Chapter 6

OCCUPATIONAL RESPIRATORY DISEASES

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"Practically all industrial poisoning is due to the inhalation of dust and fumes or contamination of the skin; and if you stop the inhalation or skin contact, you will stop the poisoning" - Sir Thomas Legge

Introduction

According to the Bureau of Labor Statistics (BLS), the *health care and social assistance* industry (as defined by the North American Industry Classification System [NAICS] sector 62) is one of the largest employers in the United States. The projected number of employees in this industry will increase by 4.3 million (30.3%), from 14.2 million in 2004 to 18.5 million in 2014.[1] In 2004, *health care and social assistance* had the highest number (n=5,700) of reports of respiratory conditions to BLS, as compared with *manufacturing* (n=3,800), *trade, transportation, and utilities* (n=2,900), *professional and business services* (n=1,600), and *leisure and hospitality* (n=1,100).[2]

Health care professionals (employees in the health care industry), a subgroup within the larger *health care and social assistance* industry, are known to encounter a variety of potentially hazardous occupational exposures that include chemicals, biological agents, radiation, and other hazards. These exposures can result in serious acute and chronic long-term adverse health outcomes, including respiratory diseases.

This report presents an overview of work-related respiratory hazards reported in the literature, as well as morbidity and mortality information for selected respiratory conditions, among health care professionals in the United States. We have considered workers in industries defined by the following NAICS subcodes: 621 (*ambulatory health care services*, which comprises six subcategories-*offices of physicians, offices of other health practitioners, outpatient care centres, medical and diagnostic laboratories, home health care services*, and *other ambulatory health care services*); 622 (hospitals); and 623 (nursing and residential care facilities).[3] These industries encompass a wide range of occupations, and here we focus on several occupations with well-documented risk for occupational respiratory disease. The following respiratory diseases are addressed: asthma, chronic obstructive pulmonary disease (COPD), tuberculosis (TB), selected other infectious diseases and lung cancer. These diseases are important causes of morbidity and mortality among health care professionals. For each of these diseases there are opportunities for reduction of potentially-causative occupational exposures. The data presented in this report may be useful in helping to focus the efforts of public health and occupational health practitioners to reduce occupational exposures and ultimately reduce adverse health outcomes.

Methods

To document hazardous exposures in health care professionals, we performed literature searches on July 26 and 31, 2006, using several databases including PubMed, NIOSHTIC, NIOSHTIC-2, and the OSH References Collection (OSHLINE, HSELINE, CISILO, Canadiana). To perform the literature searches, we used the following key words: health personnel (e.g. physicians, nurses, dentists, hospital personnel, pharmacists, dental technicians, laboratory technicians, or health care professionals); AND respiratory diseases (e.g. asthma and epidemiology, chronic obstructive pulmonary disease and epidemiology, tuberculosis and epidemiology, lung neoplasms): OR occupational exposure or environmental exposure. The results were limited to human studies published in English between 1986 and July 2006. A total of approximately 600 references were identified with many duplications among the different databases. Over 70 articles addressing respiratory diseases and hazards in health care (chemical hazards, allergenic proteins, biological hazards, physical agents, and medications) were selected for review. For recent respiratory morbidity and mortality data, we used three data sources:

1. the 2004 BLS Occupational Injuries and Illnesses statistics.[2]
2. the 2004 National Health Interview Survey (NHIS) data,[4] and
3. the mortality data derived from the National Occupational Respiratory Mortality System (NORMS) that NIOSH has developed from the National Center for Health Statistics (NCHS) National Mortality data (1990-1999).[5]

The Census Occupation Code (COC) was used in queries of the mortality data sources. The following 23 COCs in health care professionals with five or more deaths were included in this analysis: 084-089, 095-099, 103-106, 203-208, and 445-447.

The BLS collects the number of work-related injuries and illnesses in private industry each year through the BLS Survey of Occupational Injuries and Illnesses (SOII).[6] A total of 4.3 million nonfatal injuries and illnesses were reported in private industry workplaces through the SOII in 2004.[6] We abstracted the number and incidence rates (per 10,000 full-time workers) of non-fatal occupational illnesses in health care service industries classified by the NAICS through the BLS website.[3]

The NHIS is a cross-sectional household interview survey on the health of the civilian non-institutionalized population of the United States. NHIS data are collected annually from approximately 40,000 households and the survey includes about 100,000 people.[4] We used 2004 NHIS data for persons aged ≥ 18 years with available information on industry (n=27,515). Because of the multi-stage sampling design, the prevalence of respiratory diseases (e.g. asthma and COPD) in health care professionals was estimated with adjustment for sample weights and design effects using the software for Survey Data Analysis (SUDAAN) statistical package.[7] The NHIS included questions on smoking status. In the analysis, subjects were categorized as non-smokers, current smokers, and former smokers based on the smoking status. Non-smokers were defined as those who smoked fewer than 100 cigarettes during their entire life.

