Chapter 11

HEALTH HAZARDS TO HEALTHCARE WORKERS

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INTRODUCTION

This chapter is being published as an update to Chapter 5, Health Hazards to Healthcare Workers, in the previous edition of this textbook.[1] The chapter has been updated to reflect new and emerging technology and medical equipment. Much of the chapter has also been revised to focus on protecting the healthcare worker in stateside military treatment facilities (MTFs) and deployed locations. The references and figures have been updated as well.

Healthcare workers are exposed to many types of health threats, such as the physical, biological, chemical, and environmental hazards listed in Table 11-1. Healthcare facilities, in the best of circumstances, are complex environments that may threaten the worker's health. Deployments during humanitarian and civic crises, natural disasters, and traditional wartime operations pose additional challenges and health threats. To counter these threats, the occupational medicine physician must discern potential hazards, define the extent of exposure, and coordinate with safety and industrial hygiene personnel to develop and implement strategies to eliminate or reduce exposure through appropriate control measures.

In order to accomplish these tasks, the occupational health clinician must work closely with the hospital safety officer and industrial hygiene staff to identify those workers at risk who must enroll in medical surveillance. Further, the occupational health clinician must coordinate with each employee's supervisor to ensure worker participation in the medical surveillance program. Surveillance efforts are documented in the medical treatment record to comply with the Occupational Safety and Health Administration (OSHA) and The Joint Commission's environment of care requirements.

HISTORY

In the past, healthcare facilities were considered safer than industrial sites because employees were not thought of as workers exposed to a wide variety of hazards; however, that perception is far from reality. There are inherent dangers that come with caring for those who are sick and injured; these dangers range from physical injury to illness and death. Measles, diphtheria, and scarlet fever were substantial risks during the 20th century. In the past 2 decades, healthcare workers have been exposed to and died from occupationally acquired hepatitis B (HBV), human immunodeficiency virus (HIV) infection, and multidrug-resistant tuberculosis.[1–3]

Among US industries, hospitals and nursing/personal care facilities have the highest nonfatal injury and illness case rates. Among service-providing industry sectors, healthcare workers and nursing assistants in particular experience the highest risk of injury, with 200 cases per 10,000 workers, which is twice the next highest injury rate and seven times higher than the population average of 28.2 cases per 10,000 full-time workers.[4] The estimated annual death rate for healthcare workers is low at 9 per 10,000 workers compared to 34 per 10,000 workers in the US population.[5]

Most healthcare changes have resulted in improved health and safety conditions for healthcare workers. Handwashing, introduced by Dr Philipp Ignaz Semmelweis (1818–1865), reduced puerperal fever patient mortality in the mid-1800s. During the mid to late 1800s, Florence Nightingale (1820–1910), who believed hospitals were hazardous to both patients and their caregivers, opened windows to allow ventilation and tried to reduce hospital overcrowding.[1,6] The current emphasis on standard precautions is critical to protecting the patient and healthcare worker against blood-borne pathogens and airborne infectious diseases. However, there are many other hazards the occupational medicine physician must discern and protect against, and new hazards continue to appear in hospitals.[7]

For example, while caring for their patients, physicians have been exposed to infectious diseases including severe acute respiratory syndrome, the H1N1 virus (also known as swine flu), the virus that causes Middle Eastern respiratory syndrome (coronavirus), and the Ebola virus, which pose huge respiratory and blood-borne hazards, as well as radiation risks secondary to radiographs, fluoroscopy, and radio-pharmaceuticals. Flammable anesthetic gases pose explosion risks and reproductive hazards to operating room personnel. Stressors to the musculoskeletal system through repetitive tasks such as moving patients or computer work pose ergonomic hazards for healthcare workers and administrative staff. Workplace violence has become widespread, and patient attacks on healthcare workers continue to be a problem in many facilities.[8]

Addressing health hazards and providing good medical surveillance in the workplace are essential to maintaining a healthy and vital healthcare workforce. Organizations such as OSHA, the National Institute for Occupational Safety and Health (NIOSH), and the Centers for Disease Control and Prevention (CDC)

TABLE 11-1

OCCUPATIONAL HAZARDS IN MILITARY HEALTHCARE FACILITIES*

Facility Type	Hazards
Maintenance and engineering	Adhesives Ammonia Asbestos Carbon monoxide Cold Fluorocarbons Fuels Heat Lubricants Noise Solvents Sewage Welding fumes
Nuclear medicine	Biological agents Radionuclides
Pathology	Biological agents Embedding media Fixatives Fluorocarbons Formaldehyde Glutaraldehyde Solvents Xylene
Patient care	Antineoplastic agents Biological agents Hazardous drugs
Pharmacy	Antineoplastic agents Hazardous drugs
Radiology	Magnetic radiation X-radiation
Operating and delivery rooms	Anesthetic gases Antiseptics Biological agents Lasers Methyl methacrylate Sharps
Central Supply	Alcohol Ammonia compounds Biological agents Detergents Dusts Fluorocarbons Formaldehyde Glutaraldehyde Noise Sharps Soaps Xylene
Dialysis units	Biological agents Disinfectants Formaldehyde
Dental service	Anesthetic gases Biological agents Formaldehyde Glutaraldehyde Methyl methacrylate Radiation Noise Vibration
Housekeeping	Biological agents Detergents Disinfectants Glutaraldehyde Soaps Solvents Sharps
Veterinary clinic	Anesthetic gases Biological agents Glutaraldehyde Disinfectants Methyl methacrylate Noise Pesticides Radiation Sharps Soaps Vibration
Cast and brace shop	Adhesives Dusts Noise Solvents Vibration Ultraviolet radiation

*Musculoskeletal strain, psychological stress, and safety (such as electrical and explosive) hazards are not included.

TABLE 11-2

HAZARDS OF SELECTED SOLVENTS, REAGENTS, AND DISINFECTANTS

Chemical	Main Biological Effects	Type of Work	Work Site
Benzene	Carcinogen (leukemia) Neurotoxicity	Chemistry procedures	Laboratory
Benzidine-based dyes	Carcinogen (bladder) Neurotoxicity	Biological stains Chemistry procedures Print dyes	Histology lab Chemistry lab Print shop
Xylene	Neurotoxicity Cardiovascular effects Reproductive effects Liver and kidney damage	Solvent Tissue processing	Histology lab Chemistry lab
Toluene	Neurotoxicity Cardiovascular effects Reproductive effects Liver and kidney damage	Solvent Tissue processing	Histology lab Chemistry lab
Chromic acid	Carcinogen (lungs)	Tissue processing	Histology lab
Glutaraldehyde	Mutagenicity Respiratory effects Dermatitis	Tissue fixation Disinfection Dermal treatment X-ray file processing	Histology lab Central supply Dermatology Radiology
Azide	Neurotoxicity Cardiovascular effects Respiratory effects	Blood chemistries	Serology lab

Data source: 29 CFR Part 1910.1000, Occupational exposures to hazardous chemicals in laboratories.

provide guidelines listed in Table 11-2 that include recommendations for protecting healthcare workers, including vaccination, isolation precautions, personal protective equipment (PPE), and education. There have been many successes, such as the 1991 OSHA blood-borne pathogen standard,[9] which, combined with childhood immunizations for HBV, has led to the marked reduction of HBV among healthcare workers.[10] However, more can be done to protect the healthcare worker.

