Chapter 5

HEALTH HAZARDS TO HEALTHCARE WORKERS

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INTRODUCTION

Whether large or small, healthcare facilities are complex environments in which biological, chemical, and physical agents pose potential threats to the health of patients, staff, and visitors. Hospitals, medical clinics, and dental clinics that provide primary medical care are the most common healthcare facilities. Within the U.S. Army Medical Department (AMEDD), other research and service laboratories and veterinary clinics also contain many of the potential health threats that are found in the primary medical care facilities. AMEDD also uses deployable field medical treatment facilities (MTFs). These militarily unique MTFs pose greater challenges in the control of potential health threats than are found in fixed medical facilities. Effectively dealing with these potential health threats, regardless of the specific environment, requires knowledge about the hazards that might be present, the ability to define the nature and extent of exposure, and the expertise to develop and implement risk-reduction programs.

HISTORY

Ironically, patients themselves pose risks to healthcare workers. These not-insignificant risks range from contracting seemingly minor afflictions such as musculoskeletal discomfort to death from any number of infectious diseases such as tuberculosis and, in our own time, blood-borne pathogens. Bernardino Ramazzini (1633–1714), the Italian physician whom we acknowledge as the father of occupational medicine, recognized such hazards to healthcare workers when he described dermatitis and exhaustion as diseases of midwives in 1713.[1] The labor chair (which required the midwife to stand in an uncomfortable position) probably contributed to exhaustion; the constant bathing of the hands in lochia probably caused dermatitis. Ramazzini favored the new practice of having the patient labor and deliver in bed to ease the work of the midwives.[1,2]

The terrible mortality that characterized hospitals before the 20th century was at least partially iatrogenic in origin. Dr. Philipp Ignaz Semmelweis (1818–1865), as a result of his work on puerpueral fever, realized that by introducing a few simple maneuvers, he could reduce the mortality of this disease. He initiated routine handwashing by healthcare workers more than a century ago. During the second half of the 19th century, Florence Nightingale (1820–1910), who perceived that hospitals were hazardous not only to patients but also to those who took care of them, introduced open-window ventilation and worked to reduce patient overcrowding. Although most hospital hazards were considered to pose risks to patients rather than to the staff, attempts such as these to protect patients also benefited healthcare workers.[3]

The present emphasis on the hazards of blood-borne pathogens—both from patient to healthcare workers and vice versa—may be the most dramatic, but it should not obscure the numerous other, subtle hazards that also threaten healthcare workers. New hazards appeared during the early 1900s when physicians were exposed to radiation while experimenting with X rays, and operating room personnel faced possible explosions and other adverse health effects during surgery when flammable anesthetic gases were used.[3]

Until recently, healthcare facilities were traditionally considered safer than other work environments because employees were generally viewed as *providers*, not as *workers* exposed to a wide variety of hazards. The fact is, however, that hospitals are oriented toward reducing mortality and morbidity from disease, not prevention. As a result, few resources have been allocated for occupational exposures, and safety and health standards for healthcare facilities were promulgated only to protect patients.[3] The National Institute for Occupational Safety and Health (NIOSH) has identified several factors that have contributed to the lack of emphasis on the health of workers in the healthcare industry, including the beliefs that

- hospital workers were health professionals capable of maintaining their own health without assistance, and
- informal consultations with hospital physicians would replace medical-facility employee health services.[3]

To correct these misconceptions, safety and health standards have been, and continue to be, developed by various federal, national, and licensing organizations and agencies. Within the realm of their application, these standards are addressed later in this chapter.

TYPES OF HAZARDS

During the normal course of activities in healthcare facilities, exposures to (*a*) chemical; (*b*) biological; (*c*) physical, including ergonomic; and (*d*) psychosocial hazards occur routinely. Some exposures are similar to those in industrial environments, while others are unique to the healthcare setting; some exposures occur throughout a healthcare facility, while others are localized in a specific area (Exhibit 5-1). Variations in

EXHIBIT 5-1

OCCUPATIONAL HAZARDS IN AMEDD HEALTHCARE FACILITIES*

Maintenance and Engineering
- Adhesives
- Ammonia
- Asbestos
- Carbon monoxide
- Cold
- Ethylene oxide
- Fluorocarbons
- Fuels
- Heat
- Lubricants
- Mercury
- Noise
- Oils
- Paints
- Pesticides
- Sewage
- Solvents
- Welding fumes

Nuclear Medicine
- Biological agents
- Radionuclides

Pathology
- Biological agents
- Embedding media
- Fixatives
- Fluorocarbons
- Formaldehyde
- Glutaraldehyde
- Phenols
- Solvents
- Xylene

Patient Care
- Antineoplastic agents
- Biological agents
- Hazardous drugs
- Mercury
- Radiation
- Sharps

Pharmacy
- Antineoplastic agents
- Hazardous drugs

Radiology
- Developer chemicals
- Magnetic radiation
- X radiation

Operating and Delivery Rooms
- Anesthetic gases
- Antiseptics
- Biological agents
- Ethylene oxide
- Lasers
- Methyl methacrylate
- Sharps

Central Supply
- Alcohol
- Ammonia compounds
- Biological agents
- Detergents
- Dusts
- Ethylene oxide
- Fluorocarbons
- Formaldehyde
- Glutaraldehyde
- Mercury
- Noise
- Sharps
- Soaps
- Xylene

Dialysis Units
- Biological agents
- Disinfectants
- Formaldehyde

Dental Service
- Anesthetic gases
- Biological agents
- Compressed gases
- Ethylene oxide
- Formaldehyde
- Mercury
- Methyl methacrylate
- Noise
- Radiation
- Vibration

Housekeeping
- Biological agents
- Detergents
- Disinfectants
- Glutaraldehyde
- Sharps
- Soaps
- Solvents

Veterinary Clinic
- Anesthetic gases
- Biological agents
- Disinfectants
- Pesticides
- Sharps

Cast and Brace Shops
- Adhesives
- Dusts
- Noise
- Solvents
- UV radiation

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

services, patient types, and staff make the listing of every specific exposure for all healthcare facilities impossible; therefore, this chapter addresses only the more typical exposure hazards. The comprehensive identification of health hazards and elimination or control of these hazards is a responsibility of each individual workplace—whether an industrial or a healthcare facility. In any occupational setting, the methods for hazard identification and control utilize good industrial hygiene practices (see Chapter 4, Industrial Hygiene).

Chemical Hazards

Exposures to chemicals—solids, liquids, or vapors—occur through dermal absorption, inhalation, or ingestion. The health effects, which can be acute or chronic, from exposure to chemicals range from mild (dermatitis) to severe (mutagenicity, teratogenicity, and carcinogenicity). The effects depend on the extent (concentration and duration) of exposure, the route of exposure, and the physical and chemical properties of the substance. The health effects that a chemical substance exerts may also be related to simultaneous exposure to other chemical or physical agents.[3] In most cases, exposures resulting from chemical accidents, spills, leaks, fires, and ventilation failures are more common than are problems from chronic exposure.[4]

The most common manifestation of toxicity from exposure to chemicals, and the most prevalent occupational illness among healthcare workers, is contact dermatitis. Nurses who administer drugs have the highest incidence. Housekeeping personnel, whose skin is frequently in contact with cleaners and disinfectants, are second. Dermatological reactions are also common among kitchen, radiography, pathology, surgical, and maintenance personnel from exposures to cleaners, disinfectants, solvents, and other chemical solutions.[4–6]

Exposures to aerosols and vapors are also potentially hazardous. Typical exposures include

- operating room personnel to anesthetic gases,
- pharmacy and nursing personnel to antineoplastic agents and hazardous drugs,
- central material supply workers to ethylene oxide,
- laboratory workers to aromatic solvents and formaldehyde, and
- dental personnel to mercury.

The multitude of chemicals found in healthcare settings prohibits their individual discussion, but several that have become notorious as a result of their mutagenic, teratogenic, carcinogenic, or acute toxicity warrant attention. These include (*a*) anesthetic gases, (*b*) antineoplastic agents and hazardous drugs, (*c*) ethylene oxide, (*d*) formaldehyde, (*e*) mercury, and (*f*) methylmethacrylate. Numerous other chemicals, including solvents, reagents, and disinfectants are also used in healthcare facilities and may be potentially hazardous to employees (Table 5-1). The scientific literature contains a wealth of information pertaining to the hazardous properties of chemicals.[7–12]

Anesthetic Gases

Anesthetic gases (such as nitrous oxide, halothane [Fluothane], enflurane [Ethrane], and isoflurane [Forane]) can be released into work areas of the healthcare facility: operating rooms, recovery rooms, labor and delivery rooms, dental operatories, and veterinary clinics.[13–16] The implications of occupational exposure to low concentrations of common anesthetic agents remains controversial.[4,17–19] The evidence for specific chronic effects and the exposure concentrations at which they occur are conflicting; however, the literature consistently indicates an association with various short-term, acute effects such as neurotoxicity. Workers exposed to excessive amounts of anesthetic gases complain about feeling as if they themselves are anesthetized. They experience drowsiness, irritability, depression, headache, nausea, fatigue, and impaired judgment and coordination.[13,20–23] These behavioral modifications are of great concern, particularly in the operating room, where they can compromise surgical success and the health of the operating-room personnel.