For the proportionate mortality ratio (PMR), we used mortality data with occupational information

reported from 23 states for the period 1990-1999.[5,8] Respiratory diseases were restricted to asthma (ICD-9 code 493 and ICD-10 code J45-J46), COPD (ICD- 9 code 490-496 and ICD-10 code J40-J47), tuberculosis (TB) (ICD-9 code 011 and ICD-10 code J40-J47), tuberculosis (TB) (ICD-9 code 011 and ICD-10 code A15-A19), and lung cancer (ICD-9 code 162 and ICD-10 code C33-C34), which were coded as either underlying or contributing cause of death.[9,10] For this report, the PMR is defined as the observed number of deaths with asthma, tuberculosis, and lung cancer in a specified industry/occupation, divided by the expected number of deaths with these diseases. The expected number of deaths was calculated using the total number of deaths in the industry/occupation of interest multiplied by a proportion defined as the number of asthma, tuberculosis, and lung cancer for the condition of interest in all industries/occupations, divided by the total number of deaths in all industries/occupations. A PMR >1.0 indicates that there were more deaths associated with the condition in a specified occupation or industry than expected.

Results and Discussion

Chemical hazards and respiratory diseases

A number of hazards associated with respiratory diseases in health care occupations have been reported in the literature (Table 6.I). A variety of chemicals are used in health care workplaces, particularly in hospitals, dental laboratories, chemical laboratories, and nursing homes. Chemical exposure to health care professionals can occur through inhalation, ingestion, and absorption through the skin or mucous membranes.[11] These chemical exposures include glutaraldehyde, chlorhexidine, ethylene oxide, formaldehyde, silica, methyl methacrylate, cobalt, and chromium dust.[12-20]

Glutaraldehyde is used to disinfect instruments. An association between glutaraldehyde exposure and respiratory health effects is well established.[12,21,22] It has been reported to be associated with asthma in nurses, dentists, respiratory therapists, and health laboratory workers.[12,13,21,22] Another disinfectant, chlorhexidine, has also been associated with asthma in nurses.[14] Chlorhexidine is an active ingredient in various disinfectants and used to prevent and treat the redness and bleeding gums associated with gingivitis.[23]

Ethylene oxide is used as a cold sterilizing agent for medical supplies.[24] It is a powerful disinfectant and a gas sterilant for heat-sensitive surgical items.[25] Its use in hospitals constitutes an important source of potential occupational risk. Acute exposure has been reported to cause pulmonary edema.[15] Allergic asthma has been reported among nurses who might be exposed by handling ethylene oxide-sterilized equipments.[16]

Formaldehyde is usually used in aqueous solutions. Exposure occurs among workers in pathology, and histology laboratories, where formalin (a 37% solution of formaldehyde in water) is used as tissue fixative[24] in renal dialysis units and central supply where formaldehyde is used as a sterilizing agent; and in operating rooms where formaldehyde is used as a disinfectant. Formaldehyde has been reported as an asthmagen in health care professionals including hospital laboratory workers [17] and nurses in renal dialysis.[26, 27]

Health care professionals including nurses and anaesthetic assistants working in operating rooms, labour and delivery areas, and post-anaesthesia recovery units are at risk for exposure to anaesthetic gases. Evidence for an elevated risk of cancer (type of cancer not specified) and asthma in anaesthetic assistants or nurses has been reported.[18,28]

Health care professionals are exposed to natural rubber latex (NRL) which contains a number of allergenic proteins.[29-32] NRL, such as that used in NRL gloves, has been reported to cause asthma and allergy in health care professionals.[29,30] NRL protein allergens contaminating NRL products are the major sensitizing agents. In the case of powdered NRL gloves, NRL protein binds to glove powder during the manufacturing process. This is important, because the protein may be carried aloft on particles of glove powder aerosolised by donning or removal of powdered NRL gloves, creating an inhalation hazard.[33] The prevalence of IgE-mediated latex allergy in health care professionals has generally been reported as higher than in the general population.[31,32] Fortunately, with recognition of the problem and subsequent efforts to reduce NRL allergen exposure, the prevalence of NRL allergy has been declining since its peak in the mid to late 1990s.[34] Reduction in NRL allergy in Germany has paralleled decreases in use of powdered NRL gloves.[35] Decreased symptoms of latex allergy associated with decreased exposure to NRL (by use of personal avoidance practices) have also been reported in the United States.[36-38]