PERSONNEL AND POPULATIONS

All military and civilian personnel must be medically screened to ensure they meet the medical requirements for deployment. These requirements include updated and country-appropriate immunizations, a 6-month supply of the individual's medications, PPE, specific training on health threats, and appropriate medical surveillance documentation, including a medical summary of the individual's medical diagnosis. However, recent deployments have changed to include an increasing number of government service civilians, contractors, and coalition partners who provide specialized services to support military operations. After action reports and studies estimated that 19,000 civilians and contractors worked beside US troops during the first Persian Gulf War.[11]

Contractors who deploy with active duty and civilian employees must meet the combatant commanders' guidance requirements for medical fitness standards and entry into theater. Contractors, however, are sometimes not screened as rigorously before deployment as military and civilian personnel. Thus, contractors may not meet medical deployment requirements, may not be free of infectious diseases such as active tuberculosis, and may inadvertently put the unit and mission at risk. Service regulations define health conditions that prevent someone from deploying; however, providers who screen contractors and civilian employees are often not aware of restrictions or disqualifying conditions. Further, foreign nationals are hired to provide contract support for basic installation operations including food service, grounds maintenance, and Army and Air Force Exchange

Service and commissary operations in deployed areas of operation. Often, these foreign nationals receive little to no health screening, and they have transmitted tuberculosis and other infectious diseases to deployed troops.[11]

Strict requirements are necessary because the austere and hostile conditions limit available resources on the typical deployed operating base. For example, there may be a limited number of refrigerators and cooling units to store temperature-controlled medications. In addition, because the fighting force's health is first priority, care at deployed MTFs is limited to emergency care only for civilians and contractors. Thus, individuals with disqualifying disease conditions require an exception or waiver to deployment policy.[12]

Additionally, deployed US medical personnel often work with coalition and host country populations. In Operation Enduring Freedom in Afghanistan and Operation Iraqi Freedom in Iraq, the United States acted in coalition with 60 other countries. Thirty of the coalition partners were from developing countries. Baseline health; language barriers; medical credentialing; health maintenance (medications, surgical procedures, etc); environmental and personnel exposures; and readiness requirements are some of the issues healthcare providers face while working with coalition and host nation partners in the deployed MTF. For example, required medical clearance, immunizations, and prophylaxis for malaria, while standard for a deployed US service member or civilian employee, may not be routine or required in coalition or host nation forces. The coalition forces may also have a higher incidence of tuberculosis and other infectious diseases endemic to their place of origin.[11]

TYPES OF HAZARDS

In healthcare and research facilities, workers are routinely exposed to chemical, biological, radiological, physical (including ergonomic), and psychosocial hazards. Since September 2001, hazards from terrorist activities have added another dimension to protecting the healthcare facility, patients, and staff.[13] The potential terrorist threat includes weapons of mass destruction such as chemical and biological warfare agents, radiation hazards from dirty bombs, and high-yield explosives. Comprehensive risk identification, hazard reduction or elimination plans, and a response plan in the event of a terrorist incident are required components for every healthcare facility using good industrial hygiene practices and physical security measures.

Chemical Hazards

Healthcare workers are exposed to chemicals by skin contact, inhalation, or ingestion. Exposure effects range from no effects to acute or chronic and long-term effects. The chemical may be a mild irritant, or it may produce more severe reactions such as tumors or cancer because of mutagen, teratogen, or carcinogen properties. The extent of health effects depends on the exposure concentration and duration, the exposure route, and the substance's physical and chemical properties. When a healthcare worker is exposed to two chemicals simultaneously, health effects can potentiate or decrease, depending on the mixture's chemical properties. In most cases, acute exposures from chemical accidents, spills, leaks, fires, and ventilation failures pose a greater risk than chronic exposure because they happen more frequently and the chemicals' concentrations can be significantly higher.

In the healthcare setting, the most common toxic effect of chemical exposure, and the most prevalent occupational illness, is contact dermatitis. Nurses who administer drugs and housekeeping staff who routinely use cleaners and disinfectants have the most frequent contact dermatitis cases. Several cleaners, disinfectants, and solvents increase the risk of developing contact dermatitis among kitchen, radiography, pathology, nursing, surgical, and maintenance staff (see Table 11-2).[14–16]

Healthcare workers are often exposed to potentially hazardous aerosols and vapors (see Table 11-1). Chemicals with mutagenic, teratogenic, and carcinogenic properties, and those with acute toxicity, including anesthetic gases, antineoplastic agents and hazardous drugs, glutaraldehyde, formaldehyde, mercury, and methyl methacrylate are further discussed below.

Anesthetic Gases

Anesthetic gases, such as nitrous oxide, halothane, methoxyflurane, enflurane, desflurane, sevoflurane, and isoflurane, can be released into healthcare facility work areas including operating rooms, labor and delivery rooms, dental and veterinary clinics, and recovery rooms.[17–22] Studies show that exposures to anesthetic gases are kept well below the permissible exposure limit and threshold limit value.[7] However, workers have reported short-term neurotoxic effects at low exposure levels including drowsiness, irritability, depression, headache, nausea, fatigue, and impaired judgment and coordination.[17–22] These symptoms can be dangerous for operating room staff, including nurses and doctors, who need unimpaired judgment

and coordination to perform successful operations. When workers experience these symptoms, the occupational health clinician should consult with a safety and industrial hygiene professional to check equipment for leaks.

Assessing the long-term effects of exposure to anesthetic agents on human health is difficult and controversial. There are few epidemiological studies on the low-dose exposure to waste anesthetic gases (WAGs) and related health effects, most of which are retrospective epidemiological and animal studies. A 1985 study suggested that chronic exposure to WAGs is associated with an increased risk of spontaneous abortion in exposed women and the wives of exposed men.[23] Recently studies have shed more light on exposures in the workplace,[24,25] and other potential adverse reproductive effects include infertility, low birth weight, and congenital abnormalities.[26]

Whether anesthetic gases are carcinogenic is subject to analysis because of structural similarities between the known human carcinogens (dibromoethane, dichloroethane, *bis*-chloromethyl ether, and chloromethyl methyl ether) and several of the halogenated inhalation anesthetics now in use.[27–33] In addition, anesthetic compounds can be transformed into reactive metabolites, which may combine with tissue macromolecules to initiate a carcinogenic event.[31–33] Several studies have noted elevated rates of some cancers in hospital personnel who are chronically exposed to anesthetic gases. Anesthesiologists had a higher cancer rate for reticuloendothelial and lymphoid malignancies than the general population, and nurse anesthetists had a threefold increase in malignancies compared to the general worker population.[28,33]

Although no federal standard for WAGs exists, OSHA, NIOSH, and the American Conference of Governmental Industrial Hygienists recommend control of occupational exposure to WAGs.[20,22] The Army promulgated *Guidelines for the Recognition, Evaluation, and Control of Occupational Exposure to Waste Anesthetic Gases* (Technical Bulletin, Medical, 510) to ensure exposures are controlled and medical surveillance is performed on healthcare workers exposed to anesthetic gas.[34] There are preplacement, periodic, and postexposure surveillance requirements.

Exposure to WAGs can be controlled by ensuring employees are aware of their sources. Exposures usually result from careless work practices such as improperly sealing the patient's mask, failing to eliminate anesthetics before removing the patient's mask or endotracheal tube, or failing to wash anesthetic gas from the patient's lungs with oxygen. Properly functioning scavengers and ventilators control exposure to waste anesthetic gases and have reduced or eliminated significant exposures in healthcare workers.[7] However, leaking anesthetic equipment, inadequate waste-gas collection and scavenging systems, and poor general ventilation have also led to exposures. The WAG scavenging system's exhaust should be as far away as possible from the environmental control unit's air intake.

Antineoplastic Agents and Hazardous Drugs

NIOSH defines hazardous drugs as those that exhibit carcinogenicity, teratogenicity, reproductive toxicity, organ toxicity, and genotoxicity.[35] Antineoplastic agents inhibit tumor growth by disrupting cell division and killing actively growing cells.[35] They can be divided into five drug classes: alkylating agents, antibiotics, antimetabolites, mitotic inhibitors, and a miscellaneous class.[35,36] Antineoplastic agents (cytotoxic drugs) make up most of the hazardous drugs on the NIOSH list, which also includes antiviral drugs, hormones, and bioengineered drugs.[36] OSHA established guidelines for healthcare workers for the safe handling of antineoplastic agents.[37] These guidelines recommend the use of laminar flow biological safety cabinets during drug preparations, as well as PPE, worker education, specific standard operating procedures for drug handling, and medical surveillance for workers. The guidelines also call for the preparation of antineoplastic agents in a class II, type B, biological safety cabinet that is vented to the outside of the facility.[37]

While there is agreement that the guidelines have reduced hazardous drug exposures in the workplace, sampling for contamination in healthcare facilities shows widespread contamination exists.[38] Furthermore, these exposures result in reproductive hazards and genetic changes including alterations on chromosomes 5 and 7.[39,40] The Army has developed safe handling procedures for hazardous drugs and antineoplastic agents, which are commonly used in the larger medical centers and hospitals, but are rarely used in deployed settings.[41]

Alkylating agents act by covalently binding to deoxyribonucleic acid, thus interfering with normal deoxyribonucleic acid replication. Antibiotics work as deoxyribonucleic acid intercalators and interfere with transcriptional processes in protein synthesis. Antimetabolites block synthesis of essential cellular building blocks such as folate, purines, and pyrimidines, thereby inhibiting protein synthesis. Antimitotic agents act primarily as spindle poisons and block mitosis and normal cell division. The miscellaneous category contains agents with various effect

mechanisms. Several of these agents are mutagenic, carcinogenic, and toxic to the reproductive system (see further discussion below).[42]

Patients treated with these drugs have had significant adverse outcomes including hematopoietic effects and occurrences of second malignancies (usually hematological), impaired reproductive function, immunosuppression, and malformed infants born to treated mothers.[42] These reports, together with laboratory evidence of the mutagenic activity of antineoplastic agents, have triggered concern about possible long-term health risks to healthcare personnel who handle these drugs.

