Occupational Health

Jonathan M. Links, PhD
Bloomberg School of Public Health
Case 1

- You are asked by the Governor’s Development Office to write a report on the public health implications of locating a new polyurethane foam insulation manufacturing plant in a suburban community in the state.
- What do you need to know before you can write your report?
- What do you recommend?
Case 2

- A 37-year-old office worker presents complaining of eye and nose irritation, hoarseness, and shortness of breath.
- There is no significant past medical history; the symptoms started after recent renovation of the offices at work, involving paints, glues, and new carpets.
- What caused this?
- Can she continue to work?
Case 3

- Your employee has been arriving late to work for the past few weeks
- He explains that he has been having “problems” and is on medication
- You discuss a plan, but the tardiness, up to 60–90 minutes every day, continues
Case 3

- When you next meet with the employee, he asks that you make him an accommodation and allow a flexible work schedule and frequent breaks
- What do you do?

- The promotion and maintenance of the highest degree of physical, mental, and social well-being of workers in all occupations
- The prevention among workers of departures from health caused by their working conditions
The placing and maintenance of the worker in an occupational environment adapted to the worker’s physiological and psychological equipment
The adaptation of work to the worker and of each worker to the job
Occupational Health: A Multidisciplinary Field

- Occupational medicine
- Occupational health nursing
- Industrial hygiene
- Safety science
- Ergonomics
- Employee assistance programs
- Health promotion/wellness programs
- Others
Brief Chronology

- 5th Century B.C.
  - Hippocrates—*Airs, Waters, and Places*—occupation and environment relevant to health

- 1556
  - Georgius Agricola—treatise on mining and metal industries
    - Miners short of breath, die prematurely
    - Describes one widow who outlived seven husbands who mined gold and silver in Erz Mountains (Czech border)
### Brief Chronology

- **Bernardino Ramazzini (Italy)—*De Moribus Artificum Diatriba* (Diseases of Tradesmen, 1713)
  
  “When a doctor visits a working-class home, he should be content to sit on a three-legged stool if there isn’t a gilded chair, and he should take time for his examination; and to the questions recommended by Hippocrates, he should add one more—‘What is your occupation?’”
Two Important Reformers: Crystal Eastman

  - First systematic investigation of accidents occurring during one year in Allegheny County, Pennsylvania
  - 526 men killed by work accidents in county
    - 84% < 40 years old
    - 58% < 30 years of age

Photo source: http://www.ci.elmira.ny.us/history/pics/eastman_aclu.jpg.
Two Important Reformers: Alice Hamilton

- Photo: www.nlm.nih.gov/.../img/portraits/137.jpg
Two Important Reformers: Alice Hamilton

- Described lead poisoning in bathtub enamlers; phossy jaw in match makers; carbon monoxide poisoning in steel workers; heart disease in munitions workers; mercury toxicity in hatters; “dead fingers” in jack hammer users; neurologic disease in viscose rayon workers; cancer after benzene exposure
Laws Finally Arrive

- Workers’ compensation laws
  - At first, vehemently opposed and legally challenged
  - All states passed from 1910 to 1948
- Coal Mine Safety and Health Act, 1969
- Occupational Safety and Health Act, 1970
  - Alice Hamilton dies at age 101, three months after its passage
Driving Forces for Occupational Health Reform

A Continuum

Technological change

New hazards (disasters)

Recognition by medical science

Social reformers bring to public attention

Resistance by vested interests

Legislation to enlarge employer’s accountability for the hazards of work
Ten leading work-related diseases and injuries in the U.S. (1982) according to the CDC’s National Institute for Occupational Safety and Health (NIOSH)

1. Occupational lung diseases
2. Musculoskeletal injuries and disorders
3. Occupational cancers
4. Severe occupational traumatic injuries
5. Cardiovascular diseases
6. Disorders of repetition
7. Neurotoxic disorders
8. Noise-induced hearing loss
9. Dermatologic conditions
10. Psychologic disorders
Ten leading work-related diseases and injuries in the U.S. (1982) according to the CDC’s National Institute for Occupational Safety and Health (NIOSH)