Several types of respiratory hazards have been reported which are specific to dentistry. Methyl methacrylate is used in manufacture of methacrylate resins and plastics for use in dental molds and has been reported to be associated with asthma in dental technicians.[19-24] A study in Swedish dental technicians reported pneumoconiosis among those exposed to cobalt, chromium, and crystalline silica.[20] A recent study reported three silicosis cases in dental laboratory technicians identified through the Sentinel Event Notification Systems for Occupational Risks (SENSOR), indicating that these technicians might be at risk for silicosis as a result of uncontrolled exposure to crystalline silica dust.[39]

Biological hazards and respiratory disease

Health care professionals are at risk for a range of respiratory infectious diseases caused by a wide variety of agents. A few examples include TB, pertussis, influenza, and severe acute respiratory syndrome (SARS).

A resurgence of TB in the United States occurred in the 1990s in association with the HIV epidemic. Data obtained during the resurgence of TB provides information about health care professionals' risk factors. Exposure to patients infected with HIV and multidrug-resistant (MDR) *mycobacterium tuberculosis* was a risk factor for TB infection in health care professionals.[40] In 1994, Fraser and coworkers reported that 86 (24.5%) of 351 physicians at Barnes Hospital in St. Louis were tuberculin positive.[41] The physicians were predominantly U.S. born, Caucasian, and specialists in internal medicine. Only 12% of 351 had received BCG vaccination. Higher rates of tuberculin positivity were found in those who were foreign-born, non-Caucasian, and recipients of BCG vaccination. At the same hospital, 11.3% of over 6,000 employees were tuberculin positive,[42] although only 5% of the U.S. population was estimated to have positive results on tuberculin skin tests (TST).[43] Fortunately, aggressive efforts at TB control have resulted in decreased incidence within the U.S. population. National TB surveillance data indicate that the incidence of active TB

disease among health care professionals declined from 5.4 per 100,000 workers in 1994 to 3.7 in 2000.[44] A study on TST conversion rates in emergency medical service health care professionals (n=7,290) in New York reported that annual conversion rates were 1.3% in 1993, 0.7% in 1994, 0.1 % in 1995, and 0.2% in 1996 (average 0.5%).[45] In 2005, there were 14,097 cases of active TB reported to the CDC, of which 13,544 had occupational information.[46] Of those with occupational information, 419 (3.1% reported incidence rate) occurred among health care professionals.

Outbreaks of pertussis, a vaccine-preventable disease, have been reported among health care professionals.[47,48] In September 1999, a pertussis outbreak was detected among surgical staff of a 138-bed community hospital. Twelve (23%) of 53 Health Care Professionals who worked in the surgical unit had clinical pertussis.[47] Reports in the literature indicate that infected health care professionals can transmit Bordetella pertussis within health care institutions.[49-51]

Health care professionals are at risk for exposure to patients with influenza. Outbreaks of influenza virus infections have especially been a problem in nursing homes.[52] Despite recent, highly-publicised efforts to prepare for pandemic influenza, vaccination rates for seasonal influenza among health care professionals is low. Data from the 2000 National Health Interview Survey (NHIS) shows only a 38% influenza vaccination rate in health care professionals.[53] Similarly, a study on influenza vaccination rate among emergency department personnel in Canada reported a vaccination rate of 37%.[54] A recent survey on use of and attitudes toward influenza vaccination among hospital health care professionals in New York reported that the overall influenza vaccination rate was 50% and the reasons for low vaccination rate were misconceptions regarding influenza vaccine efficacy, concerns about adverse effects, and fear of contracting illness.[55]

A total of 19 SARS cases were reported in 2003. Five of these cases occurred among health care professionals who were exposed to suspected SARS cases.[56] A recent study on an outbreak of SARS among hospital workers in Hong Kong reported that SARS incidence was highest among health care assistants, followed by physicians and nurses (8%, 5%, and 4% respectively).[57] Other viruses such as hantavirus,[58] respiratory syncytial virus,[59] and adenovirus[60] have been reported as causing serious pulmonary infections in health care professionals.