Assessing the long-term effects of exposure to anesthetic agents is more difficult. The chronic effects of anesthetic gas exposures are usually identified through retrospective epidemiological studies, followed by confirmational animal studies. The conclusions that could be drawn in some studies of chronic low-level exposures have been limited due to the lack of quantitative exposure data and heavy reliance on information from questionnaires.[4,17,18,24] However, chronic exposure to waste anesthetic gases has been associated with increased risk of spontaneous abortion in exposed women workers and the wives of exposed men. Other adverse reproductive effects among exposed females include involuntary infertility and infants with low birth weights and congenital abnormalities.[19,25] Most of these studies took place before scavenger systems for recovering of waste gas were installed, and the current opinion holds that, with proper functioning scavengers and ventilators, the risk of overexposure is greatly reduced.[26,27]

TABLE 5-1

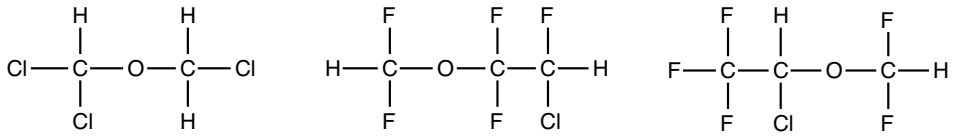
HAZARDS OF SELECTED SOLVENTS, REAGENTS, AND DISINFECTANTS*

Chemical	Main Biological Effects	Type of Work	Work Site	OSHA PEL in 29 CFR
Dioxane	Potential carcinogen Liver and kidney injury Neurotoxicity	Preparation of tissue sections Radioimmunoassay	Histology lab Serology lab	1910.1000
Benzene	Carcinogen (leukemia) Neurotoxicity	Chemistry procedures	Laboratory	1910.1028
Benzidine-based dyes	Carcinogen (bladder) Neurotoxicity	Biological stains Chemistry procedures Print dyes	Histology lab Chemistry lab Print shop	1910.1010
Xylene	Neurotoxicity Cardiovascular effects Reproductive effects Liver and kidney injury	Solvent Tissue processing	Histology lab Chemistry lab	1910.1000
Toluene	Neurotoxicity Cardiovascular effects Reproductive effects Liver and kidney injury	Solvent Tissue processing	Histology lab Chemistry lab	1910.1000
Chromic acid	Carcinogen (lungs) Irritant	Tissue processing	Histology lab	1910.1000
Phenol	Neurotoxicity Liver and kidney injury	Disinfection	Housekeeping Laboratory	1910.1000
Glutaraldehyde	Mutagenicity Respiratory effects Dermatitis	Tissue fixation Disinfection Dermal treatment X-ray file processing	Histology lab Central supply Dermatology Radiology	1910.1000
Picric acid (crystalline)	Liver and kidney injuries Dermatitis Gastrointestinal effects Hematological effects	Chemistry procedures	Chemistry lab	1910.1000
Azide	Neurotoxicity Cardiovascular effect Respiratory effects	Blood chemistries	Serology lab	None

*See 29 CFR, Part 1910 § 1000. *Occupational Exposures to Hazardous Chemicals in Laboratories.*

The possibility that a carcinogenic effect could result from exposure to anesthetic gases also has attracted attention.[3,20,28,29] The concern about this effect is partially due to the structural similarities between known human carcinogens (dibromoethane, dichloroethane, *bis*-chloromethyl ether, and chloromethyl methyl ether) and several of the halogenated inhalation anesthetics now in use (Figure 5-1). In addition, anesthetic compounds can be transformed into reactive metabolites, which can combine with tissue macromolecules and possibly initiate a carcinogenic event.[29,30] Several studies have noted elevated rates of specific cancers in hospital personnel who are chronically exposed to anesthetic gases: a higher incidence of death from reticuloendothelial and lymphoid malignancies was reported in anesthesiologists[31]; and a 3-fold increase in malignancies, which included unusual tumor types, was also noted in nurse anesthetists.[32]

Although in 1977 NIOSH recommended a standard to limit exposure to waste anesthetic gases, no federal regulatory standard currently exists.[13] The U.S. Army



bis-chloromethyl ether enflurane isoflurane

Fig. 5-1. Among the halogenated anesthetics currently in use, *bis*-chloromethyl ether is a recognized human carcinogen, with a Threshold Limit Value–time-weighted average (TLV-TWA) of 0.001 ppm. The structural similarities of other halogenated inhalation anesthetics give rise to the concern that they may also play a role in the development of cancer.

Office of The Surgeon General (OTSG) promulgated the U.S. Army exposure standards in 1982 in Technical Bulletin, Medical (TB MED) 510.[26] TB MED 510 has been revised and the 1993 draft revision is being staffed at OTSG. This draft contains the proposed army permissible exposure levels (PELs), which are the same time-weighted average (TWA) levels shown in Table 5-2. These particular TWAs are calculated from airborne concentrations that are measured over the time the anesthetic is administered. Therefore, they are *not* the 8-hour TWA exposures typically described by the Occupational Safety and Health Administration (OSHA) PELS or the American Conference of Governmental Industrial Hygienists' Threshold Limit Values (ACGIH's TLVs). This guidance applies to field hospitals during peacetime training but does not apply in combat zones.

When a halogenated anesthetic agent is used in combination with nitrous oxide, the TWA exposure limit becomes 25 ppm for nitrous oxide and 0.5 ppm for the halogenated agent. This reduction in the exposure limit is based on reported decrements in worker performance, which are believed to be caused by synergistic effects of exposure to both classes of anesthetic agents simultaneously, not to an increased health hazard.[20–23] There are no OSHA PELs, and the current TLVs are 50 ppm for nitrous oxide, 50 ppm for halothane, and 75 ppm for enflurane; therefore, the 0.5-ppm and 25-ppm exposure levels for nitrous oxide when used in conjunction with a halogenated anesthetic agent (which was recommended by NIOSH in 1977) is quite conservative. For this reason, the concept of an action level (one-half the PEL) that is customarily used in occupational health is not applicable to exposure limits for waste anesthetic gases.

Exposure to waste anesthetic gases can be controlled by following the guidelines set forth in TB MED 510 and by ensuring that employees are aware of the exposure sources. Employees should know that exposures usually result from careless work practices (such as an improper seal with the patient's mask, not eliminating anesthetics before removing the patient's mask or endotracheal tube, and not washing anesthetic gas from the patient's lungs with oxygen); leaking anesthetic equipment; inadequate waste-gas collection and containment (scavenging systems); and, to a lesser extent, poor general ventilation.

Antineoplastic Agents and Hazardous Drugs

Antineoplastic agents (cytotoxic drugs) are chemically unrelated but are capable of inhibiting tumor growth by disrupting cell division and killing actively growing cells.[33] They can be divided into structurally separate drug classes: (*a*) alkylating agents, (*b*) antibiotics, (*c*) antimetabolites, (*d*) mitotic inhibitors, and (*e*) a miscellaneous class (Exhibit 5-2).

Alkylating agents act by covalently binding to DNA, thus interfering with normal DNA replication. Antibiotics work as DNA intercalators, and interfere with

TABLE 5-2

PERMISSIBLE EXPOSURE LEVELS (PELS) FOR WASTE ANESTHETIC GASES

Anesthetic Gas	Concentrations (ppm)*
N_2O	50†
Halogenated agents used alone	2†
N_2O and halogenated agent used together	25 (for N_2O) + 0.5 (for halogenated agent)‡

*Time-weighted averages (TWAs)
†These values were adopted as PELS by the California state Occupational Safety and Health Standards Board on 24 February 1992 (General Industry Safety Orders § 5155)
‡Source: National Institute for Occupational Safety and Health. *Criteria for a Recommended Standard: Occupational Exposure to Waste Anesthetic Gases and Vapors.* Cincinnati, Oh: NIOSH; 1977. DHEW (NIOSH) Publication 77-140.

EXHIBIT 5-2

COMMON ANTINEOPLASTIC AGENTS*

Alkylating Agents
- Busulfan
- Carmustine (BCNU)
- CCNU (Lomustine)
- Chlorambucil
- Chloranphazin
- Cisplatin (Platinol)
- Cyclophosphamide (Cytoxan), (Neosar)
- Dacarbazine (DIC) (DTIC)
- Melphalan (Alkeran)
- Myleran
- Nitrogen mustard (Mustangen)
- Streptozocin (Zanosar)
- Triethylene thiophosphoramide (Thiotepa)
- Teosulfan
- Uracil mustard (Uramustine)

Antibiotics
- Bleomycin (Blenoxane)
- Dactinomycin (Actinomycin-D), (Cosmegen)
- Daunorubicin (Cerubidine)
- Doxorubicin (Adriamycin)
- Mithramycin (Mithracin)
- Mitomycin (Mutamycin)

Antimetabolites
- Azathioprine
- Cytosine arabinoside (Cytosar-U)
- Fluorouracil (Adrucil)
- Mercaptopurine
- Methotrexate (Mexate), (Folex)
- Procarbazine (Matulane)

Mitotic Inhibitors (Vinca alkaloids)
- Etoposide (VP-16-213), (VePesid)
- Vincristine (Oncovin)
- Vinblastine (Velban)

Miscellaneous
- L-Asparaginase (Elspar)

*List is not exhaustive

transcriptional processes in protein synthesis. Antimetabolites block the 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 and are discussed in greater detail later in this chapter (Table 5-3).[34,35]

Patients treated with these drugs have had significant adverse outcomes: hematopoietic effects and occurrences of second malignancies (usually hematological malignancies),[36,37] impaired reproductive function,[38] immunosuppression,[39,40] and case reports of malformed infants born to treated mothers.[41,42] 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.