A meta-analysis of 14 studies performed from 1996 to 2004 in the United States and Europe noted an association between exposure to antineoplastic drugs and adverse reproductive outcomes such as fetal loss, low birth weight, and spontaneous abortion.[43] Another study in China reported significant decreases in full-term births, premature births, spontaneous abortions, and congenital malformations.[44] These findings suggest a significant reproductive risk may exist for workers who handle antineoplastic agents during pregnancy.

A study performed by Skov in Denmark noted a link between cancer and healthcare worker exposure to antineoplastic agents. A significantly increased risk of leukemia was observed in oncology nurses for the period 1943 to 1987, and an increased risk of leukemia was observed in physicians who worked a minimum of 6 months in the department administering drugs.[45] Thus, occupational exposure increases the risk of mutagenicity and cancer risk in nurses and pharmacists following exposure.[41]

Glutaraldehyde

Glutaraldehyde is routinely used in healthcare facilities as a cold sterilant for heat or moisture-sensitive equipment and instruments. It is typically packaged in a 2% solution and supplied in jugs, which are dumped into the sterilizers situated throughout the hospital in endoscopic units, operating rooms, intensive care units, and dialysis units. There are OSHA best practices for the safe use of glutaraldehyde and a NIOSH alert on glutaraldehyde.[46,47] Glutaraldehyde's entry route into the body is through inhalation and dermal absorption.[48,49] Glutaraldehyde is a mucus membrane and respiratory irritant that causes respiratory and skin sensitization, asthma, rhinitis, contact dermatitis, and wheezing.[48,49] NIOSH recommends fully automated and enclosed sterilizers that use glutaraldehyde to disinfect sigmoidoscopies and colonoscopy scopes.[47]

Formaldehyde

Formaldehyde is used as a tissue preservative in hospital laboratories and autopsy suites and as a disinfectant in dialysis units and central supply where most medical instruments are sterilized and packaged for the next use.[50] Formaldehyde use in hospitals has been poorly controlled. As with other hazardous chemicals, the effects of formaldehyde depend on the duration and extent of the exposure. Low levels of exposure (<1 ppm) may cause direct irritation of the skin, eyes, nose, throat, and lungs.[50] Higher concentrations (10–20 ppm) may cause coughing, chest tightness, increased heart rate, and a sensation of pressure in the head. Concentrations of 50 to 100 ppm are associated with pulmonary edema and death.[51]

Repeated exposure to formaldehyde vapors causes sensitization in some healthcare workers, which may occur days, weeks, or months after the first exposure. Immunogenic responses include eye irritation, upper respiratory irritation, or an asthmatic reaction at exposure levels too low to cause symptoms in most people. Reactions can be quite severe, with swelling, itching, wheezing, and chest tightness.[51] Direct contact with formaldehyde solutions can cause severe eye injury and corneal damage as well as dermatological symptoms. Skin contact with solutions as dilute as 4% can trigger primary irritation. Dermatitis (including red, sore, cracking, and blistered skin) is a common complaint.[52] As a reactive alkylating agent, formaldehyde is a potent human carcinogen.[52] Several animal studies have demonstrated that formaldehyde is a mutagen and a carcinogen. In addition, human epidemiological studies have associated formaldehyde exposure with cancers of the lung, nasopharynx, oropharynx, and nasal passages.[52]

OSHA currently regulates formaldehyde: the permissible exposure level for an 8-hour time-weighted average is 0.75 ppm; the 15-minute short-term exposure limit is 2.0 ppm; and the *action level* (the level at which workers must be enrolled in medical surveillance programs) is 0.5 ppm.[51]

Occupational exposures can be reduced by:

- substituting safer products,
- using laboratory hoods,
- wearing appropriate PPE,
- instituting good work practices,
- installing and maintaining general ventilation, and
- training healthcare workers about relevant hazards and exposure precautions.[49]

Mercury

Mercury has been removed from almost all industrial and healthcare settings because of its acute and chronic toxicity, which prompted the establishment of occupational exposure standards and controls. Service members may still be exposed to mercury in dental clinics.[53–55] Mercury dust is generated in dental clinics when mercury-containing amalgam is cut, or ground out when older fillings containing mercury are removed.[53–55] Mercury is adsorbed through inhalation and skin contact. Good work practices including wear of appropriate PPE, periodic air monitoring, use of local exhaust ventilation, and employee education can prevent mercury exposure.[53–55]

Methyl Methacrylate

Methyl methacrylate is an acrylic cement derived from mixing a liquid containing methyl methacrylate monomer with polymethyl-methacrylate powder. It is used in orthopedic and dental applications, and prepared immediately before use.[56] Healthcare workers are exposed through inhalation and skin contact. Personnel at risk of methyl methacrylate exposure include technicians who work with dentures and hearing aids, orthopedic surgical personnel who use methyl methacrylate cement for fixation of prostheses, and pathology personnel who imbed histological preparations.[56]

Methyl methacrylate is an eye, skin, and mucous-membrane irritant that causes contact dermatitis, pulmonary sensitization, and occupational asthma.[57] NIOSH reported that health effects including dermatitis, genitourinary, and respiratory complaints were common in workers exposed to methyl methacrylate at concentrations lower than 50 ppm.[56] Exposure can be reduced by mixing methyl methacrylate under hoods equipped with local exhaust ventilation; wearing PPE including goggles to protect the eyes, gloves to protect the hands, and an impermeable apron to protect the body; practicing careful personal hygiene; and providing health education regarding the hazards of methyl methacrylate.[56,58]

Biological Hazards

The occurrence of occupational diseases in the healthcare industry has recently received considerable attention with the outbreak of Ebola in Africa and Middle East respiratory syndrome. Healthcare workers can become infected by patient contact or through contact with patient specimens in the laboratory. Bacterial, viral, fungal, and parasitic organisms pose a constant threat to the unprotected healthcare worker and patients. Medical, dental, and laboratory workers as well as housekeepers, laundry, maintenance, and supply personnel are at risk of infection through contact with patient waste, soiled laundry, and contaminated equipment.

Tuberculosis, varicella, and rubella continue to pose a risk to healthcare workers and patients despite major efforts to control these diseases. In addition, emerging diseases, such as Middle East respiratory syndrome, severe acute respiratory syndrome, and Ebola pose new threats to workers and patients. Healthcare facilities must be prepared to respond to these new threats as well as the traditional biological warfare threats, smallpox, and anthrax. Further, methicillin-resistant *Staphylococcus aureus* (*S aureus*) has become a major problem in many healthcare facilities.