Physical agent and respiratory diseases

Radiation

Radiation exposure has been linked to the development of lung cancer.[61-63] Health care professionals represent the largest group of individuals occupationally exposed to radiation. Radiation is a common physical agent widely used in various diagnostic procedures and protocols. The average radiation dose in health care professionals has been reported to be 0.7 mSv/year.[64] Health care professionals' exposure to radiation is regulated by the Occupational Safety and Health Administration, and performance of radiation machinery is regulated by the Center for Radiologic Devices, within the Food and Drug Administration.[64] Health care professionals may be at risk for radiation exposure during diagnostic radiography, while treating patients with external beam radiation or radioactive implants, and through exposure to the body

fluids of patients who have received diagnostic or therapeutic treatment with radioactive agents. A 1990 report estimated that 306,000 health care professionals in hospitals, clinics, and dental clinics were potentially exposed to radiation but no respiratory diseases in these exposed workers were reported.[65] However, a large study in U.S. radiologic technologists (n=90,305) during 1983-1998 reported that the standardised incidence ratio (observed incidence cases compared to expected cases based on calendar year-specific cancer rates from the Surveillance, Epidemiology and End Results Program [SEER]) for lung cancer was 0.77 (95% CI, 0.70-0.85), indicating these radiologic technologists experienced decreased risk for lung cancer relative to the general population.[63] This standardized incidence ratio was not controlled for tobacco smoking, which is the leading cause of lung cancer globally.

Medications

Occupational exposure to antineoplastic drugs and laxatives has been associated with the development of asthma and cancer.[11,66-70] Psyllium laxatives have been identified as causing occupational asthma in nurses preparing psyllium at work[66-70] and in employees of the pharmaceutical industry who are not health care professionals[67-69], Psyllium is a high molecular weight gum, a member of the Plantago weed family that is widely used as a laxative.[66] The prevalence of occupational asthma was 4.1% among 197 nurses exposed to psyllium in chronic care hospitals in Quebec.[66] Aerosolised ribavirin and pentamidine are associated with an increased risk of asthma-like symptoms in respiratory therapists.[13,71-74] Aerosolised ribavirin is used primarily to treat respiratory syncytial virus infection in infants, while aerosolised pentamidine is used primarily for the treatment of Pneumocystis carinii pneumonia.[13]

Respiratory illness and mortality statistics

The incidence rate (per 10,000 full-time workers) for non-fatal respiratory conditions in health care professionals in 2004 are compared with other non-fatal occupational illnesses (Table 6.2) Incidence rates for respiratory conditions ranged from 3.2 to 9.6 by NAICS codes for health care services. The highest incidence rates were found in other ambulatory health care services (9.6 per 10,000 full-time workers) and hospitals.[9,2] By comparison, the incidence rate in all industries was 2.0.

The prevalence of asthma and COPD was estimated in health care professionals in three health care service categories (NAICS codes 621-623) (Table 6.3). The prevalence of asthma among non-smokers in ambulatory health care services (NAICS code 621), hospitals (NAICS code 622), and nursing and residential care facilities (NAICS code 623) was 8.7%, 5.9%, and 11.0%, respectively. The prevalence of COPD among non-smokers was the highest (5.3%) in ambulatory health care services, followed by nursing and residential care facilities (4.2%).

Proportionate mortality ratios (PMR) were determined for asthma, COPD, TB, and lung cancer based on mortality data in 23 states from 1990 to 1999 (Table 6.4). PMR for asthma was significantly increased in eight of the occupational groups and highest in respiratory therapists (3.08, 95% CI, 1.64-5.26), followed by health diagnosing practitioners (2.17, 95% CI, 1.09-3.89).

The PMR for COPD was slightly elevated in registered nurses (with a very small statistically

significant increase at 1.03, 95% CI,1.01-1.06) and nursing aides, orderlies, and attendants (1.15, 95% CI, 1.11-1.18). PMR for lung cancer was marginally elevated in health aides, except nurses (1.15, 95% CI,1.00-1.23). PMR was significantly reduced for COPD and lung cancer among dentists and physicians, possibly due to less smoking among those groups, e.g. 2000 NHIS data indicate a prevalence of smoking in physicians of 3.7%.[8]

PMR for TB was significantly elevated in clinical laboratory technologists and technicians (1.92, 95% CI, 1.07-3.16). PMR was elevated in health diagnosing practitioners and registered nurses but not statistically significant.