Several investigations that attempted to assess this risk found increased measures of mutagenicity,[43–47] but contrarily, others found no excesses in workers who handle these agents.[48,49] Two epidemiological studies, both published in 1985, regarding reproductive outcomes of female workers exposed to antineoplastics are notable:

- Exposure to antineoplastic drugs during their first trimester of pregnancy was found to be significantly more common among nurses who gave birth to malformed infants than among those who delivered normal infants.[24]
- A statistically significant association was found between occupational exposure to antineoplastic drugs during the first trimester of pregnancy and fetal loss.[50]

These findings suggest that a significant reproductive risk may be incurred by workers who handle antineoplastic agents during pregnancy. Virtually all the reports that are discussed in these two epidemiological studies describe studies performed on oncology nursing and pharmacy personnel. However, several antineoplastic agents—cyclophosphamide, for example—are increasingly being employed for nonmalignant illnesses. Thus, the potential for exposing workers in other sectors of the healthcare setting will expand.[51–53]

While the primary focus of occupational exposure to these agents has been on measures of mutagenicity and potential chronic disease outcome (such as cancer), acute effects in exposed workers have also been reported among nurses and pharmacists who handle the drugs. These effects include dizziness, headaches, facial flushing, and nausea[54–56]; and bronchospasm, vomiting, and diarrhea.[57]

TABLE 5-3

TOXIC PROPERTIES OF REPRESENTATIVE ANTINEOPLASTIC AGENTS

Agent	Chromosomal Mutagenic*	Chromosomal Effects†	Carcinogenic‡	Teratogenic§
Actinomycin D	–	Chr ab	+ r, m; (+) hum	+ sev sp
Adriamycin	+	Chr ab, SCE	+ r	–
Azacytidine	+	–	(+) m	+ m
Azathioprine	+	–	(+) m, r; + hum	+ sev sp
Bleomycin	–	SCE	–	–
Busulfan	+	Chr ab, SCE	(+) m; + hum	–
Carmustine (BCNU)	+	Chr ab	+r	+ r
Chlorambucil	+	Chr ab	(+) m, r; (+) hum	–
Cisplatin	+	Chr ab	–	–
Cycloposphamide	+	Chr ab, SCE	+ m, r, hum	+ sev sp
Dacarbazine	+	–	+ m, r	+ sev sp
Danunorubicin	+	Chr ab	–	–
Fluorouracil	–	–	–	+ sev sp
Isophosphamide	+	Chr ab	(+) m, r	+ m
Lomustine (CCNU)	+	SCE	+ r	+ r
Melphalan	+	Chr ab, SCE	+ m, r, hum	–
Mercaptopurine	+	Chr ab	–	+ sev sp
Methotrexate	+	Chr ab	–	+ sev sp, + hum
Mitomycin C	+	Chr ab	–	–
Prednisone	–	–	–	+ rod
Procarbazine	+	–	+ m, r	+ r
Streptozotocin	+	–	–	–
Thiotepa	+	Chr ab	+ m, r	+ m, r
Treosulfan	–	Chr ab	+ hum	–
Uracil mustard	+	–	+ m, r	+ r
Vinblastine sulfate	–	–	–	+ sev sp
Vincristine sulfate	–	–	–	+ sev sp

*+: mutagenic to bacterial or mammalian cells in culture; –: not mutagenic to bacterial or mammalian cells in culture
†: Chr ab, increased incidence of chromosomal aberrations; SCE, increased incidence of sister-chromatid exchange
‡+: sufficient evidence; (+): limited evidence for carcinogenicity to mice (m), rats (r), or humans (hum) according to the International Agency for Research on Cancer (IARC)
§+: teratogenic to mice (m); rats (r); rodents (rod); several animal species (sev sp); or humans (hum)
Reprinted with permission from Edling C. Anesthetic gases. In: Brune DK, Edling C, eds. *Occupational Hazards in the Health Professions*. Boca Raton, Fla: CRC Press, Inc; 1989: 133. © CRC Press, Inc, Boca Raton, Fla.

The genotoxic nature of many of the antineoplastics, together with evidence of second malignancies in addition to the occupational populations studied, prompted OSHA to issue guidelines for handling antineoplastic drugs in 1986.[58] The guidelines recommend the use of laminar airflow biological safety cabinets in drug preparations as well as personal protective equipment (PPE), worker education, standing operating procedures (SOPs) for handling, and medical surveillance for workers. Although not federal standards (and therefore not carrying the force of law), these guide-lines may be enforced under the OSHA General Duty clause requiring employers to provide a safe and healthful workplace free of known hazards.[59] Although OSHA specified little detail in the surveillance examination content recommended for drug handlers, some guidance can be obtained in the literature.[60]

Antineoplastic agents should be prepared in a Class II biological safety cabinet (BSC) that conforms to the current National Sanitation Foundation Standard No. 49 (Figure 5-2). A Class II, Type A BSC is the minimum requirement for worker protection, but a Class II, Type B BSC is preferred.[61] Class I, Types A and B BSCs have vertical, laminar airflow. A horizontal-airflow cabinet must *never* be used for preparation of antineoplastic agents: it blows air that has been filtered

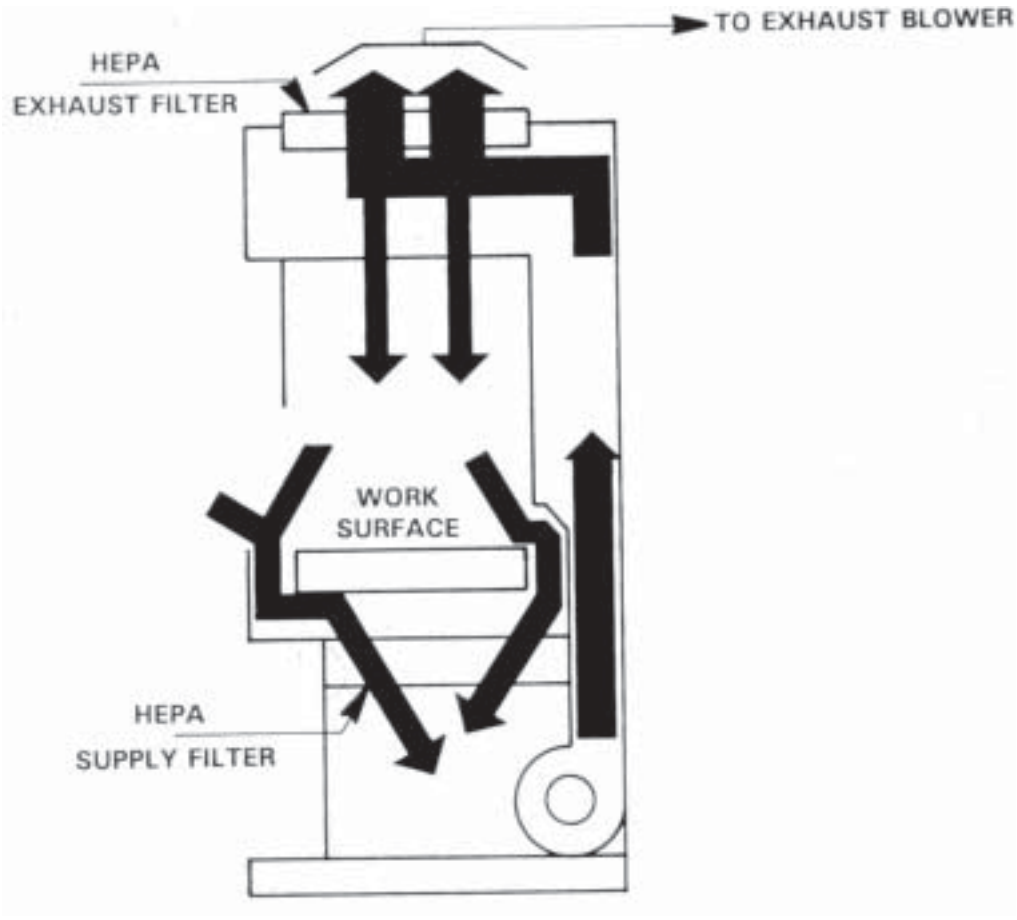


Fig. 5-2. Class II Laminar Flow Biological Safety Cabinet (BSC). The laminar airflow through the high-efficiency particulate air (HEPA) filter in the supply air provides sterile working conditions for drug preparation. The BSC also protects the worker by drawing air through the sash, thus preventing the antineoplastic agent from leaving the cabinet and entering the worker's breathing zone. The air passes through a second HEPA filter before it is exhausted. Source: Noll S, Caldwell DJ. *Guidelines for the Handling, Administration, and Disposal of Cytotoxic Drugs*. Aberdeen Proving Ground, Md: US Army Environmental Hygiene Agency; 1987: 4. Technical Guide 149 (to be published as Technical Bulletin MED 515).

through a high-efficiency particulate air filter (HEPA-filtered air) over the work area to keep the drug sterile, but then exhausts the filtered air directly into the drug preparer's breathing zone.

The blower of either vertical-airflow BSC should be turned on at all times (24 h/d, 7 d/wk). Venting exhaust air to the outside is preferable where possible, and is required with a Class II, Type B BSC.[58] The exhaust air should be filtered, discharged at an appropriate height (1.3-fold greater than the height of the building), and directed away from air-intake units. Drugs should be prepared only when the movable sash is fixed at the required operating level to accommodate the drug-reconstitution procedure.

More recently, awareness that other pharmaceuticals in the hospital setting were also potentially hazardous but were not, strictly speaking, antineoplastics, prompted a committee of the American Society of Hospital Pharmacists (ASHP) to define a class of agents as *hazardous* drugs.[62] This report specified concerns about antineoplastic and nonantineoplastic hazardous drugs in use in most institutions throughout the country. The antiviral agent zidovudine (AZT) should be classified as a hazardous drug but is not thought of as antineoplastic. Recently, AZT was found to be carcinogenic in animals and thus is a potential human carcinogen.[63]

Unfortunately, the ASHP committee did not identify the specific drugs that should be classified as hazardous, leaving the compilation of such a list to individual institutions. The committee did, however, describe the following characteristics of drugs that

could be considered hazardous:

- genotoxicity,
- carcinogenicity in animal models, the patient population, or both, as reported by The International Agency on Research in Cancer,
- teratogenicity or fertility impairment in animal studies or treated patients, and
- evidence of serious organ or other toxicity at low doses in animal models or treated patients.

Guidelines for identifying potentially hazardous drugs in the hospital environment and clarifying their handling can be found in the literature.[64]

Handling antineoplastic and other hazardous drugs may expose healthcare workers to known carcinogens and reproductive toxicants. Implementing a comprehensive program of worker education, engineering and administrative controls, and medical surveillance will ensure the safest workplace possible, one where these useful therapeutic agents may be used without risking the workers' health.

Ethylene Oxide

Ethylene oxide is used routinely in healthcare facilities as a gaseous sterilant for heat- or moisture-sensitive equipment and instruments. In its pure form, ethylene oxide is highly flammable. Therefore, it is typically supplied in compressed-gas cylinders, which contain 88% Freon and 12% ethylene oxide, or in single-use cartridges of 100% ethylene oxide.[3]

In 1977, NIOSH recognized ethylene oxide as a hazard in healthcare facilities, and since then, attention has been focused on the hazard and its effects.[65] The acute toxic effects of exposure to ethylene oxide include respiratory and eye irritation, skin sensitization, vomiting, and diarrhea; the chronic effects include secondary respiratory infection, anemia, and neurotoxicity. In 1981, NIOSH published evidence of ethylene oxide's animal carcinogenicity and the recommended exposure limit was reduced from 50 to 1 ppm.[66] The report also noted adverse reproductive effects in mammals and possible chromosomal aberrations in workers.