In Southwest Asia, military healthcare facilities encountered another hard-to-control organism when *Acinetobacter baumannii* was found in the wounds of surgical patients. This threat quickly became a nosocomial infection risk and forced staff to reemphasize the importance of infection control practices in the deployed setting.[59]

Hepatitis B and Hepatitis C

Healthcare workers may become infected by blood-borne pathogens directly through needlesticks or splashes of blood-containing fluids to the mucous membranes, or indirectly, through contaminated work surfaces. Hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV) pose the greatest risk of blood-borne pathogen infection for healthcare providers.[60] The CDC notes that the risk of HBV transmission in the occupational setting is greater than that for HIV or HCV, and practices that reduce the transmission of HBV also prevent the transmission of HCV and HIV.[60] HBV can cause persistent infections, chronic liver disease, and hepatocellular carcinoma. In acute illness, it causes fever, anorexia, jaundice, and acute liver failure.[60] HCV infections generally cause chronic infection, and 10% to 15% of infected patients will develop cirrhosis. HIV infection may cause an initial infection with flu-like symptoms. Untreated HIV will damage the immune system and progress to AIDS (acquired immune deficiency syndrome).[60]

There are 66,000 new cases of HBV; 16,000 new cases of HCV; and 1,000 new cases of HIV infection worldwide each year due to needlestick injuries.[61] Healthcare providers are at risk of blood-borne pathogen infection in intensive care units, operating rooms, emergency rooms, inpatient units, and transport teams. Almost all workers at a facility are at risk, including physicians; surgeons; nurses; nursing assistants; laboratory staff;

technicians; students; and service employees in departments such as laundry, dietary, environmental services, and maintenance. Personnel who handle medical waste are also at increased risk. Paramedics, emergency medical technicians, and public safety employees who work in prehospital evaluation and patient management must also comply with the OSHA regulations and utilize standard precautions.[60]

The most common causes of needlestick injury are manipulating a needle inside a patient (26%); disposing of a needle or scalpel (21%); bumping into a coworker (10%); and recapping needles (5%).[62] These percentages vary by country because the levels of engineering controls and patient safety education among healthcare providers differ. Devices most often involved in needlestick injuries are disposable syringes (30%), suture needles (20%), winged steel needles (12%), scalpel blades (8%), intravenous catheter stylets (5%), and phlebotomy needles (3%).[62]

Title 29 Code of Federal Regulations 1910.1030, Blood-borne pathogens,[9] was published in December 1991 and amended in April 2012. These OSHA regulations require employers to develop a written exposure control plan; use engineering controls (safe needles, sharps containers, needleless systems); issue PPE to healthcare workers; offer HBV vaccinations; provide safe work practice training to employees; and provide postexposure evaluation and follow-up for workers who have a blood-borne pathogen exposure.[9] The regulation also outlines housekeeping and decontamination procedures for cleaning and discarding sharps and regulated wastes. Healthcare providers must follow standard precautions that include treating blood and body fluids from all patients as if they were infectious, whether or not an infection has been confirmed. The regulations also require good hand hygiene, proper use of PPE, safe injection practices, safe handling of potentially contaminated equipment or surfaces, and respiratory hygiene.[9]

Needleless systems that can replace or eliminate unnecessary sharps in cost-effective ways are now required.[63,64] For example, towel clips in surgery can be eliminated and hollow bore needles can be replaced. Attention to best practices can eliminate the risk posed by exposed needles on a syringe after use and needles attached to tubing, such as butterflies, that can be difficult to place in sharps containers.[65] Sharps containers must be present in all areas where sharps are generated. Containers must be closable, puncture-resistant, leak-proof, spill-proof, and contamination-free. The level of sharps inside the container must be visible and the container must be changed when three-quarters full. The sharps container must be placed no higher than 54 in from the floor with easy access.[65]

Needleless systems and other engineering controls have greatly reduced needlestick and sharps injuries. The needlestick injury rate has gone from 5 per 10,000 to 0.06 per 10,000 between 2001 and 2010.[63] Infusion therapy needleless devices have decreased needlestick injuries related to intravenous connectors by 62% to 88% over the same timeframe.[64] Needleless systems deliver medication and fluids through a needleless catheter port. Jet injection systems, which inject medications below the skin or into the muscle, are also needleless. Syringes must have needlestick prevention features like needle retraction or a shield that caps the used needle. Healthcare providers are strictly prohibited from recapping used needles. Safe needle and self-blunting features have reduced phlebotomy needlestick injuries by 80%.[65] Blunt tip suture needles have reduced the risk of injury by 69% in operating rooms and surgical suites.[66]

The Department of Defense requires personnel in fixed and deployed hospital settings to follow 29 CFR 1910.1030. Additionally all medical treatment facilities must have an exposure control plan that has been reviewed and accepted by the executive hospital leadership and is available to all employees. Refer to Attachment 11-1 for a model copy of a blood-borne pathogen exposure control plan that can be adapted to specific work settings.

Human Immunodeficiency Virus

The CDC issued guidelines on August 21, 1987, for preventing HIV transmission in healthcare facilities, which state that healthcare workers should assume all patients are infectious for HIV and other blood-borne pathogens.[67] The CDC reported that as of December 31, 2013, there have been 58 confirmed and 150 unconfirmed occupational transmissions of HIV in the United States.[68] The CDC estimates that healthcare workers who experience a needlestick injury will become infected in 2.3 out of 1,000 cases.[68] In 2013, the CDC updated guidelines to manage healthcare worker exposures to HIV and postexposure prophylaxis.[69] In 2017, Markelz published recommendations that update the CDC guidance regarding the proper medications, dosing, and required follow-up for affected healthcare providers.[70]

Tuberculosis

Mycobacterium tuberculosis (M tuberculosis) is a bacterium that causes tuberculosis. *M tuberculosis* grows slowly in the lungs and can remain dormant for a long time.[71–73] *M tuberculosis* is transmitted through airborne particles called droplet nuclei, which are formed when

individuals with pulmonary or laryngeal tuberculosis cough, sneeze, shout, or sing. The droplets are 1 μm to 5 μm in size, remain airborne for prolonged periods of time, and spread throughout the healthcare facility.[71–73] Patients who are immunocompromised, or who have HIV, diabetes, poor nutritional status, silicosis, or end-stage renal failure are at a higher risk for developing tuberculosis. Other risk factors include overcrowded living conditions, smoking, indoor air pollution, alcohol use, corticosteroid therapy, malignancy, and genetic susceptibility.[71–73]

Latent tuberculosis infection in the patient population can range from 20% in the developed world[74,75] to about 70% in the developing world.[76] The annual rate of *M tuberculosis* infection in hospital workers ranges from 0.1% to 2% in unexposed hospital administrative personnel to from 1% to 10% among healthcare providers who perform high-risk procedures in pulmonary care, surgical services, and laboratory services.[74] However, the risk of tuberculosis transmission varies depending on the healthcare setting, the prevalence of tuberculosis in the general population, and the type of exposure. The annual incidence of *M tuberculosis* in healthcare providers is 60 per 100,000, compared to the general population incidence of 25 per 100,000.[77] Active *M tuberculosis* is symptomatic in three-quarters of the cases, and patients may exhibit clinical signs of persistent cough for 2 or more weeks, low-grade fever, weight loss, and night sweats. Most patients contract pulmonary tuberculosis, but *M tuberculosis* can infect any organ, so the signs and symptoms may vary.[73]

The OSHA "General Duty Clause"[78] requires healthcare facilities to adhere to the CDC's guidelines for control of tuberculosis transmission in healthcare facilities. Administrative measures mandated by the CDC are critical to reducing the transmission risk of tuberculosis.[71,79] The CDC guidelines include a written infection control plan, prompt detection and isolation of suspected cases, staff training materials, rapid reporting of diagnostic tests, and tuberculosis education materials for patients and their families. Healthcare facilities must perform an individualized, location-specific risk assessment of *M tuberculosis* within the facility. This risk assessment triggers a number of requirements that moderate- and high-risk facilities must meet, such as whether routine tuberculin skin testing should be performed on healthcare providers and whether isolation rooms must be available. Healthcare providers who have a positive reaction must be evaluated for treatment of active or latent *M tuberculosis* infection.[71,79]

Environmental controls help prevent the transmission of *M tuberculosis* in healthcare facilities. These controls include local exhaust ventilation, general mechanical ventilation, room air high-efficiency particulate filters, and ultraviolet germicidal irradiation units. Local exhaust ventilation is used in locations where patients undergo aerosol-generating procedures, such as sputum induction and pentamidine inhalation therapy.[71,79,80] Local exhaust ventilation is also used in autopsy rooms to reduce exposure to pathogens and embalming vapors. Class II biological safety cabinets should be used in laboratories where *M tuberculosis* tests are performed and infectious aerosols may be generated.[81]

Patients thought to have the *M tuberculosis* infection should be moved to an airborne infection isolation room. The isolation room should have twelve air changes per hour.[80] Older buildings are still allowed to have six air changes per hour. If the room uses recirculated air, it should pass through high-efficiency particulate air filters. All patient rooms and patient isolation rooms should be maintained at a slight negative pressure.[80] Ultraviolet germicidal irradiation can be effective if installed properly and carefully maintained.[82] The room airflow rate must be slow enough to properly irradiate the air, and the humidity must be kept below 70%.[81]

Healthcare providers do not always don their respirators before entering the room of a patient suspected of having *M tuberculosis*. Healthcare providers who perform high-risk procedures must wear an N95 high-efficiency particulate filtering respirator at a minimum. Healthcare workers also need extra encouragement to perform annual respirator fit testing and seal checks.[79] The Institute of Medicine reviewed respirator use in healthcare facilities by comparing the effectiveness of N95 respirators and surgical masks. The N95 respirator was found to be superior to surgical masks in filtering efficiency and protection when fitted and used correctly.[83–86]

Latex

Natural latex rubber is made from the white sap of commercially grown rubber trees. Latex contains the proteins hevein and chitinase, which are thought to cause allergic reactions in some people. For this reason, latex rubber gloves are being phased out of the healthcare industry.