Considerations for Prevention

Health care professionals are potentially exposed to a wide range of occupational respiratory hazards from infections, chemicals (including medications) and physical agents. Although it is possible to prevent or reduce worker exposure to these hazards, workers in health care are experiencing higher rates of respiratory illness compared with all private industries according to the BLS data.[3] Compared with all industries, *health care and social assistance* had a 2.6-fold greater incidence rate, and other ambulatory care services *(ambulance services and all other ambulatory health care services including blood and organ banks)* had nearly a 5-fold greater incidence rate for respiratory conditions. These findings suggest that the health care industry would be an appropriate area to focus on developing and implementing prevention and control strategies to reduce the burden of respiratory diseases.

Chemical hazards in health care professionals should be controlled to reduce related health outcomes, particularly asthma. Asthma prevalence is significantly higher in health care professionals than in the general population. Asthmagens including glutaraldehyde, formaldehyde, ethylene oxide, and natural rubber latex[13,16,18,75] should be controlled in health care facilities. Decreases in exposure of health care professionals to NRL have been associated with decreases in latex-related occupational asthma[32,76,77]. Emphasis in the health care setting on decreased exposure to other known asthmagens could have similar beneficial effects.

A comprehensive occupational health programme is essential in health care professionals to minimise the risk of occupational illness in chemically-exposed workers. Careful exposure assessment is the framework on which such a programme is built, and medical surveillance should be performed for early identification of at-risk workers.[78] Comprehensive occupational health programmes would play an important role in the correlation of adverse health effects detected in medical surveillance with occupational exposures; such programmes are a powerful tool for advancing occupational health. Worker training is also a critical element in an effective occupational health programme. Control of specific exposures associated with respiratory diseases is necessary. For example, monitoring exposure to glutaraldehyde may be useful in establishing a baseline measurement of exposure and in periodic environmental assessments. Although glutaraldehyde is an excellent cold sterilant and disinfectant, it is also a potent irritant and sensitizer. All those working with glutaraldehyde should be alerted to this potential problem, and efforts should be undertaken to assure that the risk of potential exposure is minimized. Should clinical disease develop, workplace challenge tests have been used to confirm the diagnosis of glutaraldehyde-induced occupational asthma and might be helpful in some cases.[21]

Health care professionals are at an occupational risk for a vast array of infections that cause TB and other respiratory diseases. More than 15 types of airborne infections (e.g. Mycobacterium tuberculosis, respiratory syncytial virus) have been transmitted to health care professionals.[43] Outbreak-associated attack rates to these airborne infections range from 15% to 40%.[43] In many cases, occupational transmission is associated with violation of one or more of three basic principles of infection control: proper hand-washing, vaccination of health care professionals, and appropriate isolation of infectious patients.[43] The transmission of *Mycobacterium tuberculosis* in health care settings continues to decrease because of implementation of infection control measures and reduction in community rates of TB.[79] An important current issue in MDR TB is the emergence of *Mycobacterium tuberculosis* with extensive drug-resistance (XDR) to second-line drugs in the U.S. and other countries.[80] Despite an overall decline in MDR TB incidence in the U.S., the proportion of XDR TB increased slightly from 4.1% in 1993-2000 to 4.5% in 2001-2004, indicating the existence of XDR TB as a serious and emerging public health issue.[80] The Centers for Disease Control and Prevention (CDC) is working to increase awareness of TB domestically among health care providers through educational resources and training courses developed by CDC's TB Regional Training and Medical Consultation Centers.[81]

For influenza and pertussis, improved vaccination rates are needed, since these are both vaccine-preventable diseases. To protect both health care professionals and patients from Bordetella pertussis infection, early recognition of pertussis and early implementation of appropriate intervention in health care settings are needed.[47] Infections resulting from airborne transmission of bacteria or viruses cause substantial illness and occasional deaths among health care professionals. Health care professionals should follow the 2003 CDC guidelines for infection control.[82] Further epidemiologic studies are needed to identify subpopulations of health care professionals in which new infection control strategies, as well as enhanced compliance of established approaches, should be focused.

The PMR for lung cancer in health aides was marginally elevated. It is of note that in contrast to a major study that showed decreased standardized incidence ratio for lung cancer using the SEER database[63] in U.S. radiologic technologists, PMR analysis of mortality data showed no significant association with lung cancer (PMR=1.05, 95% CI, 0.88-1.25;(Table 6.4) in radiologic technicians. This difference may relate to different capture of cases by the SEER morbidity database and the NCHS national mortality database. Efforts should be made to minimise known risk factors for lung cancer (e.g. smoking, radiation, exposure to other carcinogens) in these and other health care professionals.

