



# Occupational Health and Safety for the 21st Century

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*To C.A.F.*



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## Preface

For the majority of the world's inhabitants, work is the major focus of our existence. Since the beginnings of organized society, continuing with the Industrial Revolution, and now in the present era—and always in a changing landscape of employment, occupational exposures, and working conditions—employment has been highly salient for people's health. My goal in this text is to increase readers' awareness of the crucial role played by occupational factors in the health of workers and the many connections between occupational and environmental exposures. To this end, key topics and issues related to occupational health and safety are introduced here.

As a result of my practical experience as a health department epidemiologist, research on chronic diseases, and participation in seminars and lectures, I have become cognizant of the impact of work-related exposures on employees' health. These experiences called attention to an acute need for an accessible text that would cover the major topics in the field.

*Occupational Health and Safety for the 21st Century* is intended for graduate and undergraduate students enrolled in occupational health and safety courses in a variety of settings. The volume should also be of interest to public health, epidemiology, and health science students who want to delve more deeply into occupational health issues. Frequently, courses that explore this topic are offered by schools of public health and college health science programs. The text can also be adapted for use in online courses and intensive courses offered in a nontraditional format. Taking a nontechnical approach, it is accessible to and should intrigue students with little or no previous introductory background in the occupational health field or related disciplines. At the same time, the text should appeal to more advanced students as well.

To better elucidate the subject matter, this text includes many examples and illustrations of occupational health issues. Text boxes provide detailed information on selected topics. Other learning aids include a list of learning objectives at the beginning of each chapter and study questions and exercises at its conclusion.

—*Robert H. Friis*



# Acknowledgments

First, I express my gratitude to my teachers and colleagues at the settings where I have worked during the past four decades. Among these individuals are the late Dr. Sidney Cobb and the late Dr. John R. P. French, Jr., who were my postdoctoral supervisors at the University of Michigan's Institute for Social Research. The late Dr. Mervyn Susser was responsible for offering me my first professional employment in public health (epidemiology) at the School of Public Health, Columbia University.

I also thank many generations of students in my various classes, most recently at California State University, Long Beach (CSULB). Over the years, students' probing questions have helped me sharpen my focus and think about public health. CSULB Health Science Department faculty member Claire Garrido-Ortega helped conduct background literature research for this text.

My wife, Carol Friis, was involved extensively with this project: She proofread the manuscript, provided detailed editorial comments, verified the accuracy of the references, and helped with many other aspects of the project. Without her support and assistance, completion of this text would not have been possible.

Finally, I would like to thank the dedicated and anonymous reviewers whose insightful comments greatly enhanced the quality of this text. Mike Brown, publisher for Jones & Bartlett Learning, provided continuing encouragement and motivation for completion of the project; Jones & Bartlett Learning staff offered much helpful technical publishing expertise.

—*Robert H. Friis*



# Introduction

This text provides a broad and concise overview of the topics that make up the field of occupational health and safety. These areas include important occupational policies, legislative acts, and laws for protection of workers. A crucial issue for occupational health research is defining exposures to potentially dangerous agents found in the work environment and delineating the effects of such exposures. Epidemiology and toxicology are examples of two fields that make contributions to exposure assessments and illuminate the adverse health effects associated with work-related exposures. Broad categories of agents of occupational disease include physical hazards, biological and microbial agents, and hazardous chemicals. Among the adverse health outcomes that have been linked with the work environment are cancer, respiratory illness, and reproductive abnormalities. Unintentional injuries are one of the leading causes of work-related morbidity and mortality, but the psychological and social environment can also affect the health of workers by influencing levels of stress and morale. Methods have been developed to reduce exposures to hazards and increase occupational safety through redesign of the work environment, introduction of engineering controls, and limiting exposures to physical, microbial, and chemical agents.

## Introduction to Occupational Health and Safety

Occupational health is concerned with protecting workers from diseases and injuries associated with hazardous work-related exposures. More broadly, the field is perceived to include improvement of the work environment and promotion of employees' health in general. The Introduction to Occupational Health and Safety chapter traces the history of adverse working

conditions and highlights the achievements of leaders who were instrumental in addressing occupational health. In addition, it presents findings regarding human impacts and economic costs of significant occupational diseases and injuries. The intimate connection between the fields of occupational health and safety and public health is reinforced. National objectives for occupational health developed by *Healthy People 2020* are provided.