Since 1981, NIOSH has completed a cytogenic study that shows an increase in sister-chromatid exchanges (a measure of point mutation) and chromosomal aberrations in monkeys that were exposed to ethylene oxide. Another NIOSH study performed during this period demonstrated statistically significant associations between ethylene oxide exposure and increased incidence of neoplasms in rats.[67] In addition, a literature review of studies of workers who were exposed to ethylene oxide indicates increased mutagenic activity in human cells, carcinogenesis, reproductive abnormalities, and neurological defects.[68] In 1984, OSHA issued a new standard, 29 CFR 1910.1047, to protect workers exposed to ethylene oxide: the PEL was reduced to 1 ppm.[69] The standard was revised in 1988 to include a 15-minute short-term exposure limit (STEL) of 5 ppm.

Exposures to ethylene oxide in a healthcare facility usually occur when sterilizers and aerators are operated or during maintenance and handling of preaerated packages.[70] During these operations, skin contact with ethylene oxide gas or liquid can cause skin irritation, but the primary route of exposure is inhalation (Figure 5-3). Because the odor threshold of ethylene oxide is 700 ppm and the mucous-membrane irritation threshold is 200 ppm, odor and irritation do not provide adequate warning to workers who may be exposed to levels higher than the PEL of 1 ppm.[3] Therefore, stringent control procedures are essential to meet the current standard (the federal law). Practices should include the following:

- routine environmental monitoring and medical surveillance,
- routine equipment maintenance and leak checks,
- effective sterilizer and aerator local exhaust ventilation, and
- the use of ambient ethylene oxide concentration alarms, general ventilation, and work procedures designed to reduce exposure.[67,69,71–73]

Formaldehyde

Formaldehyde is a common and hazardous chemical that is often controlled poorly in healthcare facilities.[4] The most extensive exposures occur while it is used in autopsy rooms and pathology laboratories as a tissue preservative[74,75]; in hemodialysis units as a disinfectant[76,77]; and in central material supply as a cold sterilant for various instruments.[2] (Although embalming facilities are not specifically addressed in this chapter, many hazards to healthcare workers are also hazards to embalmers, formaldehyde being an excellent example.)

As with other hazardous chemicals, the effects of exposure to 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.[4,78] Higher concentrations (10–20 ppm) may cause coughing, chest tightness, increased heart rate, and a sensation of pressure in the

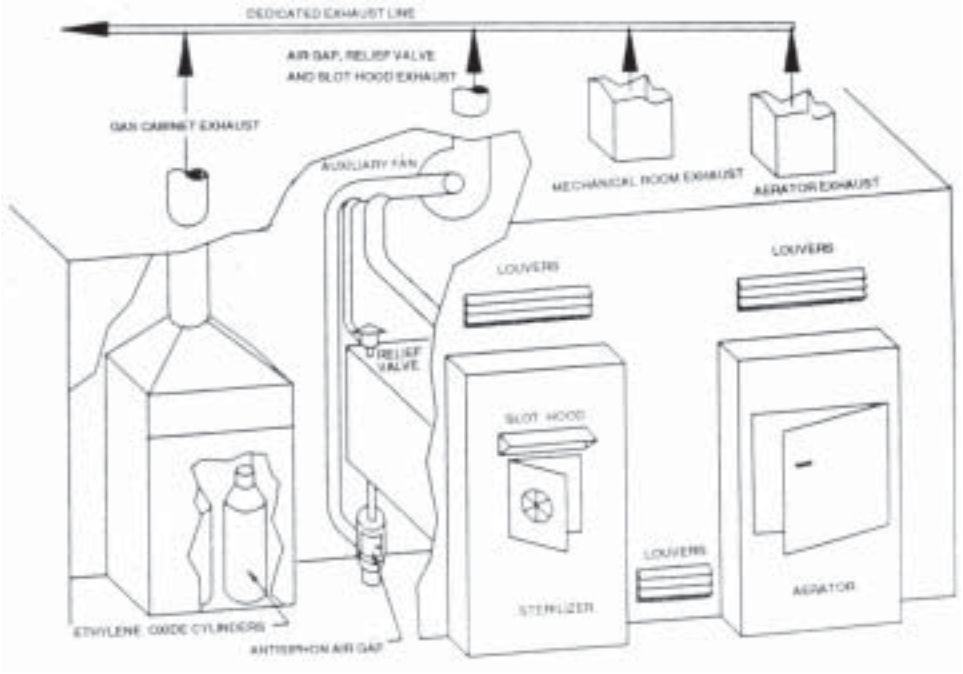


Fig. 5-3. Typical ethylene oxide sterilization equipment includes the ethylene oxide sterilizer, an aerator used to dissipate residual ethylene oxide after materials are sterilized, the ethylene oxide cylinder storage cabinet, and a local exhaust ventilation system to capture and remove ethylene oxide at the points of emission. To protect the health of hospital workers, the extent of ethylene oxide exposure must be characterized. Ethylene oxide concentrations in ambient air can be measured by a variety of sampling methods, and once the extent of exposure is known, engineering or administrative controls can be implemented to reduce the workers' exposure. A properly designed ventilation system can significantly reduce worker exposure to ethylene oxide. Sources: (1) Caldwell DJ. Evaluation of an add-on local exhaust ventilation system for an ethylene oxide (ETO) sterilizer. *Appl Ind Hyg*. 1989;4:88–91. (2) National Institute for Occupational Safety and Health. *Ethylene Oxide Sterilizers in Health Care Facilities, Engineering Controls and Work Practices.* Cincinnati, Oh: NIOSH; 1989: 4. Current Intelligence Bulletin 52.

head. Concentrations of 50 to 100 ppm are associated with pulmonary edema and death.[3,79]

Repeated exposure to formaldehyde vapors causes some healthcare workers to become sensitized. This may occur days, weeks, or months after the first exposure. Immunogenic responses include eye irritation, upper respiratory irritation, or an asthmatic reaction at levels of exposure too low to cause symptoms in most people. Reactions can be quite severe with swelling, itching, wheezing, and chest tightness.[3,4]

Direct contact with formaldehyde solutions can cause severe eye injury and corneal damage and dermatological signs. Primary irritation has been elicited when human skin has contacted solutions as dilute as 4%. Dermatitis (including red, sore, cracking, and blistered skin) is a common complaint; continuous contact may make fingernails soft and brown.[3,78]

As a reactive alkylating agent, formaldehyde is a biologically plausible potential human carcinogen because (*a*) other similar compounds are known or suspected to induce malignancies and (*b*) formaldehyde could be expected to react at the surface of the respiratory tract.[80] Several studies with animals have demonstrated experimentally that formaldehyde is both a mutagen and a carcinogen. In addition, inconclusive human epidemiological studies have associated formaldehyde exposure with cancers of the lung, nasopharynx, oropharynx, and nasal passages. This inevitably raises concern about chronic low-level exposures of humans.[3,4,75,76,79,80]

Standards and controls have been established to limit exposure to formaldehyde. NIOSH first proposed a recommended standard for formaldehyde in 1976 and published evidence of carcinogenicity in 1981.[78,79] OSHA currently regulates formaldehyde: the PEL for an 8-hour TWA is 1.0 ppm; the 15-minute STEL is 2.0 ppm; and the *action level* (the level at which workers must be enrolled in medical surveillance programs) is 0.5 ppm.[69] Occupational exposures are reduced by

- substituting safe products,
- using laboratory hoods,
- wearing appropriate PPE,
- instituting good work practices,
- installing and maintaining general ventilation, and
- training healthcare workers about the relevant hazards.[3,75,81,82]

Mercury

Mercury is used in many types of hospital equipment (manometers, thermometers, Coulter counters, Van Slyke apparatus, Miller-Abbot and Cantor tubes, and sphygmomanometers) and in tissue fixatives and dental amalgams.

Exposures to mercury in healthcare settings usually result from accidental spills, but they can also occur during routine work practices.[3] Additionally, droplets can become trapped in carpets and cracks in floors or counters. These droplets, which vaporize readily at room temperature, are not removed easily during routine cleaning and produce continuous exposure. Central material supply and maintenance personnel are exposed when biomedical equipment breaks or is repaired.[83] Technicians in histology laboratories are subjected to mercuric compounds during routine procedures.[84] However, the greatest potential for mercury exposure is found in dental clinics. Mercury-contaminated dust in dental laboratories is generated when mercury amalgam is cut, ground, and polished. In addition, vapors arise from mechanical amalgamators and ultrasonic amalgam condensers; when amalgam is mulled in the hand, or when excess mercury is squeezed from freshly mixed amalgam; when old fillings are removed; when amalgam-contaminated instruments are hot-air sterilized, and when mercury and amalgam scraps are stored.[85]

The adverse health effects associated with the absorption of mercury vapor through the lungs and skin prompted the establishment of occupational exposure standards and controls (Table 5-4). NIOSH recommended, and OSHA promulgated, a PEL of 0.05 mg/m^3.[69,86] Toxic mercury exposures can be minimized by installing impervious flooring and counters, instituting good work practices, effective handling of spills, good storage procedures, appropriate PPE, periodic air monitoring, good ventilation, and employee education.[87,88]

TABLE 5-4

HEALTH EFFECTS OF EXPOSURE TO MERCURY

Categories	Health Effects
Short-Term Exposures to High Levels	Severe respiratory irritation Chemical pneumonitis Digestive disturbances Marked renal damage
Chronic Low-Level Exposures	Tremor Ataxia Speech disturbance Psychic and emotional changes (irritability, combativeness and fatigue)
Associated Signs	Inflammation of the gums Excessive salivation Anorexia Weight loss Sensitization dermatitis

Sources: (1) US Department of Health and Human Services. *Guidelines for Protecting the Safety and Health of Health Care Workers*. Washington, DC: DHHS (NIOSH); 1988. Publication 88-119. (2) Patterson WB, Craven DE, Schwartz DA, Nardell EA, Kasmer J, Nobel J. Occupational hazards to hospital personnel. *Ann Intern Med*. 1985;102:658–680. (3) National Institute for Occupational Safety and Health. *Criteria for a Recommended Standard: Occupational Exposure to Inorganic Mercury*. Cincinnati, Oh: DHEW (NIOSH); 1973. Publication 73-1009.

