Allergic Contact Dermatitis

- Less frequent than irritant dermatitis
- Greater importance to diagnose because ordinary protective measures usually are ineffective, and many patients must change jobs or learn a new trade.
- Is an immunologic reaction classified as a Type IV, delayed or cell mediated hypersensitivity

Allergic Contact Dermatitis "Cont'd"

- Sensitization is variable among individuals and also dependent on numerous factors
- Allergic contact dermatitis must be differentiated from atopic dermatitis, psoriasis, Herpes Simplex & Zoster, idiopathic vesicular reactions to Trichophyton infections of feet, dyshidrotic eczema, and drug eruptions.

Example of Delayed or Cell Mediated Hypersensitivity Reaction

- The allergen in poison ivy or oak will sensitize nearly 70% of exposed persons where p-phenylenediamine, allergen in permanent hair dyes, sensitizes a small number of people with repeated exposure.
  - Sensitization usually requires relatively short duration of exposure to develop though many workers may have repeated contact with an allergen in their workplace for months, and even years, before developing sensitivity.
  - Once allergic sensitization occurs, the dermatitis begins quickly (24 to 48 hours) after contact.

Example of Delayed or Cell Mediated Hypersensitivity Reaction: "Cont'd"

- A pruritic, erythematous rash develops rapidly, followed by papule formation and blistering.
- Itching is always a prominent symptom.
- Dermatitis originates at site of contact with the allergen but new lesions may appear at distant sites and may also be transferred by the hands.
- After several days, a subacute or chronic stage evolves that occasionally erupts into a more acute dermatitis after re-exposure to the allergen.

Mechanical Causes of Occupational Dermatoses:

- Friction
  - Calluses
  - Blisters
  - Abrasions
- Pressure
  - Bullae
  - Atrophy
  - Necrosis
- Other
  - Wounds
  - Koebner Phenomenon

Physical Causes of Occupational Dermatoses:

- Heat
  - Burns
  - Hyperhidrosis
  - Erythema
  - Telangiectasia
- Cold
  - Raynaud's Dz
  - Trench Foot
  - Frostbite
- Radiation
  - Keratoses
  - Sunburn
  - Radiodermatitis
  - Photosensitivities
  - Cancers

Biological Causes of Occupational Dermatoses:

- Plants
- Insects
- Animals
- Microbiological
  - Viruses
  - Bacteria
  - Fungi
  - Rickettsia
  - Protozoa

Worksite Evaluation

- Best place to evaluate etiology of occupational skin diseases
- Physicians should tour the plant with representatives of all interested groups.
- Note protective gear as well as personal hygiene.
- Examine tasks and work environment
- Ask to review MSDS's

Diagnostic Studies:

- Skin scrapings for microscopic examination
  - Yeasts
  - Fungi
  - Parasites
  - Fibrous glass
- Cultures
- Patch testing
  - to detect contact allergy
- Skin biopsy

Role of Patch Testing:

- Useful if allergen is believed to be the cause of an occupational skin disease.
- Valuable laboratory test to add scientific support to one's diagnosis.
- Cannot be used to determine the presence of an irritant.
- Limitations
  - Compounds can be primary irritants and can lead to false positive reactions
  - Can sensitize individual to number of different substances to which sensitization did not exist.
- True Test (1-800-TRUETEST):
  - Uses 24 common industrial allergens

General Treatment Strategies:

- Identify cause and eliminate causal agents - basis for Occupational Medicine as a Preventive Medicine specialty
- Topical steroids
- Oral steroids
- Antihistamines
- Moisturizing agents
- Drying agents

Prevention of Occupational Skin Disorders:

- Engineering Controls
  - Materials selection
    - ID potential irritants and allergens
    - Substitute for less irritating or allergic substances
  - Ventilation
  - Closed systems
- Personal Protective Equipment
  - Protective gear
  - Cleanliness
  - Barrier agents

Prevention of Occupational Skin Disorders: "Cont'd"

- Good Work Practices
  - Materials handling
  - Good housekeeping
  - Educational efforts to promote awareness of potential irritants and allergens both at work and home
- Administrative Controls
  - Pre-placement exams
  - Periodic monitoring
  - Job rotation
  - Motivational techniques to assure safe work practices

Solvent Exposures

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National Center for Environmental Health &
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The Case

- A 24 year old male who recently finished his track career at the University of Oregon decided he wanted to experiment with shoe making to create the "optimal surface for the sole of a running shoe". He worked at home using his wife's waffle iron as a template and combined various polymers and adhesives to develop the precise texture for cushion and traction