It should be noted that there are some limitations to this review. The BLS data are from employers' reports, and consequently, the number of cases could be underreported. A recent study reported that the current BLS system for work-related illnesses greatly underestimates the magnitude of these conditions.[83] The NHIS data provide no temporal information on onset of asthma or COPD and also the industry of current employment may not be the industry of employment when asthma or COPD developed. Information on occupations and industries from death certificates was available only for certain years and certain states. Thus, the PMRs only reflect the industrial and occupational profiles for those states in those years. In addition, the usual industry and occupation recorded on each death certificate may not have been the industry and occupation in which the decedent's causative exposure occurred.

Conclusion

The number of health care professionals is large and expected to grow substantially. These workers are exposed to a variety of occupational respiratory hazards. Identifying these hazards is important, because comprehensive exposure prevention and infection control strategies can prevent adverse health effects. However, the respiratory hazards and associated diseases among health care professionals are not well documented in the United States. The data presented here suggest that asthma and respiratory infections are respiratory problems for which health care professionals are at especially increased risk, and for which prevention strategies among health care professionals should be implemented. There is currently no national work-related respiratory surveillance system in the United States. A more comprehensive surveillance system is needed to better evaluate the public health issue of work-related respiratory conditions. Furthermore, there is an increasing need for a surveillance system that allows for the evaluation of the impacts of interventions, which may require surveillance of hazard prevalence.[84]

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Table 6.1 Selected references describing hazards and respiratory disease risks in Health Care Professionals

Hazards	Respiratory disease risks	Associated occupations
Chemical hazards		
Cleaning products, glutaraldehyde	Asthma	Nurses, dentists, respiratory therapists[12,13,75]
Chlorhexidine, alcohol aerosols	Asthma	Nurses[14]
Inhalation anesthetics	Asthma	Anesthetic nurses, anesthetic assistants[18]
Silica	Silicosis	Dental laboratory technicians[39]
Formaldehyde	Asthma	Medical technicians[17]
Methyl methacrylate	Asthma	Dental technicians[19]
Cobalt, chromium, silica	Pneumoconiosis	Dental technicians[20]
Ethylene oxide	Pulmonary edema	Sterilizer operators[15]
	Asthma	Nurses[16]
Allergenic protein Natural rubber latex	Asthma, allergy	Physicians, dentists, nurses, technicians, maintenance staff[29-32]
Biological hazards		
Mycobacteria (Mycobacterium tuberculosis)	Tuberculosis	Nurses, physicians, ward clerks, correctional Health Care Professionals[41,42,44,46]
Bacteria (Bordetella pertussis)	Pertussis	Nurses, physicians[47,49-51]
Viruses: Orthomyxovirus	Influenza	Nurses, physicians[52,53]
Coronavirus	SARS	Nurses, physicians[56,57]
Hantavirus	Pulmonary syndrome	Health Care Professionals[58]
Respiratory syncytial virus	Respiratory infection	Health Care Professionals[59]
Adenovirus	Respiratory infection	Health Care Professionals[60]
Physical hazards		
Radiation	Lung cancer	Radiologists, radiologic technologists[64,61-63]
Chemical hazards (Medication)		
Antineoplastic drugs	Asthma, Cancer	Oncology nurses, pharmacists, laboratory technicians[66-70]
Aerosolised pharmaceuticals		
Ribavirin	Asthma	Nurses, physicians[74]
Pentamidine	Asthma	Health Care Professionals[71-73]
Psyllium (laxatives)	Asthma	Nurses[66,67,69,70]

Abbreviations: SARS=Severe acute respiratory syndrome.