1. Occupational lung diseases
2. Musculoskeletal injuries and disorders
3. Occupational cancers
4. Severe occupational traumatic injuries
5. Cardiovascular diseases
6. Disorders of repetition
7. Neurotoxic disorders
8. Noise-induced hearing loss
9. Dermatologic conditions
10. Psychologic disorders
U.S. has very diverse workforce

In 2005, there are

- 147 million workers
- 48% female
- 28% minority
- 15% over age 55 years
In 1994, employers reported
- 6.3 million work injuries
- 515,000 cases of occupational illness
- Injuries alone cost $121 billion in lost wages, productivity, administrative expenses, and health care costs
The NIOSH NTOF Database

- The NIOSH National Traumatic Occupational Fatality (NTOF) database
  - 6,500 traumatic fatalities per year
- 1997 study, estimated for 1992
  - ~ 900,000 new occupational illnesses
  - ~ 65,000 occupational illness deaths
Economic Burden of Disease and Injury, 1997

Source: NIOSH. (May 1999).
Section B

International Health and Development
Industrialization and Development: Detriments

- Development since World War II has meant
  - Industrialization and price-setting markets
- Industrialization involves
  - Processing of materials, discharging wastes
  - Air pollution, land degradation, water/soil toxification
  - Increasing occupational health problems
Industrialization and Development: Benefits

- The fruits of development
  - Improved diet, overall level of physical comfort
  - Increased material wealth is invested in social services, public health, medical care, water distribution, sanitation facilities
Kinds of Development Projects

- Roads and transport systems
- Water supply and sanitation
- Water resource development
  - Dams, irrigation—change distribution and flow of surface water
- Industrial facilities, mines
  - Multinationals in search of cheap labor, resources, new markets
1. Demographic
   - From: “Traditional equilibrium”—stable population size with high death rates and high birth rates
   - Through: “Population explosion”—with rapidly declining death rates and stable birth rates
   - To: “Modern equilibrium”—birth rates decline and reach equilibrium with death rates
2. Epidemiologic
   - Decline in “traditional” diseases (through sanitation, vaccination)
   - More “modern” diseases (cancer, heart disease, pollution)
3. Risk
   - #2 (shift from traditional to modern diseases) due to underlying shift in risk factors—pollution, smoking, diet
   - With development, see new risks, interaction among risks, risk concentrating (equity), risk transfers (malaria vs. pesticides)
Stages in National Development

- UNDERDEVELOPMENT & POVERTY
- ACCELERATED ECONOMIC DEVELOPMENT
- ADJUSTMENTS to ENTER GLOBAL MARKETS
- ADJUSTMENTS of FOREIGN POLICY for GLOBAL MARKETS
- LONG-TERM SUSTAINABLE DEVELOPMENT

Source: Mendes.
"Mosaic Pattern" in Less Developed Country

Source: Mendes.
“Mosaic Pattern” in Developed Country

UNDERDEVELOPMENT & POVERTY

ACCELERATED ECONOMIC DEVELOPMENT

ADJUSTMENTS to ENTER GLOBAL MARKETS

ADJUSTMENTS of FOREIGN POLICY for GLOBAL MARKETS

LONG-TERM SUSTAINABLE DEVELOPMENT

Source: Mendes.
Worker training and education levels of workers may be lower than in developed countries.

Child labor more prevalent in some countries.