Methylmethacrylate

Methylmethacrylate is an acrylic cementlike substance derived from mixing a liquid containing methylmethacrylate monomer with polymethylmethacrylate powder immediately before using in orthopedic and other procedures.[89] Workers in healthcare facilities are subjected to exposures through inhalation of vapors, skin contact, or both. Those at risk include technicians who make and mend acrylic dentures and hearing aids, orthopedic surgical personnel who use the cement for fixation of metallic and plastic prostheses, and pathology personnel who work in areas where methlymethacrylate is used for imbedding histological preparations.[90]

Myriad health effects have been associated with exposure to methylmethacrylate. It is an eye, skin, and mucous-membrane irritant and is known to cause contact dermatitis and occupational asthma.[3,90] Surgical patients exposed to this compound have suffered acute episodes of hypotension and cardiac arrest.[91] In a 1976 study, NIOSH reported adverse health effects such as cutaneous, genitourinary, and respiratory complaints in workers exposed to methylmethacrylate in concentrations lower than 50 ppm.[92] Studies with

animals have shown that methylmethacrylate is teratogenic[93] and mutagenic with the potential for carcinogenicity.[94] There have also been multiple findings of liver damage in rats exposed to various levels of methylmethacrylate.[89]

The OSHA PEL for methylmethacrylate is 100 ppm.[69] Exposure can be reduced by using portable or permanent local exhaust units when mixing the components; wearing appropriate PPE for the eyes, hands and body; practicing careful personal hygiene; and providing hazard-recognition training.[3,89]

Biological Hazards

The germ theory of disease made acceptable the fact that disease is spread by ill persons and fomites (contaminated objects). The germ theory also allowed for the recognition that patient care could, therefore, pose risks to healthcare facility workers. Medical history is replete with anecdotal reports of medical personnel who have succumbed to infectious diseases that were contracted during their work with patients or specimens from patients.[95] Recent attention has focused on the contribution of infectious diseases to the overall burden of work-related illnesses found among healthcare workers. Exposures to bacterial, viral, fungal, and parasitic organisms pose a constant threat to healthcare facility workers in essentially every work area. The healthcare professionals at greatest risk for exposure are medical practitioners,[4,95,96] dental practitioners,[97,98] and laboratory workers.[99] In addition, housekeeping, laundry, maintenance, and supply personnel within the healthcare environment also incur some degree of risk from contact with patient waste, soiled laundry, or contaminated equipment.

Within the healthcare setting, general infection control procedures have been developed to minimize the risk of nosocomial infection.[100–105] Such procedures are designed to prevent transmission of microbiological agents and to provide a margin of safety in the varied situations encountered in the healthcare environment. The modes of transmission found in the healthcare setting are also observed in the working environments of paramedics, emergency medical technicians, and public-safety employees. Therefore, the precautions developed for healthcare organizations are also applicable to these settings. Good infection and biosafety control measures include the following:

- eliminating infective organisms with systemic antimicrobial agents, disinfection, and sterilization;
- eliminating contact, airborne, or fomite transmission routes through personal hygiene (especially handwashing); judicious use of gloves, masks, and gowns; isolation techniques; and proper ventilation; and
- reducing worker susceptibility with immunization, medical surveillance, physical exams, and effective hazard training programs.

Many agents—including tuberculosis, varicella, and rubella—pose significant threats and deserve attention. However, the current interest of the medical community is strongly oriented toward exposure to blood-borne pathogens, especially the hepatitis B virus (HBV), the hepatitis C virus (HCV), and the human immunodeficiency virus (HIV). In December 1991, OSHA promulgated the final rule for occupational exposure to blood-borne pathogens.[106] This performance-oriented law states the required standards; however, it permits the employer to develop and implement individual programs that are protective and cost effective. The standard requires that the employer (*a*) produce a written exposure control plan, (*b*) identify those employees at risk for occupational exposure to blood and other infectious material, (*c*) provide appropriate PPE and enforce wearing compliance, and (*d*) provide hazard training for the employees. Housekeeping requirements and decontamination procedures, including a written schedule for cleaning and discarding sharps and regulated wastes, are also addressed in the standard. Limiting a worker's exposure to blood-borne diseases is achieved by implementing the following categories of controls:

- engineering;
- immunization programs;
- work practices, such as procedures for handling sharps;
- disposal and handling of contaminated waste;
- use of PPE such as gloves and gowns;
- use of mouth pieces, resuscitation bags, and other ventilation devices;
- use of disinfectants;
- labeling and signs; and
- training and education programs.

All healthcare facilities are required to comply with Title 29, Code of Federal Regulations (CFR) 1910.1030. As an example of the level of compliance that is required, an excerpt from Walter Reed Army Medical Center's *Exposure Control Plan*, adopted 4 May 1991, is included at the end of this chapter.

In 1982 and 1983, the Centers for Disease Control

(CDC) issued precautions against acquired immunodeficiency syndrome (AIDS) for healthcare facility workers and allied professionals.[107,108] In 1985, the CDC developed the strategy of *universal blood and body-fluid precautions* to address concerns regarding transmission of HIV in the healthcare setting.[109] This concept (now simply called the *universal precautions*) stresses that (*a*) all patients should be assumed to be infectious for HIV and other blood-borne pathogens and (*b*) health-care workers should perform their duties with prescribed work practices. Universal precautions apply in the healthcare environment when workers are exposed to blood and certain other body fluids (including amniotic, pericardial, peritoneal, pleural, synovial, and cerebrospinal fluids, and semen and vaginal secretions), or any body fluid visibly contaminated with blood.

Some body fluids are exempted from these universal precautions because the transmission of HBV and HIV via exposure to them has not been documented. For example, universal precautions do not apply to saliva when it is not visibly contaminated, or is unlikely to be contaminated, with blood. In the dental setting, however, where saliva is likely to be contaminated, universal precautions do apply. When differentiation between body-fluid types is difficult or impossible, the CDC recommends that medical professionals should treat all body fluids as potentially hazardous. Other body fluids to which universal precautions do not ordinarily apply include feces, nasal secretions, sputum, sweat, tears, urine, and vomitus.[110]

The CDC usually presents information concerning HBV and HIV together for several reasons:

- the modes of transmission for HBV are similar to those of HIV;
- the potential for HBV transmission in the occupational setting is greater than that for HIV;
- a larger body of experience has accumulated relating to controlling transmission of HBV in the work place; and
- because HIV is fragile in the environment, general practices to prevent the transmission of HBV will also minimize the risk of HIV transmission.[110,111]

Precautionary measures to prevent the spread of both HIV and HBV are found in various publications, which address general universal precautions, invasive procedures, autopsies, dialysis, blood or body-fluid spills, waste, emergency medical treatment, dentistry, laboratories, housekeeping, and laundry.[105,110–114]

Physical Hazards

Noise

Some workers in healthcare facilities encounter exposures exceeding the present OSHA standard of an 8-hour TWA of 90 dBA.[69] Most healthcare workers, however, are subjected principally to nuisance levels that are annoying and may interfere with work.[115–120] Noise can become a problem in food-service areas, laboratories (hospital and dental), maintenance and engineering areas, brace shops, incinerators, orthopedic cast rooms (from cast cutting), administrative areas (from printing and reproduction), and dental operatories (from high-speed hand pieces). Technical and physiological aspects of noise and noise control are addressed comprehensively in Chapter 7, Noise and the Impairment of Hearing.

Radiation

Sources of ionizing and nonionizing radiation are present in many areas of fixed medical, dental, and veterinary facilities. Most radiation sources are used for diagnostic and therapeutic purposes; other uses include food preparation with microwave ovens and germicidal treatment of room air with ultraviolet light. Additionally, diagnostic X-ray equipment can be found in field medical units. The health threats posed by these sources and appropriate control measures are discussed in Chapter 15, Nonionizing Radiation and Chapter 16, Ionizing Radiation.

Musculoskeletal Strain

Among the most common problems encountered by healthcare facility workers are back pain and musculoskeletal injury; these are the primary reasons for job-related lost time among these workers.[96,121,122] Most of these problems are associated with workers' attempting to lift or transfer patients. Those workers who are physically unfit, unaccustomed to the task being performed, suffering from postural stress, or doing work that approaches or exceeds the limits of their strength are at greatest risk. Other contributing factors include understaffing, lack of regular training programs regarding the proper procedures for lifting and other work motions, and inadequate general safety precautions.[3,123] The healthcare personnel associated with a high risk for sustaining back problems include surgeons, nurses, nurses aides, emergency medical technicians, dentists, dental assistants, physical and

occupational therapists and aides, radiology technicians, housekeeping and laundry workers, food service employees, maintenance and supply personnel, and, to a lesser extent, laboratory technicians and clerical staff.[3,96,124,125]

Primary and secondary approaches to preventing back pain and injury are the foundation of any back-injury-prevention program. In general, the primary approach to prevention involves reducing manual lifting and other load-handling tasks that are biomechanically stressful. The secondary approach relies on teaching workers how to perform stressful tasks while minimizing the biomechanical forces on their backs. The secondary approach also emphasizes maintaining flexibility and strengthening the back and abdominal muscles.[3] In addition to these approaches, several important techniques to prevent back injuries among hospital staff can be employed (Exhibit 5-3). Written guides and programs for preventing back pain and injury are available for all workers and specifically for healthcare personnel.[126–128]

Psychosocial Hazards

Workers in healthcare facilities face a variety of highly stressful work-related conditions in meeting the physical and psychological needs of patients (Exhibit 5-4). Supervisors and workers must be able to identify the many manifestations of psychological stress and be knowledgeable about stress-management techniques. Additionally, shift work, a major cause of stress, must be implemented properly.