Prepowdered gloves that are treated with cornstarch adsorb latex allergenic proteins. Repeated glove donning and removal generates a large amount of latex allergen. These particles remain airborne for up to 24 hours and travel throughout ventilation systems.[87] In addition, some common medical devices contain natural latex, including blood pressure cuffs, bulb syringes, catheters, dental coffer dams, elastic bandages, endo-

tracheal tubes and airways, enema syringes, ventriculoperitoneal shunts, finger cots, intravenous-access injection ports, manual resuscitators, penrose surgical drains, pulse oximeters, stethoscope tubing, stretcher mattresses, tourniquets, and vascular stockings.[87]

The population at greatest risk for latex allergies includes healthcare personnel who wear latex-powdered gloves and people who have undergone multiple surgical procedures as a result of injury, disease, or chronic conditions (eg, spina bifida, genitourinary congenital defect).[87] Others at risk are those who have severe allergic reactions to certain foods such as banana, kiwi, avocado, and nuts, and individuals who are atopic.[87] Latex can cause allergic or irritant dermatitis, which can be seen several days after initial exposure or may not show up for several weeks. Allergic symptoms include rhinitis, conjunctivitis, asthma, urticaria (hives), facial edema, bronchospasm, and in some cases, anaphylaxis and death.[88–90]

Irritant dermatitis is a nonallergic condition that affects the skin and is usually reversible. Patients complain of dry, itchy, scaly skin, which becomes aggravated by repeated handwashing and contact with irritating alcohol-based hand sanitizer.[88–90] Healthcare facilities have taken great steps to protect latex allergic patients and staff by converting to powder-free and latex-free gloves.[89] Vinyl, nitrile, polymer, and neoprene gloves have nearly replaced latex gloves for routine use in healthcare facilities and pose no risk to latex-sensitive people.[90]

Methicillin-Resistant Staphylococcus Aureus

Staphylococcus aureus (*S aureus*) causes both skin infections and more severe systemic blood infections. *S aureus* is found in hospital settings that are resistant to methicillin and other antimicrobials.[91–93] Mortality is higher in hospital acquired methicillin-resistant *S aureus* (MRSA) infections, so efforts are underway to prevent patient infections. Between 1% and 4% of healthcare providers have MRSA colonization, which commonly occurs as a result of poor hand hygiene.[91] MRSA is a multidrug-resistant organism that is difficult to treat with typical antibiotics. MRSA can also be contracted from patients; identifying infected patients has reduced infection rates more effectively than other control efforts.[91] Humans can contract MRSA from their own nasal bacteria, or by contact with an infected person's sore or from an asymptomatic carrier. Hands are the most common means of transmission.[93] Objects such as clothing and equipment can also be a source of infection. Workers with open wounds, those with chronic illness, and immuno-compromised individuals are more likely to contract MRSA. A recent study noted several MRSA outbreaks caused by a single healthcare provider who transmitted it to patients.[94]

There are no OSHA standards for MRSA. The CDC recommends the following control measures to prevent the spread of MRSA:

- contact precautions,
- proper hand hygiene,
- recognition of previously colonized and infected patients,
- rapid reporting of lab results, and
- the proper training of healthcare providers on control measures.[93]

Healthcare providers should only be tested if there is a persistent cluster of infections in one unit, and all other efforts to identify the source have failed.[94] Employees with staph infections can continue working in most patient care areas. However, infected employees should cover their wounds and follow normal precautions (handwashing, use of gloves, etc).

Radiation Hazards

Ionizing and nonionizing radiation are present in fixed and deployed medical, dental, and veterinary facilities. The radiation safety officer should be consulted to ensure that recommended safe exposure levels are not exceeded within these medical facilities. Distance, time, and shielding are important in determining whether healthcare workers are adequately protected. Ionizing radiation sources are used for diagnostic and therapeutic purposes. Nonionizing radiation sources are used in food preparation and germicidal treatment of room air with ultraviolet light. Refer to Chapter 22, Ionizing Radiation, and Chapter 23, Nonionizing Radiation, for a discussion of workplace controls.

Physical Hazards

Noise

Noise can be a problem in healthcare facilities when it exceeds the OSHA permissible exposure level of 85 dBA, which is an 8-hour time-weighted average. Most healthcare workers are not routinely exposed to this much noise.[95–97] However, high noise levels are a problem in food service, laboratory, maintenance, and engineering facilities. Incinerator rooms, orthopedic cast rooms, administrative areas (printers), and dental clinics (high-speed hand drills) may also have high noise levels.[95–97]

Healthcare providers who deploy may encounter high noise levels when they retrieve patients from air evacuation aircraft and personnel carriers. Fixed- and rotary-wing aircraft, high-mobility multi-wheeled vehicles, air conditioners, and generators all produce high noise levels that range from 80 to 106 dBA. Deployed personnel who work in conditions with high noise levels have a significantly elevated risk of developing hearing loss.[98]

Musculoskeletal Strain

Lower back pain and other musculoskeletal injuries are among the most common injuries among healthcare workers and the most common reason for lost time and limited duty.[99–101] Most workers are injured while lifting or transferring patients.[99–102] Healthcare workers are at increased risk of injury when they use excessive force to lift, push, pull, or transfer patients to a bed, chair, toilet, diagnostic and treatment tables, and stretchers. The risk is increased when providers do not ask for assistance or there are not enough staff to assist.[99–102] Patient handling risks occur in most patient treatment areas. In addition, maintenance and housekeeping staff are at risk of injury when they perform manual material handling. They may be asked to move or lift heavy medical equipment, linen, garbage, cleaning supplies, furniture, tools, food carts, and other equipment.[99–102]

There are no federal ergonomic or lift standards in the United States. Both NIOSH[101] and OSHA[102] have guidelines for the safe handling of patients in healthcare and nursing facilities that call for the elimination of manual patient handling.[101–102] The Facility Guidelines Institute planning guide calls for one ceiling or portable lift for every 8 to 10 patients.[103] There is an excellent return on investment for lifting equipment; it pays for itself in less than 3 years.[104] Several studies have reviewed the medical evidence and reported on the efficacy of lift-assist devices for patient transfers, including total lifts, sit/stand lifts, and stand aids.[105,106] Selection depends on the patient's weight-bearing status and medical condition. Electrically powered ceiling lifts are preferable to portable floor-based lifts because they are easier to turn and need less storage space. Slide sheets with handles are effective when moving patients up in bed or transferring patients from the bed to a stretcher, and when rolling the patient from one side to another to make an occupied bed.[107]

In the deployed environment, personnel are routinely asked to set up medical treatment facilities and tents for sleeping. However, these soldiers may be impaired due to sleep deprivation, jet lag, or lack of acclimatization to altitude or temperature. They are likely also unaccustomed to the task they are asked to perform. Additionally, military healthcare personnel may be wearing body armor and a Kevlar (DuPont; Wilmington, DE) helmet, which add to the lifted weight and decrease maneuverability. Other contributing factors include understaffing, lack of regular training on proper lift procedures, inadequate safety precautions or lift-assist devices, and lack of awareness of lift-assist devices. During deployments, all personnel responsible for setting up and establishing operations of the hospital facility are at risk of sustaining back problems.[108]

The Army has implemented a program to increase awareness of back pain and strain and prevent back injury. The use of lift-assist devices has reduced manual lifting and helped Veterans Administration healthcare facilities reduce back injuries and lower Federal Employee Compensation Act costs. (Refer to Chapter 9, Federal Workers' Compensation Programs, for more information regarding the Federal Employees Compensation Act.)