Table 6.2 Number and Incidence rates (per 10,000 full-time workers) of respiratory conditions and other selected conditions in health care industry within the health care and social assistance sector, 2004

Industry	NAICS code	2004 Annual average employment (thousands	Number (Incidence rates per 10,000 full-time workers)					
			Total cases	Skin diseases or disorders	Respiratory conditions	Poisonings	Hearing loss	All other illnesses
All health care and social assistance	62	14,005.7	45,900 (41.7)	7,100 (6.5)	5,700 (5.2)	400 (0.4)	100 (0.1)	32,600 (29.5)
Ambulatory health care services	621	4,937.5	9,300 (24.3)	900 (2.4)	1,300 (3.4)	200 (0.4)	* (0.1)	6,900 (18.0)
Offices of physicians	6211	2,052.2	3,600 (20.9)	300 (1.6)	800 (4.9)	100 (0.3)	(0.1)	2,400 (14.1)
Offices of other health practitioners	6213	524.4	400 (9.7)	* (**)	* (**)	* (**)	* (**)	400 (9.3)
Outpatient care centers	6214	444.7	1,000 (28.5)	100 (3.6)	100 (3.7)	* (**)	* (**)	700 (21.2)
Medical and diagnostic laboratories	6215	188.5	700 (42.4)	* (1.3)	* (**)	* (**)	* (**)	700 (40.2)
Home health care services	6216	770.7	1,400 (27.4)	400 (8.2)	200 (3.2)	* (**)	* (**)	800 (15.7)
Other ambulatory health care services	6219	199.0	1,800 (106.7)	* (2.6)	200 (9.6)	100 (5.5)	* (**)	1,500 (88.2)
Hospitals	622	4,246.7	25,000 (72.9)	3,100 (8.9)	3,100 (9.2)	100 (0.4)	* (**)	18,600 (54.3)
Nursing and residential care facilities	623	2,810.2	9,500 (42.7)	2,600 (11.7)	900 (4.0)	100 (0.3)	100 (0.3)	5,900 (26.4)
All industries		107,551.8	249,000 (27.9)	38,900 (4.4)	17,600 (2.0)	3,300 (0.4)	28,400 (3.2)	160,900 (18.0)

Abbreviation: NAICS=North American Industry Classification System
Numbers of cases are for employers randomly surveyed by the U.S. Bureau of Labor Statistics
*Number less than 50 cases
** Incidence rate less than 0.05 per 10,000 full-time workers

Adapted from U.S. Bureau of Labor. Statistics Occupational Injuries and Illnesses: Incidence rates of nonfatal occupational illness by industry and category of illness, 2004.

Table. 6.3 Estimated prevalence (percent) of asthma and COPD in health care service workers by smoking status, aged 18 and over- U.S. National Health Interview Survey, 2004

	Asthma			COPD		
Health care industry (NAICS code	**Estimated number of cases**	**Percent prevalence (95% CI)**		**Estimated number of cases**	**Percent prevalence (95% CI)**	
		Nonsmokers	**Current smokers**		**Nonsmokers**	**Current smokers**
Health care services (621)	601,920	8.7 (5.2-14.2)	7.2 (5.3-9.7)	444,120	5.3 (3.7-7.5)	9.4 (5.6-15.2)
Hospitals (622)	651,660	5.9 (3.2-10.6)	6.6 (4.8-9.0)	394,036	2.8 (1.8-4.5)	9.7 (6.3-14.8)
Nursing and residential care facilities (623)	340,711	11.0 (7.2-16.3)	7.4 (4.6-11.7)	280,635	.2 (2.2-7.9)	10.3 (6.6-15.8)
All industries	13,104,908	6.3 (5.9-6.8)	7.0 (6.3-7.8)	10,386,668	3.4 (3.1-3.8)	8.4 (7.7-9.2)

Abbreviations: CI=confidence interval, COPD=chronic obstructive pulmonary disease, NAICS=North American Industry Classification System.

Table 6.4 PMR for asthma, COPD, TB, and lung cancer by health care occupation, aged 15 years and over, 1990-1999, based on data from 23 U.S. states+