Emotional Stress

Healthcare workers who are most subject to severe emotional stress while working include those in oncology units, burn units, emergency rooms, operating rooms, and intensive care units. Although most studies address the stress factors found among physicians and nurses, some have also identified labora-tory and food-service work as high-stress occupations.[129–133]

The manifestation of stress, which may ultimately

EXHIBIT 5-3

TECHNIQUES TO PREVENT BACK PAIN AND INJURY TO HEALTHCARE WORKERS

Use mechanical devices for lifting patients and other heavy objects

Use wheels and other devices for transporting heavy, nonportable equipment

Provide adequate staffing to prevent workers from lifting heavy patients or equipment alone

Closely supervise newly trained workers to assure that proper lifting techniques have been learned

Use the preplacement evaluation of workers to identify those with existing back disorders and to tailor their job tasks to prevent additional injury

Educate and train both new and experienced staff on the proper measures for avoiding back pain, including: proper lifting techniques to prevent initial back pain (once back pain occurs, there is a higher probability for reoccurrence) and requesting help for tasks that may strain the back

Use proper patient-transfer techniques:

- Communicate the plan of action to the patient and other workers to ensure that the transfer will be smooth and without sudden, unexpected moves
- Position the equipment and furniture effectively (eg, move a wheelchair next to the bed) and remove obstacles
- Ensure good footing for the staff and patients (patients should wear slippers that provide good traction)
- Maintain eye contact and communication with the patient; be alert for trouble signs
- Request that a coworker stand by before attempting the transfer, if help is needed
- Record any problems on the patient's chart so that other shifts will know how to cope with difficult transfers; note the need for any special equipment, such as a lift

Post, remove, or repair accident hazards such as wet floors, stairway obstructions, and faulty ladders on step stools

Source: US Department of Health and Human Services. *Guidelines for Protecting the Safety and Health of Health Care Workers.* Washington, DC: DHHS; 1988. NIOSH Publication 88-119.

EXHIBIT 5-4

COMMON STRESS-ASSOCIATED FACTORS AMONG HEALTHCARE WORKERS

- Lack of essential support services and inadequate resources
- Strenuous work loads and prolonged work schedules
- Rotating shift work
- Sleep deprivation
- Working in unfamiliar areas
- Understaffing
- Discrimination
- Role conflict and ambiguity
- Underutilization of talents and abilities
- Lack of control and participation in planning and decision making
- Communication problems among aides, nurses, physicians, and administrators
- Lack of administrative rewards
- Keeping abreast of rapidly changing and increasingly complex technology
- Unrealistic self-expectations
- Guilt about negative feelings toward patients
- Participation in intense emergency situations
- Difficulty in dealing with deformity, terminal illness, and death
- Constant contact with ill and depressed patients
- Making rapid, complex, and critical decisions on the basis of inadequate data
- Constant interruptions that impair concentration
- Exposure to toxic substances and physical hazards
- Exposure to infectious patients
- Ergonomic factors

lead to *burnout* (physical or emotional exhaustion from long-term stress), differs greatly among healthcare workers.[134,135] Stress can manifest as adaptive reactions such as delayed gratification, compulsiveness, and expressing the need for support. If continued for many years, some of these manifestations may lead to obvious physiological and psychological problems. Stress has also been associated with loss of appetite, ulcers, migraine headaches, fatigue, nausea, diarrhea, sleep disorders, oversleeping, increased smoking, disruption of social and family life, disorientation, disorganization, apathy, indecisiveness, reluctance to accept responsibility, and emotional instability. Stress also manifests as even more serious conditions: substance abuse, mental illness, suicide, and providing inadequate patient care (eg, careless examinations, poor treatment, abuse of patients, and gross sociopathic behavior).[3,4,6]

Methods of coping with stress have concerned educators, managers, and workers for many years (Exhibit 5-5). One study attempted to improve the work environment in a burn unit by providing feedback about the work setting and helping the staff use that information to formulate and implement changes[136]:

- The staff were encouraged to think about the elements of their work setting in terms of those elements that were stressful and those that were nonstressful.
- The staff began to focus on work-setting characteristics that are often overlooked, such as clarity of expectations.
- The staff attempted to effect change in only a few areas at a time, rather than in many.

As a result, improvements in morale and the quality of patient care were apparent:

- The staff's involvement in their work increased as they began to work together to affect change.
- The staff began to feel concern not only for their individual patients but also for all patients and staff members.

Shift Work

A major cause of stress in healthcare facilities is shift work, especially rotating work schedules. Shift-work–related stress results from three general problems: (1) disruption of the circadian rhythm (sleep-awake cycle), (2) disruption of social and family life, and (3) sleep deprivation. These factors may interact to produce deleterious effects on the general psychological and physical well-being of the shift worker. While there is insufficient evidence to demonstrate conclusively that shift work causes a specific illness, shift workers (especially those who rotate shifts) do have more health-related complaints such as digestive problems, chest pain, wheezing, nervousness, colds, and fatigue.[137]

As a rule, workers on rotating shifts dislike those aspects of their work schedules that violate circadian physiology. Worker satisfaction, subjective health estimates, personnel turnover, and productivity all seem to improve when schedules are designed to incorporate circadian principles.[138] Despite variations in current practice, most researchers advocate either a slow rotation of three or more weeks to permit circadian

EXHIBIT 5-5

METHODS FOR MANAGING STRESS

Institute educational sessions to improve skills and confidence
Institute stress-management and employee-assistance programs
Learn to identify the signs and sources of stress
Engage in activities to facilitate disengagement from work (such as hobbies)
Learn to reserve time and energy for oneself without feeling guilty
Emphasize the fun and reward of healthcare and intellectual achievement
Foster employee ability to recognize and respect each one's own limits
Provide readily available counseling from a nonjudgmental source
Provide group support systems, using a skilled neutral facilitator, for staff with particularly difficult professional problems
Facilitate effective teamwork and trust
Promote high-quality communication
Hold regular staff meetings and discussions to communicate feelings, gain support, and share innovative ideas
Encourage supervisory flexibility and innovation to create alternative job arrangements
Recognize and act on legitimate complaints regarding overbearing supervisors
Schedule rotation of assignments to allow adequate time for employee planning
Optimize shift-work schedules
Provide reasonable schedules for house staff to allow adequate time for sleep
Encourage organized and efficient work functions and environment
Provide adequate staff and resources

adaptation, or a rapid rotation of one to three consecutive nights followed by rest to prevent circadian disruption.[139] Shift changes should always be progressively later in rotation (ie, day to evening to night).[138]

STRATEGIES FOR HAZARD ABATEMENT

The initial step in eliminating or reducing hazards to human health in any healthcare setting is to develop a hazard inventory, which is usually the responsibility of the safety officer. This requires that the worksite hazards be observed, identified, and then compiled into an inventory. Support for this effort can be provided by the environmental science officer, industrial hygienist, occupational medicine physician, occupational health nurse, preventive medicine officer, and preventive medicine and industrial hygiene technicians. Hazard identification is only the first step; it is followed by the more difficult tasks of evaluation and control. Evaluation encompasses environmental sampling, surveillance, or both; detailed work-practice investigations; and medical surveillance. Hazard control comprises the following:

- diverse engineering interventions,
- proper ventilation,
- appropriate PPE,
- educational training for recognizing and avoiding hazards,
- safe work techniques or practices, and
- written safety or health procedures and programs that contain enforcement provisions.

Knowledge is the key to the prevention of hazardous exposures. To ensure that employees are knowledgeable about the hazards present and the proper use of safety equipment, personnel must be trained regarding

- the proper use of PPE;
- the potential hazards associated with toxic chemicals, equipment, and operations;
- safe work practices; and
- proper emergency procedures and abatement requirements.

THE MILITARILY UNIQUE ENVIRONMENT

U.S. Army healthcare operations in the field may be conducted using Table of Organization and Equipment (TOE) facilities (such as tents) and standard TOE 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, listed in the TOE, or in any combination. The lack of an established, familiar fixed facility; the use of unfamiliar medical items; the absence of water, waste disposal, and other similar services in the field; and the physical and psychological stresses of training—or actual or threatened hostilities—can all greatly increase the potential that personnel in field healthcare facilities will face hazardous exposures and overexposures. Therefore, preventive medicine personnel assigned to division or corps preventive medicine sections or teams must be able to make (*a*) quick, thorough evaluations of the actual and potential health threats in field MTFs and (*b*) appropriate recommendations to reduce or eliminate the potential health threats. (There are no identified occupational medicine physician, occupational health nurse, or industrial hygienist positions in TOE units. All U.S. Army preventive medicine physicians, environmental science officers, sanitary engineers, and enlisted preventive medicine technicians receive training in occupational health and occupational medicine functions for TOE units.)

All actions taken to evaluate actual and potential hazards in a field MTF must be geared to the tactical situation. Circumstances may not allow the level and sophistication of hazard identification and evaluation normally found in a fixed medical facility. For example, state-of-the-art monitoring equipment and techniques may not be available, or may be impractical, and the time available for observing procedures within the facility may be limited. Additionally, each evaluation must be conducted with a clear understanding of the mission and priorities of the field facility and the means available to eliminate or control hazards. Therefore, preventive medicine personnel who conduct evaluations of field MTFs must be knowledgeable about field operations, able to quickly make qualitative assessments about hazards and their associated risks, and capable of clearly and concisely communicating to commanders (or their representatives) the significant hazards that require attention. Both a thorough base of knowledge about the hazards in medical facilities and common sense are absolute requirements. It is unrealistic to assume that an evaluation protocol used at an army medical center or other fixed medical facility could be directly applied to a field facility, particularly one that is engaged in receiving combat wounded. In the field, preventive medicine personnel must identify the hazards and threats and place them in perspective relative to the mission and task at hand.

The emphasis on hazard identification and control in an MTF may be dictated by the command surgeon, theater policy, or both.[140] Additionally, the nature of the diseases and injuries that occur may influence the emphasis placed on certain hazards. For example, if large numbers of patients present with enteric disease, then strict adherence to enteric-disease precautions would be warranted to ensure that spread of the disease-causing agent (patient-to-staff or patient-to-patient) would be minimized.

Depending on the type of unit and the nature of operations, the categories of hazards that are present in a field MTF will usually be similar to or the same as those found in a fixed facility. However, the harshness of the environment, disruption of the body's natural defenses through fatigue and other factors, and breakdowns in basic sanitation all require that considerable emphasis be placed on variables that are often taken for granted in fixed facilities, such as the availability of water and basic sanitary facilities.[140,141] Concerns about potable water, handwashing sources, and basic field sanitation may demand greater attention than environmental and occupational hazards such as ethylene oxide.