Environmental Extremes

Soldiers often face environmental extremes and austere environments during operations. Cold, heat, and altitude are encountered in all parts of the world and are still significant barriers to conducting military operations. Medical personnel typically work in environmentally controlled fixed facilities prior to deployment. Acclimatization to a new environment prevents or reduces illness or injuries in medical staff.[109]

Facilities and Medical Maintenance

Field medical operations may be conducted using tents and standard material, supplies, and equipment. Additionally, field medical operations are sometimes carried out in existing facilities (such as buildings located in the training area or area of operations) using material, supplies, and equipment found in the fixed facility. The deployed MTF must have a functioning field sanitation program. Basic services such as water, waste, electricity, and environmental control are essential.[108] The volume of solid waste and wastewater can be significant due to laundry, showers, bedpan washing, handwashing, waste from radiograph units, and disposable supplies.

Appropriate and meaningful evaluations of field MTFs can prevent morbidity and mortality, as well as preserve valuable human resources. Evaluations must be performed by knowledgeable, preventive medicine personnel who are experienced in this area.[108] When conducting a survey, specific aspects of the field sanitation program should be reviewed, including:

- the water supply (water containers and trailers), to ensure it is being monitored and properly disinfected;
- food operations, to confirm basic food sanitation guidance is being followed;
- waste disposal operations (medical and chemical waste, wastewater, and solid waste), to ensure acceptable policies are established and followed;
- arthropod and other animal-control measures, to ensure they are appropriate and adequate;
- safety and health training programs, to ensure relevance to fixed or field environments;
- WAGs, laboratory chemicals, and radiation, to ensure that potential hazards are recognized and controlled; and
- autoclave operations, to ensure sterilization procedures are adequate, and that explosive and burn hazards are controlled.

Psychosocial Hazards

Healthcare workers face a large amount of stress and pressure to meet the physical and psychological needs of patients. Healthcare workers and their supervisors must recognize when stress becomes a problem in the workplace and employ stress-management techniques. Shift work may also be a stressor, particularly when it is assigned without consulting the employee about family circumstances or other considerations.

Emotional Stress

Healthcare workers most at risk for severe emotional stress are those employed in burn units, emergency rooms, operating rooms, and intensive care units. Most emotional stress studies have focused on physicians and nurses, but laboratory and food-service workers may also be affected.[110–114] Excessive stress may lead to physical or emotional exhaustion.[110–114] Stress indicators in workers who demonstrate adaptive reactions include delayed gratification, compulsiveness, and expressing the need for support. These behaviors may lead to physiological and psychological problems including loss of appetite, ulcers, migraine headaches, fatigue, sleep disorders, and oversleeping. Emotional stress may also disrupt social and family life, causing apathy, indecisiveness, and a reluctance to accept responsibility. It can also lead to more serious conditions including substance abuse, mental illness, and suicide.[110–114] To address these problems, Department of Defense leadership has incorporated programs to address stress in the redeployment cycle of service members, including methods for coping with burnout, caregiver fatigue, and work-related stress.

Shift Work

Shift work is a major cause of stress in healthcare facilities, especially when the supervisor employs a rotating work schedule. Shift work disrupts the circadian rhythm and can cause fatigue due to sleep deprivation. Shift work also disrupts social and family life, which may affect the worker's psychological health and physical well-being. There is insufficient evidence to demonstrate conclusively that shift work causes a specific illness in workers; however, shift workers have more health complaints than other workers, such as digestive problems, chest pain, wheezing, nervousness, colds, and fatigue. Studies also note an association between shift work and a higher incidence of cancer, myocardial infarction, and diabetes mellitus.[115] Generally, shift workers have lower job satisfaction and productivity, and have more subjective health complaints and personnel turnover. Workers adapt better if the shift transition is done slowly over 3 or more weeks to permit adaptation. Shift changes should be progressively later, going from day to evening and then to night shift.[115]

STRATEGIES FOR HAZARD ABATEMENT

The first step in controlling or eliminating a workplace hazard is to conduct an inventory of the hazards present in the healthcare facility. The facility safety officer should conduct a joint worksite visit with the industrial hygienist, environmental science office, and occupational health staff to identify any hazards, observe controls in place to minimize exposure, and see what, if any, protective equipment are being used to protect workers. The worksite visit should document in detail whether:

- engineering interventions are available and used to control the hazard;
- proper ventilation of the spaces is occurring if the hazard is respiratory;
- PPE is available and used by workers;
- worker training to recognize and avoid hazards has been provided;
- safe work practices are written and utilized; and
- safety and occupational health programs are enforced.

Once the hazard inventory is completed, the risks should be prioritized, and those posing the greatest hazard targeted for elimination first. Workers must be trained about the hazard and the steps necessary to prevent exposure. They need training on safe work practices and how to properly use safety equipment and PPE, including respiratory devices, to protect against toxic chemicals and other workplace hazards. Additional evaluation methods include environmental or workplace sampling and medical surveillance to assess the success of workplace controls. Guidelines for workplace hazards control are listed in Table 11-3.

TABLE 11-3

GUIDELINES FOR THE CONTROL OF HAZARDS IN HEALTHCARE FACILITIES

Hazard	Resources
Cryosurgery	NIOSH control of nitrous oxide during cryosurgery: https://www.cdc.gov/niosh/docs/99-105/
Dietary	OSHA hospital etool: https://www.osha.gov/SLTC/etools/hospital/dietary/dietary.html
Temperature extremes	NIOSH heat stress: https://www.cdc.gov/niosh/topics/heatstress/ NIOSH cold stress: https://www.cdc.gov/niosh/topics/coldstress/
Radiology film development	https://www.cdc.gov/niosh/topics/glutaraldehyde/default.html
Housekeeping	OSHA hospital etool: https://www.osha.gov/SLTC/etools/hospital/housekeeping/housekeeping.html
Indoor air quality	NIOSH indoor air quality guidelines https://www.cdc.gov/niosh/topics/indoorenv/buildingventilation.html
Infection control	CDC guidelines for environmental infection control in healthcare facilities https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm NIOSH site for hospital hazards (See Biologicals and Controls) https://www.cdc.gov/niosh/topics/healthcare/#c CDC guidelines for infection control in healthcare Facilities (2003): https://www.cdc.gov/infectioncontrol/guidelines/environmental/index.html Immunization of healthcare workers https://www.cdc.gov/vaccines/adults/rec-vac/hcw.html Hepatitis B and healthcare personnel- frequently asked questions http://immunize.org/catg.d/p2109.pdf CDC guidance for evaluating healthcare personnel for hepatitis B virus protection and for administering postexposure management https://www.cdc.gov/mmwr/pdf/rr/rr6210.pdf Clinical framework and medical countermeasure use during an anthrax mass-casualty incident https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6404a1.htm?s_cid=rr6404a1_w CDC guidelines for MDRO[§] in the healthcare setting: https://www.cdc.gov/infectioncontrol/guidelines/mdro/index.html Updated USPHS guidelines for the management of occupational exposures to HIV and recommendations for postexposure prophylaxis https://stacks.cdc.gov/view/cdc/20711 Guidelines for preventing the transmission of Mycobacterium tuberculosis in healthcare settings, 2005 MMWR 2005; 54 (No. RR-17) https://www.cdc.gov/tb/publications/guidelines/infectioncontrol.htm Clinical guidance for smallpox vaccine use in a postevent vaccination program https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6402a1.htm?s_cid=rr6402a1_w Interim infection prevention and control recommendations for hospitalized patients with Middle East respiratory syndrome coronavirus (MERS-CoV) https://www.cdc.gov/coronavirus/mers/infection-prevention-control.html Guidelines for prevention and control recommendations for hospitalized patients with known/suspected Ebola virus disease in US hospitals- 2015 https://www.cdc.gov/vhf/ebola/healthcare-us/hospitals/infection-control.html

(**Table 11-3** *continues*)

(**Table 11-3** *continued*)

Laboratory	OSHA hospital etool: www.osha.gov/SLTC/eTools/hospital/lab/lab.html OSHA hospital laboratory hazards: https://www.osha.gov/SLTC/etools/hospital/lab/lab.html]
Maintenance	OSHA hospital etool: https://www.osha.gov/SLTC/etools/hospital/engineering/engineering.html
Material handling	NIOSH material handling guidelines: https://www.cdc.gov/niosh/docs/2007-131/
Operating rooms	OSHA guidelines for workplace exposures anesthetic gases - May 18, 2000 https://www.osha.gov/dts/osta/anestheticgases/index.html
Noise	NIOSH noise and hearing loss prevention: https://www.cdc.gov/niosh/topics/noise.
Security	OSHA preparing and protecting security personnel in emergencies https://www.osha.gov/Publications/3335-security-personnel.pdf