COC	Occupation	Asthma		COPD		TB		Lung cancer	
		No. of deaths	PMR (95% CI)	No. of deaths	PMR (95% CI)	No. of deaths	PMR (95% CI)	No. of deaths	PMR (95% CI)
084	Physicians	57	1.23 (0.95-1.62)	806	0.52 (0.48-0.56)	19	1.11 (0.67-1.74)	721	0.69 (0.64-0.74)
085	Dentists	26	1.89 (1.23-2.77)	279	0.54 (0.48-0.61)	1	*	218	0.64 (0.56-0.74)
086	Veterinarians	3	*	96	0.73 (0.60-0.90)	2	*	63	0.64 (0.50–0.83)
087	Optometrists	5	1.60 (0.52-3.73)	81	0.67 (0.54-0.84)	-		54	0.66 (0.50-0.87)
088	Podiatrists	-		20	0.40 (0.25-0.62)	2	*	17	0.54 (0.31-0.86)
0.89	Health diagnosing practitioners	11	2.17 (1.09-3.89)	95	0.65 (0.53-0.80)	5	2.59 (0.84-6.05)	77	0.71 (0.57-0.90)
095	Registered nurses	457	1.17 (1.06-1.28)	5,409	1.03 (1.01-1.06)	73	1.23 (0.97-1.56)	3,488	0.99 (0.96-1.03)
096	Pharmacists	26	1.26 (0.82-1.85)	472	0.71 (0.65-0.78)	8	1.22 (0.53-2.41)	341	0.78 (0.70-0.87)
097	Dietitians	54	1.01 (0.77-1.34)	594	0.93 (0.86-1.01)	6	0.56 (0.21-1.22)	373	0.85 (0.77-0.95)
098	Respiratory therapists	13	3.08 (1.64-5.26)	43	1.19 (0.86-1.61)	1	*	40	0.90 (0.64-1.23)
099	Occupational therapists	5	1.66 (0.54-3.89)	47	1.16 (0.85-1.54)	2	*	30	1.04 (0.70-1.49)
103	Physical therapists	9	1.51 (0.69-2.86)	81	1.00 (0.80-1.25)	1	*	46	0.72 (0.53-0.96)
105	Therapists	3	*	46	0.87 (0.64-1.16)	2	*	59	1.08 (0.83-1.41)
106	Physicians' assistants	2	*	27	1.04 (0.68-1.51)	1	*	25	0.97 (0.63-1.43)
203	Clinical laboratory technologists and technicians	47	1.42 (1.04-1.88)	381	1.00 (0.90-1.11)	15	1.92 (1.07-3.16)	312	0.90 (0.80-1.01)

COC	Occupation	Asthma		COPD		TB		Lung cancer	
		No. of deaths	PMR (95% CI)	No. of deaths	PMR (95% CI)	No. of deaths	PMR (95% CI)	No. of deaths	PMR (95% CI)
204	Dental hygienists	3	*	63	1.05 (0.81-1.35)	-		35	0.82 (0.57-1.15)
205	Health record technologists and technicians	5	0.87 (0.28-2.04)	65	0.98 (0.76-1.26)	1	*	59	1.08 (0.83-1.41)
206	Radiologic technicians	9	0.90 (0.41-1.71)	160	1.15 (0.98-1.34)	4	*	128	1.05 (0.88-1.25)
207	Licensed practicial nurses	153	1.18 (1.00-1.39)	1,775	1.09 (1.04-1.15)	18	0.84 (0.50-1.32)	1,085	0.98 (0.93-1.04)
208	Health technologists and technicians	43	1.34 (0.97-1.80)	360	1.00 (0.90-1.11)	8	1.00 (0.43-1.97)	356	1.05 (0.95-1.17)
445	Dental assistants	10	0.68 (0.33-1.25)	176	0.94 (0.81-1.10)	1	*	139	1.10 (0.93-1.31)
446	Health aides, except nursing	52	1.38 (1.04-1.83)	427	1.00 (0.91-1.10)	5	0.61 (0.20-1.44)	376	1.11 (1.00-1.23)
447	Nursing aides, orderlies, and attendants	465	1.15 (1.05-1.26)	4,833	1.15 (1.11-1.18)	88	1.05 (0.85-1.30)	3,476	1.02 (0.99-1.06)

Abbreviations: CI=confidence interval, COC=Census Occupation Code, COPD=chronic obstructive pulmonary disease, No.=number, PMR=proportionate mortality ratio, TB=tuberculosis. *No PMRs presented due to less than 5 deaths.
Dash (-) indicates no deaths.
+Data from 23 states: Colorado, Georgia, Hawaii, Idaho, Indiana, Kansas, Kentucky, Maine, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, South Carolina, Utah, Vermont, Washington, West Virginia, and Wisconsin.

Occupational Health for Health Care Professionals
Caring for the Carers

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Snippets from the foreward contributors:

- *"It will be a good tool to have to protect ourselves against possible hazards and risks at the workplace" - President, Malaysian Medical Association*
- *"The 'Occupational Health for Health Care Professionals – Caring for the Carers is a commendable first for the Asia Pacific Region" - Director General of Health, Malaysia*
- *"We the International Commission of Occupational Health (ICOH) regard this book, Occupational Health for Health Care Professionals to be a highly valuable contribution to Occupational Health" – President, International Commission on Occupational Health & ICOH Scientific Committee "Occupational Health for Health Care Workers*

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