The first step in hazard abatement in a field MTF is to identify the hazards that are potential sources of danger. Identification of hazards in a field medical environment is a responsibility delegated by the commander to the staff. Execution of this task varies from unit to unit but usually requires someone with both access to all areas of the field medical unit and direct access to the commander for decision making. Preventive medicine personnel supporting field medical units should seek out the responsible staff member and work with him or her to evaluate and assess the hazards.

Appropriate and meaningful evaluations of field MTFs can prevent morbidity and mortality and preserve valuable human resources. Evaluations performed by preventive medicine personnel who are not knowledgeable or experienced in this area can waste the valuable time of healthcare providers and create confusion by issuing inappropriate recommendations.[142]

When conducting a survey, specific aspects of the field sanitation program should be reviewed, including:

- the water supply (water containers and trailers), to ensure that it is being monitored for potability, and that disinfection of the unit's water supply is being properly supervised;
- the unit's food operations, to confirm that basic food sanitation guidance is followed;
- unit waste-disposal operations, to ensure that acceptable policies are established and followed (in a field MTF, this element must include medical and chemical waste, in addition to wastewater and solid waste. The volume of solid waste and wastewater can be significant due to laundry, showers, bedpan washing, handwashing facilities for infection-control purposes, waste from X-ray units, and the use of disposable supplies);
- arthropod- and other animal-control measures, to ensure that they are appropriate and adequate;
- safety and health training programs, to evaluate their relevance to hazards found in the field medical environment;
- waste anesthetic gases, laboratory chemicals, and radiation, to ensure that the potential hazards are recognized and controlled; and
- autoclave operations, to ensure that sterilization procedures are adequate, and that explosive and burn hazards are controlled.

Simply talking with the personnel working in the field MTF can be extremely helpful. For example, these conversations may reveal valuable information about common health problems among the staff (eg, dermatitis or diarrhea); hazards that are not easily identified by short periods of observation (eg, malfunctioning switches on X-ray equipment); or supply shortages for critical items (eg, gloves or disinfectants).

After identifying the potential hazards, each must be analyzed to determine the probability that it will cause disease or injury, and the severity of the consequences should such a problem occur. Once the risks have been determined, the risk analysis must be presented to the decision maker (usually the commander), so that the risk is weighted against the benefits of performing a mission or task. It is the responsibility of the preventive medicine officer (who is a physician) or his or her representative to communicate to the decision maker (briefly and specifically) both the identified risk and appropriate recommendations on ways to reduce or eliminate the hazard.[141] The controls may be as substantial as substituting a less-toxic chemical and providing PPE or engineering controls. Or they may be as simple as implementing administrative controls such as writing an SOP, briefing personnel, and supervising adherence to the new procedures.

SUMMARY

Healthcare facilities are highly complex work environments with many varied occupational hazards. Employees are subjected to a surprising array of chemical, biological, physical, and psychosocial agents. The facility or unit commander, staff, supervisors, and workers themselves all have a responsibility to protect workers' health. Awareness of the hazards that are most likely to be encountered in the healthcare environment will, in most instances, enable the hazards to be identified and will generate the actions necessary to minimize, prevent, or eliminate the danger.

Although this chapter primarily addresses the hazards associated with fixed garrison healthcare facilities, many of the concepts presented also apply, in general, to field MTFs. Differences lie in the facts that (*a*) requirements for mobility may reduce the numbers of hazards, and (*b*) austere field conditions can lead to increased severity of exposures. Whether in a fixed or field healthcare facility, however, the effort to protect a worker's health reaps benefits beyond that afforded the individual. An ill or impaired healthcare worker can (directly or indirectly) adversely affect the morale and health of coworkers, patients, or both. Although such adverse effects are undesirable in any setting, in a field MTF supporting a combat operation, the impact could be catastrophic.

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EXCERPT FROM WALTER REED ARMY MEDICAL CENTER'S EXPOSURE CONTROL PLAN

The following excerpt is from the *Exposure Control Plan* that was adopted at Walter Reed Army Medical Center on 4 May 1991. Students may find this helpful because it illustrates the level of compliance required by Title 29, Code of Federal Regulations (CFR) 1910.1030. The appendices mentioned, which are part of the original document, are not included in this excerpt.

10. METHODS OF COMPLIANCE.

a. Universal Precautions.

Universal precautions were implemented at WRAMC [Walter Reed Army Medical Center] in 1987. Universal precautions require all employees to treat blood, body fluids, and tissues of all patients as potentially infective with HBV [hepatitis B virus], HIV [human immunodeficiency virus], and other blood-borne pathogens. The precautions are intended to prevent parenteral, mucous membrane, and skin exposure to blood and body fluids. Universal precautions are outlined in Section 4, Isolation Procedures and Universal Precautions, of the Infection Control Policy and Procedure Guide (Appendix B).

b. Engineering and Work Practice Controls.

(1). Engineering and work practice controls will be implemented as the primary means of eliminating or minimizing employee exposure to blood and body fluids. When occupational exposure remains after institution of engineering and work practice controls, personal protective equipment (PPE) will be used.

(2). Engineering controls are controls that either isolate the employee from the hazard or remove the hazard from the workplace. Examples include sharps disposal containers, bio-safety cabinets, splash guards, and needleless IV systems.

(3). Work practice controls are those that reduce the likelihood of exposure by altering the manner in which a task is performed. An example of a required work practice control is prohibiting recapping of needles with a two-handed technique.

(4). All engineering and work practice controls in this section that are not currently in use will be implemented NLT [no later than] 6 July 1992.

(5). Handwashing.

(a). Handwashing facilities will be readily accessible to employees. Approved alcohol based waterless hand cleansers and paper towels must be used in all areas where sinks are not available. Handwashing technique is described in Section 5.1, Handwashing and Use of Gloves, in the Infection Control Policy and Procedure Guide (Appendix C).

(b). Employees will wash their hands immediately or as soon as feasible after removal of gloves or other personal protective equipment.

(c). Employees using a waterless hand cleaner must wash hands with soap and running water as soon as feasible.

(d). Employees will wash hands and any other skin with soap and water, or flush mucous membranes with water, immediately or as soon as feasible following contact of such body areas with blood or other potentially infectious materials.

(e). Hand cream application is permitted in a contaminated area if the hands are thoroughly washed immediately prior to application. Hand creams must be from small, individual, nonrefillable containers and not shared between individuals.

(6). Prevention of Sharps Injuries.

(a). Contaminated needles and other contaminated sharps will not be bent, sheared, or broken.

(b). Contaminated needles will not be recapped or removed from syringes unless it can be demonstrated that there is no feasible alternative or the action is required by specific medical procedure. The two exceptions where recapping the needle is permitted are: Performing a blood gas and administering incremental doses of a medication such as an anesthetic to the same patient. Removing the needle from a vacutainer sleeve is permitted. Recapping with the traditional two-handed method is prohibited in these situations. Recapping will be performed with the one-hand scoop method (the hand holding the sharp is used to scoop up the cap from a flat surface) or by using forceps to replace the cap. Removing the needle from a vacutainer sleeve will be done using the special area on the sharps container where the needle is inserted and the vacutainer is used to unscrew the needle and the needle drops into the sharps container. NOTE: Other exceptions must be submitted to the Infection Control Committee for approval. Applications must include a justification for the need to recap or remove a needle.

(c). Immediately, or as soon as feasible after use, contaminated needles or other sharps will be placed in leakproof, puncture resistant sharps containers which are located in patient rooms and in other areas as close to where sharps are used as feasible. Sharps containers in patient rooms are in a wall cabinet. This cabinet and the disposable sharps liners are to be labelled with a biohazard symbol IAW [in accordance with] the Labels and Signs section of this plan. Chemotherapy sharps containers will be labelled IAW the Labels and Signs section of this plan. All other sharps containers will be red in color.

(d). A red sharps container will be available in the laundry.

(e). Disposable sharps containers will be removed and replaced with a new one when ¾ full. They will be closed off by securely locking the closure mechanism, tagged with a burn label, and placed in the trash area for pick-up by housekeeping. If a sharps container is found to be leaking, it must be placed in a larger sharps container that is labelled and sealed. The OIC [officer in charge] in each work area is responsible for insuring that sharps containers are replaced when ¾ full and are not overfilled.

(f). Contaminated reusable sharps will be placed in containers until properly processed. The containers are puncture-resistant, leakproof on the sides and bottom, and labelled with a biohazard label IAW the Labels and Signs section of this plan. The containers need not be closable. Employees will not reach by hand into these containers. Employees will not reach into a water-filled sink or pan to retrieve contaminated instruments. Instead a perforated tray can be used or the instruments can be retrieved with forceps. A container for reusable sharps will also be available in the laundry.

(g). Reusable sharps containers will be cleaned with soap and water and then disinfected with a 1:10 solution of bleach after each use.

(h). In psychiatric units where there are no in-room sharps containers, needle users have two options: Carry a small sharps container to the room to immediately discard the sharp or use a self-sheathing needle-syringe unit.

(i). The Baxter needleless IV [intravenous] system will be used for access into IV lines. Stopcocks may also be used.

(7). Bio-safety cabinets and splash guards are used in laboratories to minimize splashing, spraying, splattering, and generation of droplets.

(8). Engineering controls will be examined and maintained or replaced on a regular schedule to insure their effectiveness, that they have not been removed or broken, that ventilation systems are functioning properly, and that filters are replaced frequently enough. The OIC in each work area will establish a written inspection and routine maintenance schedule for the engineering controls in that area.

(9). All specimens of blood, body fluids, and tissues will be handled using Universal Precautions and will be transported in sealed plastic bags. Specimen containers will be securely closed before placing in the bag. If outside contamination of the bag or primary container occurs, the bag or primary container shall be placed within a second container which prevents leakage during handling, processing, storage, transport, or shipping. If the specimen could puncture the primary container, the primary container will be placed within a second container which is puncture resistant. Containers used for transporting or shipping specimens outside the facility will be labelled with a biohazard label IAW the Labels and Signs section of this plan.