CDC: Centers for Disease Control and Prevention
HIV: human immunodeficiency virus
MDRO: Multidrug-resistant organisms
MERS-Cov: Middle East respiratory syndrome coronavirus
MMWR: Morbidity and Mortality Weekly Report
NIOSH: National Institute for Occupational Safety
OSHA: Occupational Safety and Health Administration
USPHS: US Public Health Service

WORKPLACE VIOLENCE

Workplace violence, which NIOSH defines as violent acts (including physical and threats of assaults) directed toward persons at work or on duty, includes harassment, intimidation, or other threatening disruptive behavior.[116] The burden of workplace violence is high: nearly two million American workers are victims of workplace violence each year,[117,118] and these incidents are on the rise. It fact, homicide is the fourth-leading cause of fatal occupational injuries in the United States and the leading cause of death for women in the workplace. According to the Bureau of Labor Statistics Census of Fatal Occupational Injuries, of the 4,547 fatal workplace injuries that occurred in the United States in 2010, 506 were workplace homicides.[117,118] A study of the Department of Justice's National Crime Victimization Survey from 1993 to 1999 noted that the average annual rate for nonfatal violent crime for all occupations was 12.6 per 1,000 workers.[117,118]

Healthcare professionals, along with public service workers, law enforcement, and those who work alone or in small groups, are at higher risk of workplace violence. The average annual workplace violence rate for physicians is 16.2 per 1,000; for nurses, 21.9; for mental health professionals, 68.2; and 69 for mental health and custodial workers.[117,118] The cost of workplace violence can be staggering, with lost production, loss of focus, and mission impact. Prevention is key; a work environment that minimizes hostility, creates a secure and physically safe workplace, provides education, and conducts early interventions is helpful in minimizing and preventing workplace violence.[119] For more information, refer to the workplace violence section of the Department of Labor's website: https://www.osha.gov/SLTC/workplaceviolence/.

SUMMARY

This chapter reviewed common exposures and hazards present in healthcare facilities. Healthcare workers face myriad workplace exposures to chemical, biological, physical, and psychosocial hazards. The facility or unit commander, staff, supervisors, and healthcare workers all have a responsibility to participate in safety and occupational health programs designed to protect the employee and patient health at military healthcare facilities. The MTF is unique because there is greater risk of exposure to chemical and biological warfare agents and highly explosive devices. Therefore, workers require extra training and preparations to respond to casualties who have been exposed to these agents. Furthermore, new and emerging

threats, such as severe acute respiratory syndrome and Ebola, require healthcare workers to stay current with new developments in biological threats. If these or similar diseases occur at their facility, workers must be aware of their risks and precautions.

This chapter dealt primarily with hazards routinely encountered in fixed US MTFs. However, the principles discussed here are equally applicable in deployed military healthcare settings. The challenge in deployed settings is that many of the engineering controls in place at US facilities are difficult to institute. However, proper screening of deploying personnel and healthcare providers should minimize or eliminate the exposure potential to many of the biological and blood-borne pathogen hazards discussed here. Protective measures for healthcare workers translate into protective measures for their patients. An ill or impaired healthcare worker can spread disease to coworkers and other service members, thus affecting the morale and health of all. The impact could adversely affect the deployed force's fighting strength, which could be catastrophic.

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ATTACHMENT:

BLOOD-BORNE PATHOGEN EXPOSURE CONTROL PLAN

XXXX MILITARY MEDICAL CENTER
OCCUPATIONAL MEDICINE SERVICE
STANDARD OPERATING PROCEDURES

SOP Title: **Blood-borne Pathogen Exposures Program**	SOP No
	Version 1.0
Effective Date: 17 NOVEMBER 2018	Page 1

1. Purpose: To implement an effective blood-borne pathogen (BBP) postexposure program at the XXXXXX military medical center by establishing a process to inform the workforce of the proper procedure for reporting and evaluation of blood-borne pathogen exposure incidents.

2. Scope: Applies to all workers (military, government civilians, contractors, and volunteers) with potential exposures to blood or bodily fluids.

3. Background: Healthcare workers are at risk of exposure to blood-borne pathogens such as hepatitis B (HBV), hepatitis C (HCV), and the human immunodeficiency virus (HIV). The risk of infection is decreased by completing the HBV three-shot immunization series and by following the proper procedures and utilizing the appropriate personal protective equipment with all patients. Despite these preventive measures, exposure incidents still occur. It is important to immediately report the incident and be evaluated right away. If postexposure medications are needed due to a significant HIV exposure, then it is most effective if started within 2 hours of the exposure. Nonresponders to the HBV vaccine also require HBV immune globulin following exposure to HBV.

4. Responsibilities:
   a. The assistant chief of staff for public health, chair of the Public Health Advisory Committee, is the blood-borne pathogen program coordinator.
   b. The occupational medicine service chief is responsible for:
      1) Overseeing this program and reviewing this standard operating procedure (SOP) on an annual basis.
      2) Designating a clinical provider to implement the program as the blood-borne pathogen surveillance program manager (BBP-SPM).
   c. The BBP-SPM is the clinic's primary point of contact for liaison with other departments for:
      1) Annual computerized training requirements.
      2) Training provided by clinic staff.
      3) Working with the contracting department to ensure that contract personnel working at XXXXXX are screened appropriately by their organization.
      4) Policy and procedures to ensure the timely evaluation of BBP exposures by the occupational medicine service or emergency department (ED).
      5) Prompt reporting of BBP exposures to the safety office and unit supervisors.
      6) Quarterly reports to the Infection Control Committee of all BBP incidents.
   d. The clinic's senior occupational health nurse will ensure the prompt evaluation of exposed employees by a clinic provider or ED if a clinic provider is not present.
   e. The inpatient provider (of the source patient) is responsible for ordering source labs in the Center for Healthcare Services (CHCS)/Essentris system and ensuring the exposed employee is referred to either the occupational medicine clinic or the ED for evaluation. The source patient and employee should have baseline labs ordered and, if necessary, Infectious Disease (ID) should be consulted to assess the need for employee postexposure prophylaxis.
   f. The occupational medicine service staff is responsible for the initial BBP assessment screening and education during business hours. When the occupational medicine service is closed, the exposed employee will report to the ED for evaluation and treatment. The employee will then follow up in the occupational medicine service the same day or next business day.
   g. All personnel with blood and bodily fluid exposures in the eye will report directly to the ED for evaluation and treatment; follow up in occupational medicine same day or next business day.

5. Policy: The occupational medicine service will assist the XXXXXX staff to work in a safe and healthy workplace by the proactive implementation of federal, military, and professional guidance regarding the reduction of risk for BBP exposures at XXXXXX.