Pre-existing levels of health may be lower.
Nature of occupational health problems

- Overt occupational diseases—chemical poisonings, pneumoconioses—more common; pesticide poisoning particularly problematic
- Poorly controlled occupational health hazards
Occupational Health Issues in Developing Countries

- Less-developed surveillance systems
- Fewer laws in some countries
- Strong laws in other countries, but poor enforcement
Child Labor

- International Labor Organization (Geneva) has estimated child labor issues (1996)
- 250 million children between 5 and 14 working in developing countries; larger proportion of girls
  - Slaughterhouses, agriculture, carpet-weaving, domestic service, entertainment, mining, metal working
- 70% work under hazardous conditions
Child Labor

- Of global total, Asia has 61%, Africa 32%, Latin America 7%
- Of children between 5 and 14 years, 41% of those in Africa work, 22% in Asia, 17% in Latin America
- In U.S., child labor is an important issue on family farms and other selected workplaces
Section C

Problem Solving, Monitoring, and Control
Types of Environmental Exposures (Factors, Stressors)

- Chemical hazards
  - Clinical toxicology
- Dusts and particulates
- Physical hazards
  - Temperature, pressure, vibration, radiation
- Ergonomic hazards
  - Exposure to these hazards causes work-related musculoskeletal disorders
Types of Environmental Exposures (Factors, Stressors)

- Biologic hazards
  - Infectious, allergic issues
- Psychologic hazards
- Safety hazards
Three categories of problems
1. Individual—clinical paradigm
2. Population—epidemiologic methods
3. Environment—industrial hygiene methods

Obstacles to problem solving
- Technical/scientific—no
- Political/economic—yes
U.S. Model—Triangle of Prevention

Triangle of prevention of occupational disease and injury

Prevention of Occupational Disease and Injury

Workers—Unions
Employers—Companies

NIOSH
Academia

MSHA
OSHA

Balance and/or tension between the above parties produces conflict and leverage

Driving prevention of occupational disease and injury

### Healthy Work Approach, WHO (1997)

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Setting</th>
<th>Work</th>
<th>General (community/society at large)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Environment</td>
<td>Physical Environment</td>
<td>Occupational Health and Safety</td>
<td>Sustainable Development</td>
</tr>
<tr>
<td>(Psycho-) Social Environment</td>
<td>(Psycho-) Social Environment</td>
<td>Human Resource Management</td>
<td>Health Promotion</td>
</tr>
</tbody>
</table>
Controlling Hazardous Agents: Engineering, Ventilation

- Engineering controls
  - Substitution
  - Isolation or enclosure
  - Modification of process
- Ventilation
  - General area
  - Local exhaust
Controlling Hazardous Agents: Work Practices

- Work practices
  - Good housekeeping
  - Separate eating, washing, and changing areas
  - Wet methods
- Training and education of workers
Administrative Controls, Surveillance, Protective Gear

- Administrative controls
  - Limit exposure by rotation or decreased work hours
- Medical surveillance
  - Exposure assessment
  - Biologic monitoring
  - Health effects monitoring
- Personal protective equipment
The Continuum for Surveillance: A Framework

EXPOSURE ➔
EARLY BIOLOGIC EFFECTS ➔

EXPOSURE MONITORING

BIOLOGIC MONITORING

SUBCLINICAL HEALTH EFFECTS ➔
1ST CLINICALLY DETECTABLE EFFECTS ➔

HEALTH EFFECTS MONITORING

MINOR CLINICAL DISEASE ➔

(MAJOR CLINICAL DISEASE) ➔

(DEATH)
Biologic Monitoring

- The measurement and assessment of agents or their metabolites in tissue, secreta, excreta, or expired air, to evaluate exposure and health risks compared to an appropriate reference
  - Reference most often used—Biologic Exposure Index (BEI) of the ACGIH
Biologic Monitoring

- Only possible when sufficient toxicologic information is available on mechanism of action and on fate of chemical
  - BEIs are available only on about 35 agents
Biologic Monitoring Better Than Exposure Monitoring

- Closer to health effect
- Integrates ROUTES of exposure
- Integrates SOURCES of exposure
- Captures effects of PERSONAL PROTECTIVE EQUIPMENT
- Captures INDIVIDUAL VARIABILITY in work practices
- Captures INTER-INDIVIDUAL VARIABILITY in toxicokinetics
Health Effects Monitoring