The Case

- Over time he developed numbness, cramping, tingling, and eventually began to walk with leg brace. He developed both upper and lower extremity weakness……
- He died at age 88 in May of 2000 living most of his adult life with significant neuropathies and weakness

The Case

- The former athlete now entrepreneur was Bill Bowerman the co-founder of Nike
- His symptoms are believed to have been caused by n-hexane induced neuropathy

Objectives

- Define solvents and common industrial terms
- Discuss principles of absorption, distribution, metabolism and excretion
- Review toxicity by organ system
- Basic review of chemistry and types of solvents
- Basics of prevention
- Board review word association

What is a solvent?

- They are a heterogeneous class of chemicals used to dissolve and provide a vehicle for delivery of other chemicals.
  - Organic
    - Most are liquids
    - Several subtypes
    - Most common in the industrial setting
  - Inorganic
    - Very few compared to organic, however water is the most common solvent used

What is a solvent?

- Few solvents are just one chemical, the majority are a mixture for enhanced efficacy
- Hundreds of chemicals are combined to make up over 30,000 different solvents
- Exposures can often be a combination of many solvents

Solvent Exposures

- Large quantities at various concentrations are used in chemical manufacturing as well as industry in general
- Combined exposures can have synergistic health effects

Solvent Exposures

- Active ingredients:
  - Isopropyl alcohol
  - Trichloroethylene
  - Multiple hydrocarbons

Solvent Characteristics

- Lipid Solubility
  - Miscible = water is appropriate for cleaning
  - Immiscible = water will not work, you need a soap or detergent
- Flammability
  - The ease with which a substance will ignite causing a fire or explosion
- Volatility / Vapor Pressure
  - The measure of tendency of a liquid or solid to evaporate or sublimate into a gaseous state

Some Definitions

- Threshold Limit Value (TLV)
  - The level at which most workers can be exposed day after day without adverse health effects (ACGIH)
- Time Weighted Average (TWA)
  - Average conc. For a 8 hour work day/40 hour week that most workers may be exposed to
  - Permissible Exposure Limit (PEL)
    - Regulatory limit on the amount or concentration of a substance in the air (OSHA)

Exposure Definitions

- Short Term Exposure Limit (STEL)
  - The concentration to which workers can be exposed continuously for a short period of time (15 minutes) without suffering health effects
  - Cannot be longer than 15 minutes, need 60 minutes between exposures, and a maximum of 4 exposures per 8 hour shift (ACGIH)
- Immediately Dangerous to Life and Heath (IDLH)
  - No exposure at this level, unless adequate protection provided

Solvent Mixture Exposures

- $E_m = (C_1/EL_1 + C_2/EL_2 + C_3/EL_3 + C_4/EL_4 + ...C_n/EL_n)$
- If E_m is > 1, the mixture exposure exceeds acceptable levels
- E_m = Mixture exposure
- C_1 = Measured conc. of component 1 etc.
- EL_1 = Permissible exposure level for component 1

Mixture Example

Chemical	TLV (8-hr TWA)	Measured Concentration (8-hr TWA)	Measured/ TLV	Fraction of TLV
2-Butoxyethanol	20 ppm	5 ppm	5 ppm/ 20 ppm	0.25
Methanol	200 ppm	60 ppm	60 ppm/ 200 ppm	0.30
Methyl Ethyl Ketone	200 ppm	40 ppm	40 ppm/ 200 ppm	0.20
Toluene	50 ppm	20 ppm	20 ppm/ 50 ppm	0.40

Ref: Jesse L Finney, Jr., CIH

Routes of Exposure

- Inhalation
  - Most common route and lipid solubility and volatility determine amount absorbed
  - Uptake can be as high as 40-80%
  - High intensity work can increase absorption
- Dermal Absorption
  - Lipid solubility enhances absorption
- Ingestion
  - Consider suicidal attempt versus mislabeled container
- Injection
  - Almost always self inflicted

Where Do Solvents Go?