## Occupational Health Policy and the Regulatory Climate

Occupational health policies are statements of plans for actions recommended to protect the health and safety of workers. Many contemporary health policies and legislative acts for protection of workers' health originated during the Industrial Revolution, when the deleterious effects of hazardous exposures and dangerous occupational environments became starkly apparent. Examples of key occupational laws in the United States include the Occupational Safety and Health Act of 1970 and the Federal Mine Safety and Health Act of 1977. Policies and legislative acts rely on government agencies such as the Occupational Safety and Health Administration (OSHA) to ensure their enforcement. These activities are supported by international and private organizations that promote occupational health and safety. Given the importance of policy issues for the field, many of the source documents are provided in their original wording in the Occupational Health Policy and the Regulatory Climate chapter.

## Epidemiologic and Toxicologic Aspects of Occupational Health and Safety

The Epidemiologic and Toxicologic Aspects of Occupational Health and Safety chapter describes applications of methods derived from epidemiology and toxicology to occupational health and safety. Occupational epidemiology provides a body of methods for assessing hazards and risks from occupational exposures, identifying associations between exposures and adverse health outcomes from work-related factors, developing standards for permissible levels of exposures, and suggesting methods for protecting workers from occupational hazards. In comparison with other fields concerned with job-related health issues, occupational epidemiology is unique with respect to maintaining a focus on an entire population of workers. Toxicology provides methods for assessing and characterizing the effects of exposures to hazards such as toxic chemicals. Occupational epidemiology and toxicology are complementary disciplines, with toxicology providing methods for examining the toxic effects of agents and exposures that may impact the work environment.

## Hazards from Chemicals and Toxic Metals

Chemicals are essential to the functioning of society and modern industrial operations. Furthermore, the number of chemicals in use continues to increase each year. Hazardous chemicals encountered in the work environment include toxic metals and gases, pesticides, and solvents. From an international perspective, thousands of injuries associated with unsafe chemical use occur each year. Some chemicals have cancer-causing properties; others have been linked to a variety of unwanted human health effects such as adverse birth outcomes.

## Physical Hazards in the Workplace

Physical hazards encountered at work include radiation (both ionizing and non-ionizing), noise and vibration, extreme temperatures, and atmospheric variations (high and low atmospheric pressures). Examples of ionizing radiation are radiation from X-ray and imaging devices and radiation from cancer treatment. Examples of non-ionizing radiation are radiation from microwave ovens and intense light beams from lasers. Physical hazards are a feature of many work settings—for example, in the construction, healthcare, food processing, and transportation fields. Affected employees include physicians and nurses who may be exposed to ionizing radiation from imaging procedures and cancer treatments. Nurses who monitor hyperbaric chambers may need to accompany patients inside these devices and consequently be placed under high atmospheric pressures. Construction workers are exposed to noise and vibration from power tools and often are required to work outdoors in frigid temperatures during the winter months and, conversely, in torrid conditions during the summer. The Physical Hazards in the Workplace chapter presents information on the nature of these hazards and their potential health effects.

## Biological and Microbial Hazards in the Workplace

Biological and microbial hazards include infectious disease agents such as bacteria, viruses, and fungi. Healthcare personnel, veterinarians, laboratory technicians, and sanitation workers are among the groups of workers who may come into contact with infectious disease agents during the course of their work-related activities. For example, healthcare personnel can become infected as a result of direct contact with patients and through indirect contact with infectious agents from blood and bodily fluids.

## Examples of Major Occupational Diseases

Examples of adverse health outcomes associated with the occupational environment include dermatologic conditions (skin diseases/occupational dermatoses), cancer (e.g., breast cancer, liver cancer, and skin cancer), respiratory diseases (e.g., lung cancer and asbestosis), neurologic conditions, and reproductive abnormalities. Associations between these conditions and specific occupational exposures are discussed in the Examples of Major Occupational Diseases chapter.