- There are very few specific health effects of workplace exposures.
- Generally use standard clinical tests to evaluate health effects in workers.
- Must thus consider issue of low prevalence and positive predictive value.
Medical Surveillance: Screening

- Medical history, physical examination, and lab tests to detect a specific disease process at an early, potentially reversible stage
- Focus on case identification
- Medical screening is one type of surveillance activity, if data are treated appropriately
Medical Surveillance: Health Effects Monitoring

- Health effects monitoring: “Screen again”
  - Periodic screening and other medical evaluations of individuals or groups of workers
Medical Surveillance: Group Analysis Surveillance

- Surveillance: “Analyze, interpret, and act”
  - The systematic collection, analysis, interpretation and dissemination of data on groups or populations
  - Use of data to direct active prevention programs
Occupational and Environmental (O/E) Disease

**Principles**
- Clinical and pathologic presentation of O/E diseases are indistinguishable from non-O/E diseases
- Many diseases of O/E origin are multifactorial, with non-O/E factors playing a role
- Effects of O/E agents occur after biologically predictable latent period

Source: Rosenstock and Cullen.
Occupational and Environmental (O/E) Disease

- **Principles**
  - Clinical and pathologic presentation of O/E diseases are indistinguishable from non-O/E diseases
  - Many diseases of O/E origin are multifactorial, with non-O/E factors playing a role
  - Effects of O/E agents occur after biologically predictable latent period
  - Dose of O/E agent is strong predictor of probability and type of effect
  - Individuals differ substantially in responses to O/E exposures

Source: Rosenstock and Cullen.
The History: Three Essential Components

1. Description of current job
2. History of work with any known hazards (e.g., chemical, physical, biologic, ergonomic)
3. Description of health problems thought by patient to be related to work
   - Change in symptoms during work day
   - Change in symptoms over work week
   - Change in symptoms on weekends and vacations
   - Onset of symptoms away from work

Many standard instruments available
The Environmental Evaluation

- History may not be sufficient
- Obtain prior medical records
- Obtain Materials Safety Data Sheets from employer
- Obtain exposure records from employer
  - Relevant OSHA law
The Environmental Evaluation

- History may not be sufficient
- Obtain prior medical records
- Obtain Materials Safety Data Sheets from employer
- Obtain exposure records from employer
  - Relevant OSHA law
- Information from health and regulatory agencies
- Information from unions and community groups
- Perform a worksite visit
Specialized Use of the Laboratory

- Overall role of laboratory in OEM practice is surprisingly limited
Specialized Use of the Laboratory

1. Tests that elucidate pathophysiology
   - Detect effects, i.e., most general medical tests
2. Tests that identify or quantify exposure and dose
3. Tests that evaluate relation between exposure and effect (e.g., patch testing, challenge testing)
Making a Diagnostic Inference

- Exposure assessment databases
  - Link job to exposure
- Epidemiologic databases
  - Link exposure to disease
- Toxicologic databases
- Case reports and case series
- Clinical experience
Section D

Regulation
Regulation of Workplace Exposures in the U.S.

Toxic substances in the workplace regulated primarily through three federal laws:

- Occupational Safety and Health (OSH) Act of 1970
- Mine Safety and Health Act of 1969 (MSHA)
- Toxic Substances Control Act of 1976 (TSCA)
Regulation of Workplace Exposures in the U.S.