- Primarily go to areas in the body that have high lipid concentration
  - CNS, liver, adipose tissue
- Tissues with high blood flow also get significant solvent exposure
  - Cardiac and skeletal muscle
- Obese individual accumulate higher levels and can exhibit delayed concentration
- Most cross the placenta and enter into the breast milk

Solvent Metabolism

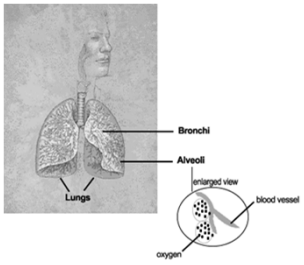
- Some can be excreted unchanged, but most are metabolized in the liver
- Often the metabolic by-product can be more damaging than the parent compound
- Some solvents are metabolized by the same metabolic pathways as alcohol
  - This can lead for competition with alcohol and aldehyde dehydrogenase
  - Can lead to longer exposure times

Solvent Excretion

- If the solvent is not highly metabolized it can often be excreted via the respiratory tract
- Most metabolized solvents and their metabolites are excreted in the urine
- A smaller portion can be excreted in the feces.

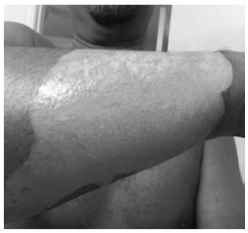
Solvent Targets of Toxicity

- Skin
- Nervous System
- Cardiac
- Pulmonary
- Hepatic
- Renal
- Hematological
- Reproductive
- Cancer



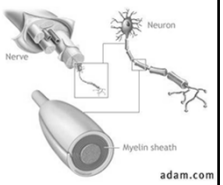
Dermatologic Effects

- Directly irritating to the epithelium
- Lipid solubility can enhance absorption
- Can dissolve subcutaneous fatty tissue
- Can range from contact dermatitis to significant burns



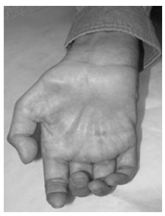
Nervous System

- Solvents can have CNS and PNS effects
- Acute manifestations range from general anesthesia to headache
- Symptoms of ataxia, disorientation, LOC, and respiratory depression and death reported
- Tolerance may develop



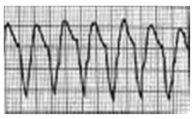
Nervous System

- Chronic effects generally have a dose-effect relationship
- Personality and mood changes
- Short term memory deficits
- Psychomotor disturbances
- Sensory and motor neuropathies can lead to muscle wasting



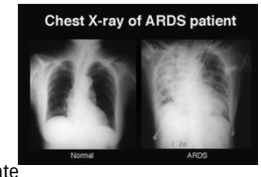
Cardiac

- Halogenated hydrocarbons predispose for arrhythmias
- Sudden cardiac death can occur in the setting of near anesthetic levels
- Carbon Disulfide associated with CAD risk
- Methylene Chloride is converted into carbon monoxide



Pulmonary System

- Local irritant effects predominate
- Low water soluble gases like phosgene can cause ARDS
- Typically reactive airway disease symptoms predominate
- Underlying asthma / COPD may be exacerbated
- Treatment is supportive care



Hepatic

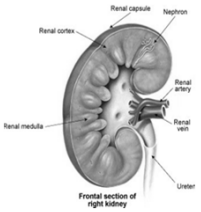
- Solvents with halogens or nitro groups are specifically toxic to the liver
- Carbon tetrachloride, 2-nitropropane, and dimethyformamide are classic examples
- Be aware of potentiation of effects with alcohol
- Monitor LFT's

Fatty liver from Carbon tetrachloride

- May progress to liver transplantation
- Consider hepatitis vaccines

Renal

- Kidney does not seem to be major target of most solvents
- Carbon tetrachloride is associated with ATN, toluene (glue) and ethylene glycol associated with renal failure
- Few studies on solvents and renal complications



Hematological and Cancer

- Benzene is a known cause of aplastic anemia and AML
- Implicated in multiple myeloma but causality has not been established
- Glycol ethers are associated with hemolytic and aplastic anemia's
- Carbon tetrachloride associated with hepatocellular carcinoma and vinyl chloride is associated with angiosarcoma of the liver

Reproductive

- Toxicity is a concern because of lipid solubility allows crossing into the placenta and testes
- Most studied is ethyl alcohol (fetal alcohol syndrome)
- Men with chronic glycol ether exposures have increased incidence of oligospermia and sperm abnormalities
- Lack of studies makes counseling extremely difficult

General Chemistry Review

- Inorganic compound by definition does not contain a carbon in its chemical structure
  - Examples include water (H_2O) and hydrogen peroxide (H_2O_2)
  - These are used in industry, but most solvents are organic

Water

HYDROGEN PEROXIDE

General Chemistry Review

- Organic compounds by definition are have a carbon in the chemical structure
- Organic solvents are generally classified into categories based on their chemical structure
  - Is there a double or triple bond?
  - Is there a ring formation?