## Work-Related Injuries and Fatalities

Work-related unintentional injuries kill more than 4,500 individuals each year in the United States. The most frequent cause of such deaths is transportation fatalities on the job. Also a crucial factor in the occupational environment is the risk of nonfatal injuries—a major source of worker morbidity and lost work time. Nonfatal injuries include falls and musculoskeletal injuries. Workplace violence is another cause of both fatal and nonfatal injuries.

## Psychosocial Aspects of Work: Job Stress and Associated Conditions

Approximately two-thirds of all U.S. workers indicate that they experience stress in the workplace. Stress is associated with a changing work environment—for example, workers' inability to obtain and maintain employment, reduction of salary and benefits, increased emphasis on productivity, and globalization of the workforce. The way in which work is organized can lead to isolation and demoralization of workers. Other psychosocial influences on workers include lifestyle factors such as the level of physical activity at work (e.g., being sedentary due to the requirement for long hours of sitting), dietary changes, and abuse of alcohol and other substances.

## Occupational Safety and the Prevention of Occupational Disease

As noted elsewhere in this text, occupational injuries and illnesses are a global phenomenon, being especially common in the developing world. A substantial proportion of these tragic events are preventable. The Occupational Safety and the Prevention of Occupational Disease chapter describes methods for increasing the safety of the work environment. For example, surveillance of occupational injuries and illnesses can aid in the development

of descriptive epidemiologic studies that identify settings with high frequencies of adverse health outcomes. Related to occupational safety is risk assessment, which aids in targeting high-risk work environments. Another section in this chapter presents information on occupational health career specializations that contribute to the improvement of worker health and safety.





## About the Author

**Robert H. Friis, PhD**, is Professor Emeritus of Health Science and Chair Emeritus of the Department of Health Science at California State University, Long Beach (CSULB), and former Director of the CSULB-VA Long Beach Healthcare System Joint Studies Institute. He is also a former Clinical Professor of Community and Environmental Medicine at the University of California at Irvine. Previously, he was an Associate Clinical Professor in the Department of Medicine, Department of Neurology, and School of Social Ecology, University of California at Irvine. Dr. Friis was also on the faculty at the Columbia University School of Public Health, Albert Einstein College of Medicine, and Brooklyn College. He was employed as an epidemiologist in a local health department, where he obtained applied public health experience. Dr. Friis is past president and a member of the Governing Council of the Southern California Public Health Association. Currently, he serves on the advisory boards of several health-related organizations, including the California Health Interview Survey. He is an epidemiologist by training and profession.

Dr. Friis has conducted research and published and presented papers related to tobacco use, mental health, nursing home infections, chronic disease, disability, minority health, and psychosocial epidemiology. He has been principal investigator or co-investigator on grants and contracts from the University of California's Tobacco-Related Disease Research Program, the National Institutes of Health, the joint CSULB and University of Southern California METRANS program, and other agencies. He has been a visiting professor at the Center for Nutrition and Toxicology, Karolinska Institute, Stockholm, Sweden; the Max Planck Institute, Munich, Germany; and twice at the Technical University of Dresden, Germany. Dr. Friis is a fellow of the Royal Society for Public Health and a member

of the International Editorial Board of the journal *Public Health*. He is also a member of the Society for Epidemiologic Research and the American Public Health Association. Early in his career, he was awarded a postdoctoral fellowship for study at the Institute for Social Research, University of Michigan, and later the Achievement Award for Scholarly and Creative Activity from California State University, Long Beach.

Dr. Friis is the author of several books and textbooks, including *Epidemiology 101* (Jones and Bartlett), *Essentials of Environmental Health, Second Edition* (Jones and Bartlett), *Epidemiology for Public Health Practice, Fifth Edition* (senior author; Jones & Bartlett Learning), *Introductory Biostatistics for the Health Sciences* (co-author; Wiley), *Praeger Handbook of Environmental Health* (editor; Praeger), and *Community and Public Health* (senior author; Bridgepoint Education).