6. Procedures:
   a. The occupational medicine service staff schedules the worker, performs the initial assessment screen, and orders baseline postexposure labs for the exposed employee. The following steps will be performed in a timely fashion at the direction of the senior occupational health nurse when an employee presents to the occupational medicine service after a BBP incident:
      1) Determine if an occupational medicine provider is available in the clinic; otherwise a referral by (telephone) phone ___-___-____ to the XXXXXX ED will be made. The exposed employee will be escorted with a direct transfer to the nursing staff of the ED.
      2) If seen by the occupational medicine service: entry into GENESIS with vital signs and a 15-minute observed wash of the exposure site (if indicated) as the occupational medicine provider is notified.
      3) The location of the exposure source will be identified and contact made with the supervisor to ensure the source remains in the hospital. This will allow the supervisor and/or the occupational medicine service to attain informed consent for the collection of source laboratory studies.
   b. The clinic's designated occupational medicine provider is responsible for appropriate care and a follow-up plan for BBP exposures:
      1) Incidents reports by either online or hard copy are forwarded to XXXXXX safety as soon as possible.
      2) If the source is inpatient, labs (HIV Rapid, Hep BsAG (hepatitis B surface antigen) and Hep C AB (hepatitis C antibody) must be ordered in Essentris using order set: **bbpexp-source**. If the source is outpatient, labs must be ordered in CHCS using order set: **bbpexp-source**.
      3) For the exposed employee, postexposure baseline labs (HIV, Hep B sAG, Hep B sAB, Hep C AB and alanine aminotransferase (ALT) must be ordered in CHCS using order set: **bbpexp.** In Essentris it is**: bbpexp-exposed**.
      4) The occupational medicine provider refers the exposed employee depending on review of all labs (exposed and source):
         a) HBV – depending on vaccination status of the exposed employee and immune status of source, hepatitis B immune globulin (HBIG) and/or vaccine may be indicated.
         b) HIV – if source Rapid is positive or source is known to have HIV, then refer exposed employee to infectious disease.
         c) HCV – if source positive with/without elevated liver function tests (LFTs), refer to gastroenterology.
         d) Refer pregnant women to obstetrics (especially in the case where source may have positive labs and the exposed employee may require treatment (HBIG, HIV prophylaxis).
         e) Determine tetanus, diphtheria, and acellular pertussis vaccine (Tdap) status in accordance with the Centers for Disease Control and Prevention (CDC) recommendations.
      5) Another resource is the National Clinicians' Postexposure Prophylaxis Hotline (PEPline) through the University of California, San Francisco, School of Medicine National Clinicians' Postexposure Prophylaxis Hotline; 24/7 telephone number: 1-888-448-4911. http://www.nccc.ucsf.edu/
      6) Employees who would benefit from HIV postexposure prophylaxis will be escorted to the ID (infectious disease) clinic and a walk-in consult will be made to the on-call attending physician.
      7) The treating occupational medicine provider will ensure the BBP-SPM is notified and provided the appropriate clinical records for reporting and clinical follow-up.
   c. The BBP-SPM is responsible for the reporting, follow-up, and tracking of exposed personnel. Refer to Tables 1 and 2.
      1) A physician's written opinion compatible with OSHA, service, and local guidance will be provided to the exposed employee as soon as appropriate.
      2) The BBP-SPM will complete follow-up visits and make appropriate tracking entries in AHLTA and local database.
      3) Quarterly summaries of all exposures will be reported to the XXXXXX Infection Control Committee. This report will include data on XXXXXX and tenant command personnel receiving occupational health services at the XXXXXX occupational health center (OHC) for BBP exposures both onsite and offsite in the course of their duties.

7. Explanation of Abbreviations and Terms:

AG	antigen
ALT	alanine aminotransferase
AR	Department of the Army Regulation
BBP	blood-borne pathogens
BBP-SPM	blood-borne pathogen surveillance program manager
BUMED	Navy Bureau of Medicine and Surgery
CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations

CHCS	Center for Healthcare Services
DoD	Department of Defense
DODI	Department of Defense Instruction
GENESIS	The DoD electronic health record (formerly AHLTA)
HBIG	hepatitis B immune globulin
HBsAg	hepatitis B surface antigen
HBV	hepatitis B virus
HCV	hepatitis C virus
Hep B sAB	hepatitis B surface antibody
Hep C AB	hepatitis C antibody
HIV	human immunodeficiency virus
ID	infectious disease
INST	instruction
LFT	liver function test
MMWR	Morbidity and Mortality Weekly Report
NMCPHC-TM	Navy and Marine Corps Public Health Center Technical Manual
OASD	office of the assistant secretary of defense
OHC	occupational health center
OSHA	Occupational Safety and Health Administration
PEPline	postexposure prophylaxis hotline
PWO	physician's written opinion
SOP	standard operating procedure
Tdap	tetanus, diphtheria, and acellular pertussis vaccine
USPHS	United States Public Health Service

8. Tables:

Table 1. Follow-up of Workers for HIV and HCV Exposures

Test	Known Positive or Positive Risk Factor	Known Negative	Unknown
HIV	6 wk, & 4 mo	None	6 wk, & 4 mo
LFT, HCV, RNA	6 wk, 3 & 6 mo Perform at 6 wk, 3 mo; AB at 6 mo	None	6 wk, 3 & 6 mo

Table 2. Screening for Hepatitis B Postexposure Prophylaxis

Vaccination and/or Antibody Response Status of Exposed Person[1]	Treatment When Source Patient is:		
	HBsAg[2] Positive	**HBsAg[2] Negative**	**Source Unknown or Not Available for Testing**
Unvaccinated[3]	HBIG[4] ×1; initiate HBV[5] vaccine series	Initiate HBV vaccine series	Initiate HBV vaccine series
Previously vaccinated			
Known responder[6]	No treatment	No treatment	No treatment
Known nonresponder[7]	HBIG[4] ×1 and initiate revaccination[8] or HBIG ×2	No treatment	If known high-risk source, then treat as if source were HBsAg positive
Antibody response unknown	Test exposed person for antibody to HBsAg 1. If adequate Ab to HBsAg[6] no treatment needed 2. If inadequate Ab to HBsAg[7], give HBIG X1 & vaccine booster	No treatment	Test exposed person for antibody to HBsAg 1. If adequate Ab to HBsAg no treatment needed 2. If inadequate Ab to HBsAg, give booster & ck titer in 1-2 mo

Notes
[1]Persons who have previously been infected with HBV are immune to reinfection and do not require postexposure prophylaxis.
[2]HBV surface antigen
[3]People who have not yet received all three HBV shots should get HBIG and complete the series.
[4]HBV immune globulin; dose is 0.06 ml/Kg intramuscularly.
[5]HBV vaccination includes three shots of HBV vaccine.
[6]A responder is a person with adequate levels of serum antibody to HBsAg with antiHBs > 10mIU/mL.
[7]A nonresponder is a person with inadequate antibody response to vaccination, ie serum anti-HBsAg < 10 mIU/mL.
[8]The option to give one dose of HBIG and reinitiate the vaccine series is preferred for nonresponders who have not completed a second three-dose vaccine series. Two doses of HBIG are preferred for persons who previously completed a second three-dose vaccine series but failed to respond.

9. References:

Regulation/Citation	Document Title
29 CFR 1910.1030 OSHA	29 Code of Federal Regulations; Blood-borne pathogens http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10051.
USPHS (2013)	Updated US Public Health Service guidelines for the management of occupational exposures to human immunodeficiency virus and recommendations for postexposure prophylaxis. *Infect Control and Hosp Epidemiol*. 2013. Sep 34(9):875-892.
USPHS (CDC)	Updated US Public Health Service Guidelines for the Management of Occupational Exposures to HBV, HCV, and HIV and Recommendations for Postexposure Prophylaxis. MMWR Recomm Rep. 2001 Jun 29;50(RR11);1-42. *(www.cdc.gov).*
USPHS (CDC)	Updated recommendations for use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis (Tdap) vaccine from the Advisory Committee on Immunization Practices, 2010, MMWR January 14, 2011 / 60(01);13–15. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6001a4.htm.
DoD	OASD Policy. Hepatitis B Immunization Policy for Department of Defense Medical and Dental Policy. 23 Oct 96.
DODI 6055.05-M	*Occupational Medical Examinations and Surveillance.* Table C2.T14, Blood borne Pathogens.
AR 40-501	*Standards of Medical Fitness*.
AR 40-501 BUMEDINST 6230.15.	Joint Instruction Immunizations and Chemoprophylaxis 29 SEP 2006.
BUMEDINST 6220.14	Bloodborne Pathogen Control Program.
NMCPHC-TM OM 6260	Medical Surveillance Procedures Manual and OEM Medical Matrix 11th Edition November 2010, NMCPHC-TM OM 6260.
NMCPHC-TM-OEM 6260.7	Bloodborne Pathogen Exposure Control Manual Navy and Marine Corps Public Health Center Technical Manual NMCPHC-TM-OEM 6260.7 November 2010.
NNMCINST 6220.5G	NNMC Infection and Control Program. HIV Prophylaxis Following Occupational Exposure: Guideline and Commentary; Barry S. Zingman; January 30, 2013.
NNMC	Infection Control Manual. HIV Prophylaxis Following Occupational Exposure: Guideline and Commentary; Barry S. Zingman, MD; January 30, 2013.

I. Forms and Appendices

Form/Appendix No	Title
WRNNMC OMC	Blood-borne Pathogen Post-Exposure Management Guidelines.

II. Document Revision History

Version No	Brief Description of Changes	Effective Date
001	NEW	17 NOV 2012
002	**Incorporated CDC changes in postexposure prophylaxis recommendations.**	**1 DEC 2013**

III. Authorizing Signature

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