General Classification of Organic Solvents

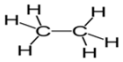
- Alkanes
- Alkenes (Dienes)
- Alkynes
- Alicyclic hydrocarbons
- Aromatic hydrocarbons
- Alcohols
- Phenols (aromatic alcohols)
- Chlorinated hydrocarbons
- Aliphatic Amines
- Glycol Ethers
- Ketones

Alkanes

n-hexane

- Methane, ethane, hexane, paraffin wax are examples – no double bonds!
- Gases are odorless / liquids can have slight odor
- Used as pure solvents or in mixtures in petroleum distillates
- Common environmental contaminants
- Millions potentially exposed

Alkanes


ethane

- Easily absorbed through the lungs
- Moderate skin absorption potential, but no "skin" TLV designation
- Usually metabolized through P-450 system
- Often have alcohols or some polar group added during metabolism to enhance elimination

Alkanes Health Effects

- Generally low toxicity
- High levels of exposure may result in asphyxiation or anesthesia
- Can produce both respiratory irritation and a dermatitis
- N-hexane is associated with a significant neuropathy (can monitor 2,5-hexanedione in the urine)

Alkenes, Dienes, and Alkynes

- Aliphatic hydrocarbons with 1 double bond (alkene), 2 double bonds (diene) or a triple bond (alkyne)
- They can be contaminants of ambient air
- Workers in polymer production and synthetic rubber plants are at higher risk
- None have "skin" TLV designation


ethene


isoprene


ethyne or "acetylene"

Alkenes and Alkynes Health Effects

- Similar to alkanes except even higher lipid solubility
- Produces more anesthesia than irritation
- Double bonds make these more reactive with other chemicals
- 1,3 butadiene is carcinogenic (leukemia and lymphosarcoma)
- N-hexene does NOT cause peripheral neuropathy

Alicyclic Hydrocarbons

- Alkanes or alkenes arranged in a ring structure
- Not commonly found in ambient air
- Well absorbed by inhalation but only minor dermal absorption (no "skin" notation)
- Cyclohexane is a widely used in nylon manufacturing

Alicyclic Hydrocarbons Health Effects

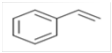
- Similar toxicity to alkanes and alkenes
- Primarily cause CNS effects, dermatitis, and respiratory irritation
- Not associated with peripheral neuropathy
- Effects tend to be dose related and minimizing the exposure is most important

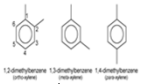
Aromatic Hydrocarbons

- Contain one or more benzene rings
- Commonly used industrial solvents in manufacturing paints, adhesives, pesticides, and rubber / plastics
- Approximately 5 million workers a year uses these solvents on at least a weekly basis


benzene


toluene


styrene


xylene

Aromatic Hydrocarbons

- Significant ambient air contamination
- Significant pulmonary absorption
- "Skin" notation for styrene and cumene
- Health effects are extremely variable depending on the substitutions on the benzene ring

Aromatic Hydrocarbon Health Effects

- Generally higher anesthetic and irritant effects
- Substitutions on benzene can increase lipid solubility and toxicity
- Primarily have short half lives and symptoms resolve after removal from exposure
- Biological monitoring possible but not readily available

Alcohols

- Widely used as cleaners, thinners, diluents, and disinfectants
- 400,000 occupational exposures annually and millions of end users
- Very potent CNS effects but less significant irritant effects
- Excellent absorption (most routes)
- "Skin" notation for isopropyl alcohol and methanol

Aromatic Alcohols (Phenols)

- These are benzene rings with an alcohol (-OH) attached
- High toxicity
- Primary used as intermediaries in chemical and drug manufacturing as well as cleaning and disinfecting agents
- Exposure to concentrated phenols are uncommon as most are dilute


phenol


cresol


resorcinol

Chlorinated Hydrocarbons

- These are structures with a carbon backbone with chlorine(s) attached
- Used widely as degreasers, cleaning, and thinning agents
- Significant ambient air and water concentrations
- Examples include trichloroethylene, perchlorethylene, carbon tetrachloride, and methylene chloride


TCE


PERC


Methylene chloride or dichloromethane

Estimates of Workers Exposed to Chlorinated Hydrocarbons

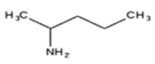
Solvent	Occ. Exposure Est
Trichlorethylene	3.6 Million
Perchlorethylene	570,000
1,1,1, Trichloroethane	100,000
Methylene chloride	70,000
Carbon Tetrachloride	160,000
Chloroform	80,000