- OSHA does not cover:
  - Self-employed, family-owned-and-operated farms, workplaces covered by other federal statutes, and state and local governments
  - Federal agencies—can’t be fined
- Employers with ten or fewer employees exempt from:
  - Routine OSHA safety inspections
  - Record-keeping requirements
Other Agencies Concerned with Occupational Health

- Environmental Protection Agency (EPA) regulates users of pesticides
- Nuclear Regulatory Commission (NRC) regulates users of radioactive materials
Other Agencies Concerned with Occupational Health

- Department of Transportation regulates transportation safety (a major cause of work-related deaths and injuries) through:
  - National Highway Transportation Safety Administration
  - Federal Aviation Administration
  - Federal Railroad Administration
  - U.S. Coast Guard
Key Provisions of OSHA

- Ensure, if possible, that every employee has safe and healthful working conditions
- Require employers to maintain certain records
- Require employers to notify/train workers
- Provide procedures for investigating violations
- Can issue citations and assess monetary penalties against employers
Key Provisions of OSHA

- Can issue safety and health regulations and standards that have the force and effect of law
- Established National Institute for Occupational Safety and Health (NIOSH) to undertake health studies
- Provide half the funding for states that wish to establish state programs
Permanent Standards: Nine-Step Process

1. Decision to initiate development process
2. Drafting proposal, including economic and environmental impact
3. Advisory committee—all relevant parties
4. Revision and review
5. Publication in the Federal Register
6. Informal hearing for public comment
7. Staff analysis of records (major issues presented to the assistant secretary)
8. Final standard developed
9. Final standard published in Federal Register

- Hazards of chemicals “must be evaluated”
- Information transmitted to employers and employees
- Employers must have written program
  - Must include provisions for employee training, container labeling, materials safety data sheets (MSDS), employee training
Employee training
- Explanations of the requirements of standard
- Details about chemical hazards in workplace
- Details about methods and observations used to detect hazardous workplace chemicals

- Assessment of health hazards of chemicals
- Details on warnings, labels, MSDS, controls
Chemicals covered highly variable in different jurisdictions—range from 300–30,000

OSHA regulation

- Basic list of ~600 chemicals
- Requires “performance-oriented” evaluation of hazard potential of other chemicals
Material Safety Data Sheets

- Quality highly variable; toxicity and health effects data are often inadequate
- Data on MSDS do not quantitate exposures; provide no method to reliably determine “dose”
OSHA Enforcement: Theory

- OSHA identifies workplace hazards, promulgates rules to regulate hazards, and ensures compliance through enforcement
  - Enforcement strategy: Conduct inspections, issue citations, assess penalties for violations

Classic deterrence theory

- General deterrence: In short term, can dissuade firms from violating law if they believe non-compliance will be detected (certainty) and punishment will be severe and swift
- Specific deterrence: If firm is caught, will be less likely to violate again

If both general and specific deterrence are strong, compliance incorporated as organizational norm.

OSHA Enforcement—Recent Data

- Certainty
  - OSHA inspections are infrequent ("every 144 years")
- Severity
  - Average federal penalty for "serious" = $763 (1995), 10% of maximum; "other than serious" = $52

OSHA Enforcement—Recent Data

- Swiftness
  - Average time from start of inspection to citation = 31 days for safety, 42 days for health (1996–1997)
  - 9.2% of these citations were contested—delays months to years

Impairment—Definition

- Impairment
  - Objective loss of organ or body part function
  - A medical determination
  - Supposed to be standardized, reproducible
Disability—Definition

- **Disability**
  - Impact of impairment on individual’s functions at work or in society (alteration of capacity to meet personal, social, or occupational demands)
  - Impairment, work, home environment considered
  - Disability is an administrative decision made by persons who often are not health professionals
Three Major Disability Compensation Systems

1. Workers’ compensation systems
   - Cause is determining factor for entry into system

2. Programs for the severely disabled
   - Inability to perform any gainful activity
   - Include Social Security Disability Insurance (SSDI) for contributing workers; Supplemental Security Income (SSI) for aged, blind, severely disabled
3. Private disability plans
   − Protect income if unable to perform regular job duties, regardless of cause
   − Any illness preventing usual employment
   − Employer benefit or privately purchased
26 July 1990: President Bush signed into law P.L. 101-336
   Extended existing rights and created new rights for 43 million Americans with disabilities
The law requires that employers make
- Reasonable accommodations
- Which are not an undue hardship
- So that any qualified individual with a disability can perform
- The essential functions of a job
The ADA prohibits discrimination against persons with disabilities in:

- Employment (Title I)
- Public programs and services (Title II)
- Public accommodations and services operated by private entities (Title III)
- Telecommunications (Title IV)
Coverage of Act

- The ADA charges the Equal Employment Opportunity Commission (EEOC) with issuing regulations to carry out Title I of the Act.
- The ADA covers all employers with more than 15 employees.
Examinations for Capability

- These examinations must relate to the employee’s ability to do the essential functions of the job.
Examinations for Capability

- Must consider *job demands*
  - Ergonomic evaluation; evaluation of physical and nonphysical job demands; time allocation to tasks
- Job analysis information should be used
  - Physicians must be familiar with specific job demands
- Considerations of job capability must be individualized
Worker Involvement in OHS

Some recent trends

- A decrease in U.S. manufacturing
- An increase in service (including health care)
- Decreased unionization
- A decrease in proportion of those with “middle-class” incomes
Worker Involvement in OHS

- Unions
  - Try to regain some control over labor process through collective bargaining
  - 18% of U.S. workforce unionized; manufacturing = 12%
  - Much lower than in other Western industrialized countries
Relationships between employers and unions are governed by laws that are designed to:

- Make employers bargain fairly with unions on “conditions of employment” related to OSH
- Protect unions/members in employer relationships
- Ensure democratic procedures, sound fiscal practices
Labor Laws

- National Labor Relations Act (Wagner Act, 1935)
- Labor-Management Relations Act (Taft-Hartley, 1947)
- Labor-Management Reporting and Disclosure Act (Landrum-Griffin, 1959)
Ethical Concerns in Occupational Medicine

- Confidentiality
  - What are employers entitled to know about their employees?
- Tension between role as physician and corporate employee
Ethical Concerns in Occupational Medicine

- Nature of physician-patient relationship
  - Company physicians, relationship may be more complex
  - Primacy of obligation to treated patient still exists
- Other important issues
Section E

Health Promotion in the Workplace
Health Promotion in the Workplace: 1980s Increase

- 1980s: Impressive increases in health promotion activities in the workplace
- Two studies in 1990s: Random samples
  - Office Disease Prevention and Health Promotion—1992 National Worksite Health Promotion Survey
  - CDC’s 1995 Worksite Benchmark Survey
Health Promotion in the Workplace: Decrease in 1990s

- Overall decrease in health promotion activity prevalence from 12.0% in 1992 to 6.5% in 1995
  - Corporate downsizing
  - Uncertainty about effectiveness
  - Employers’ perceptions of duplication of services—role of managed care
“Efficacy of worksite-based screening programs has not been conclusively established”
Purported Benefits of Workplace Health Promotion

- Improved employee health
- Reduced health care and other employee costs
- Increased productivity
- Decreased absenteeism, improved morale
- Easier recruitment of skilled/professionals
- Greater employee loyalty, reduced turnover
Purported Benefits of Workplace Health Promotion

- Ability to meet employee requests
- Enhancement of corporate image, public relations
- Dogma—health promotion yields $2–3 per $1 invested
  - Often based on company reports, not rigorous evaluations
Benefits of Workplace Health Promotion

- Long-term effectiveness studies not common
  - Studies expensive (> $1 million)
  - Few companies study programs
  - Many studies used for marketing purposes
Benefits of Workplace Health Promotion

  - Methodologic errors
  - Little evidence of effectiveness

- Health promotion raises employee awareness of personal health issues; less clear how successful in affecting behavioral change
Summary of Benefits

- Health care costs
  - Some controversial supportive evidence
  - Some negative evidence
  - Overall: Little evidence to support claim

- Absenteeism
  - Several short-term studies show reductions
Summary of Benefits

- Health risks
  - Several short-term studies show reductions (blood pressure, cholesterol, body weight, Type A behavior)
- Attitudes towards health and company
  - Some supportive evidence; presence of program cannot negate consequences of other workplace changes