Health Effects of Chlorinated Hydrocarbons

Solvent	TLV (PPM)	Health Effects
Trichlorethylene	50	CNS, Poss. Reproductive
Perchlorethylene	25	CNS, Reproductive & Cancer (in animals)
1,1,1, Trichloroethane	350	**Weak CNS, Cardiotoxic,**
Carbon Tetrachloride	**5 (S)**	**CNS, Hepatic tox and Ca, Renal, Reproductive**
Chloroform	10	CNS, Hepatic, ? Cancer
Methylene Chloride	**25**	**CNS, Hepatic, CO toxicity, ?Cancer**

Aliphatic Amines

- Solvents with a linear hydrocarbon backbone with an amine (-NH2) attached
- Strongly alkaline with a characteristic odor
- Widespread industrial use, but poor understanding of pharmacokinetics
- Causes severe irritation, corneal edema, allergic and irritant dermatitis and asthma


2-aminopentane

Glycol Ethers

- Ether – a class of chemical compounds that has an oxygen separating 2 alkyl groups
  CH3-CH2-O-CH2-CH3
- Glycol – a chemical compound containing 2 alcohol groups (-OH) also known as a diol


ethylene glycol or ethane diol

Glycol Ethers

- Miscible in water and most organic liquids
- Used widely as diluents, cleaning agents, de-icers
- Most exposures due to direct dermal contact
- "Skin" notation for all glycol ethers
- TLV for all is 5 ppm

Glycol Ether Health Effects

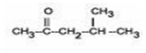
- Delayed encephalopathy
- Bone marrow depression and hemolysis
- Significant potential for male reproductive toxicity (spermatic abnormalities and oligospermia), associated with spontaneous abortion
- Likely that 2-methoxyethanol and 2 ethoxyethanol are both teratogenic

Ketones

- Chemical structure has a double bond to an oxygen
- Examples include methyl ethyl ketone (MEK), methyl isobutyl ketone (MBK), and cyclohexanone
- Millions of workers exposed and consumer exposures also common
- Inhalation in the primary route except for cyclohexanone which has a "skin" notation

Ketones Health Effects

- Good warning properties due to low odor thresholds; relatively high TLV's
- Headaches / nausea are common but CNS depression is uncommon
- MBK is a potent peripheral neurotoxin and is no longer produced in the US
- MEK and others do not produce peripheral neuropathies but may potentiate other neurotoxins



MBK

Biomonitoring

- VOCs are ubiquitous in the environment
- Occupational exposures tend to be much higher than environmental exposures
- Blood and /or urine levels generally reflect recent exposures only

Biomonitoring

- Testing is technically challenging, particularly for environmental exposures
- Careful assessment of exposure to various sources is critical (including tobacco and gasoline)

Prevention

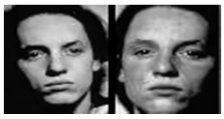
- Appropriate solvent selection and substitution if available
- Engineering controls
- Education
- Personal Protective Equipment

Substitution Challenges

- Must evaluate a number of factors including flammability, health risks, environmental fate
- Carbon tetrachloride was replaced by perchloroethylene
- Perchloroethylene is probable carcinogen
- Tricholorofluorethane is effective and not flammable, but may deplete the ozone

"Solvent Board Review"

- Degreasers flush: worker who drinks alcohol and then exposed to chlorinated hydrocarbons
  - Accumulate alcohols and aldehydes because of competing substrates for alcohol and aldehyde dehydrogenase



"Solvent Board Review"

- Hydrocarbons (petroleum, kerosene) → Pulmonary aspiration / ARDS complication
- MBK, n-hexane → Peripheral neuropathy
- Halogenated hydrocarbons (TCE, PERC), toluene → Cardiac toxicity "sudden sniffing syndrome"
- TCE → Trigeminal Neuralgia
- Carbon Tetrachloride → Hepatotoxicty (centrilobular necrosis)

"Solvent Board Review"

- Methylene Chloride → Carbon monoxide
- Phenol → Painless burn, systemic toxicity
- N-hexane → Urinary 2,5-hexanedione, peripheral neuropathy
- Benzene → AML
- Carbon disulfide → CAD
- Phosgene → Pulmonary Edema

Summary

- Solvents are frequently used but poorly studied
- Substitution is challenging because you do not often know long term health effects
- Personal protection and removal from the source are the key activities to limiting exposures
- Biomonitoring is of limited use, particularly for lower level environmental exposures