(10). Equipment which may be contaminated with blood or body fluids will be examined prior to servicing or shipping and will be decontaminated as necessary. If decontamination of the equipment is not possible (personnel do not have training to take apart technologically advanced equipment or equipment design prohibits cleaning), a readily observable label will be attached to the equipment stating which portion may be contaminated and this information will be conveyed to all affected employees, the servicing representative, and/or the manufacturer, as appropriate, prior to handling, servicing, or shipping so that appropriate precautions will be taken. See section on Labels and Signs for required label characteristics. See section on Housekeeping for instructions on decontamination. Biomedical maintenance personnel will be instructed in precautions to practice during decontamination of equipment.

(11). All procedures involving blood or other body fluids shall be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets of these substances.

(12). Mouth pipetting/suctioning of blood or other body fluids is prohibited.

(13). Eating, drinking, smoking, applying cosmetics or lip balm, and handling contact lenses are prohibited in all work areas where there is a reasonable likelihood of occupational exposure. Eating or drinking are permitted only in designated areas separate from contaminated areas. Employees must remove any contaminated clothing or protective barriers prior to entering the clean area.

(14). Food and drink shall not be placed in refrigerators, freezers, shelves, cabinets, or on countertops or benchtops where blood or other potentially infectious materials are present or where specimens have been placed.

(15). All employees will be trained by their supervisor in the use of any engineering control before they are required to use it.

(16). Employees who have exudative lesions or weeping dermatitis will not perform or assist in invasive procedures or other direct patient care activities or handle equipment used for patient care.

(17). The Hospital Product Review Subcommittee will review the feasibility of testing engineering controls as new ones enter the market.

c. Personal Protective Equipment (PPE).

(1). Supervisors will insure that personal protective equipment in the appropriate sizes is readily available to employees in each work area that requires it. Supervisors will insure that employees are trained in its use and use it as required. PPE not currently in use must be implemented NLT 6 Jul 92.

(2). PPE is provided at no cost to the employee and includes, but is not limited to, gloves, gowns, laboratory coats, face shields, masks, eye protection, and mouthpieces, resuscitation bags, pocket masks, or other ventilation devices.

(3). PPE is considered appropriate only if it does not permit blood or other potentially infectious materials to pass through or reach the employee's work clothes, street clothes, undergarments, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the PPE will be used.

(4). Supervisors will insure that employees use appropriate personal protective equipment unless the supervisor can show that the employee temporarily and briefly declined to use PPE when, under rare and extraordinary circumstances, it was the employee's professional judgment that in the specific instance its use would have prevented the delivery of health care or public safety services or would have posed an increased hazard to the safety of the worker or a coworker. When an employee makes this judgment, the supervisor will investigate and document the circumstances. The documentation will be forwarded to the Safety Manager NLT the next duty day. The supervisor and the Safety Manager will determine whether changes need to be instituted to prevent such occurrences in the future. A decision not to use protective barriers will not be applied to a particular work area or a recurring task. Neither interference with ease of performance of a procedure nor improper fit of equipment are acceptable reasons to not use PPE.

(5). Supervisors will insure that PPE in the appropriate sizes is readily accessible at the worksite or is issued to employees. Hypoallergenic gloves, glove liners, powderless gloves, or other similar alternatives will be readily accessible to those employees who are allergic to gloves normally provided.

(6). PPE will be cleaned, laundered, or disposed of by WRAMC at no cost to personnel. Laboratory coats that are used as PPE will be laundered by the hospital and not taken home for laundering. Personal clothing contaminated by blood or body fluids will be laundered by the hospital laundry at no cost to the employee. Supervisors will contact Linen Services to make arrangements for laundering personal clothing when contaminated.

(7). Supervisors will insure repair or replacement of all reusable equipment as needed to maintain effectiveness.

(8). If PPE items are penetrated by blood or other potentially infectious materials, the item will be removed immediately or as soon as is feasible.

(9). All PPE will be removed prior to leaving the work area. PPE will not be worn into designated break areas.

(10). Gloves.

(a). Latex gloves will be worn when it can be reasonably anticipated that the employee may have hand contact with blood, other body fluids, mucous membranes, and non-intact skin; when performing vascular access procedures; and when handling or touching contaminated items or surfaces.

(b). Examples of tasks where gloves will be worn are: Phlebotomy, performing finger or heel sticks; during instrumental examination of the oropharynx, gastrointestinal tract, and genitourinary tract; during invasive procedures; during all cleaning of body fluids and decontaminating procedures; handling and processing blood and body fluid and tissue specimens; when examining abraded or non-intact skin or patients with active bleeding; when emptying drains and Foley catheter bags; and when rendering emergency medical assistance to individuals with traumatic injury.

(c). Single use disposable latex gloves shall be replaced as soon as practical when contaminated or as soon as feasible if they are torn, punctured, or when their ability to function as a barrier is compromised.

(d). Gloves will be changed and hands washed between patients or during the care of a single patient when moving from a contaminated to a clean body site or from one contaminated site to another contaminated site. Phlebotomists working in the outpatient phlebotomy room may wear gloves with several patients until they become visibly contaminated. This exception does not apply to phlebotomists drawing blood on inpatients or to any other personnel who draw blood.

(e). Hands will be washed as soon as possible after removal of gloves.

(f). Gloves should be discarded in the appropriate container.

(g). Disposable gloves such as surgical or examination gloves will not be washed or decontaminated for re-use.

(h). Sterile surgical gloves should be used for procedures involving contact with normally sterile areas of the body.

(i). Latex examination gloves should be used for procedures involving contact with mucous membranes, unless otherwise indicated, and for other patient care or diagnostic procedures that do not require the use of sterile gloves.

(j). Double gloving may be used for invasive surgical procedures where prolonged contact with blood may be expected.

(k). Used gloves will not be used to touch telephones, computers, keyboards, charts, elevator buttons, or other uncontaminated surfaces.

(l). Non-patient care services should use gloves appropriate to their type of work. Heavy duty utility gloves may be preferable for housekeeping personnel. These gloves may be washed and disinfected for reuse if the integrity of the glove is not compromised. If gloves are cracked, peeling, torn, or punctured, they are discarded.

(11). Masks, Eye Protection, and Face Shields.

(a). In general, whenever a mask is required, eye protection is required.

(b). Masks in combination with eye protection devices, such as goggles or glasses with solid side shields, or chin-length face shields shall be worn whenever splashes, spray, splatter, or droplets of blood or other body fluids may be generated and eye, nose, or mouth contamination can be reasonably anticipated.

(c). Prescription glasses may be used as protective eyewear as long as they are equipped with solid side shields that are permanently affixed or of the "add-on" type.

(d). Procedures requiring masks and eye protection include endotracheal intubation, bronchoscopy, GI endoscopy, dental procedures that splatter, autopsy, and certain surgical and other invasive procedures.

(e). During microsurgery, when it is not reasonably anticipated that there would be any splattering, it would not constitute a violation for the surgeon, while observing surgery through a microscope, not to wear other eye protection.

(f). Masks should be used once and discarded in the appropriate waste receptacle.

(g). Masks should not be worn around the neck or on top of the head.

(h). Masks must cover both the nose and mouth with no gaping at the sides.

(i). Reusable goggles and face shields will be washed with an approved detergent and water and disinfected with a 1:10 solution of bleach after each use.

(12). Gowns

(a). Gowns, aprons, laboratory coats, or clinic jackets must be worn where there is the potential for reasonably anticipated soiling of clothing with blood or other potentially infectious materials.

(b). A cover garment is appropriate only if it does not permit blood or other body fluids to pass through to or reach the employee's work clothes, street clothes, or undergarments.

(c). Gowns impervious to fluid will be worn for surgical procedures and autopsies.

(d). A long-sleeved cover will be worn when arms are likely to become contaminated.

(e). Scrubs are not considered PPE and will be covered by appropriate gowns, aprons, or laboratory coats when splashes to skin or clothing are anticipated.

(f). A gown which is frequently ripped or falls apart under normal use would not be considered appropriate PPE.

(g). A cloth gown or disposable cover gown will not generally prevent gross liquid contamination from soaking through to the skin, but they are adequate protection for common bedside patient care procedures in situations when gross liquid/blood contamination is not likely.

(h). Examples of activities requiring gowns or aprons are: changing the bed of an incontinent patient, lifting or moving a patient with draining wounds, diagnostic and therapeutic procedures that may cause splattering or aerosolization, and autopsy.

(i). Gowns and aprons should be worn only once and then removed and placed in the appropriate receptacle. These items will not be worn out of the work area.

(j). Cloth gowns and lab coats will be placed in the hospital laundry containers.

(k). Paper or plastic gowns/aprons will be discarded in the appropriate waste receptacle.

(13). Surgical caps or hoods and/or shoe covers or boots will be worn during surgical procedures, autopsies, or other situations when gross contamination can be reasonably anticipated. Shoe covers must be removed prior to leaving the work area to limit migration of contamination via shoes into other areas.

(14). Seal-easy masks are available in each patient room and in other areas of the hospital for use during mouth-to-mouth resuscitation to prevent direct contact between the employee and the patient. Ambu-bags are at each bedside in critical care areas and on each crash cart at the hospital. The seal-easy masks are disposable and will be discarded after each use. Ambu-bags that are reusable will be bagged and sent to CMS [central material supply] for high-level disinfection or sterilization.

d. Housekeeping.

(1). Supervisors will insure that the work area is maintained in a clean and sanitary condition. The provisions of this section not currently implemented will be in use NLT 6 Jul 92.

(2). All equipment and environmental and working surfaces will be properly cleaned and disinfected after contact with blood or other potentially infectious materials and on a regular schedule with an appropriate disinfectant.

(3). Contaminated work surfaces will be decontaminated with an appropriate disinfectant after completion of procedures; immediately or as soon as feasible when surfaces are overtly contaminated or after any spill of blood or other body fluids; and at the end of the work shift if the surface may have become contaminated since the last cleaning. A phenolic disinfectant approved by the Infection Control Committee and used according to the manufacturer's directions will be used in the laboratory, the Operating Room, and Delivery Room. The Dialysis Unit uses bleach.

(4). Blood spills will be cleaned up with an approved detergent and water and the area disinfected with a 1:10 solution of household bleach or an approved phenolic disinfectant.

(5). Protective coverings such as plastic wrap, aluminum foil, or imperviously-backed absorbent paper may be used to cover equipment and environmental surfaces. These shall be removed and replaced as soon as feasible when they become overtly contaminated and between patients.

(6). All bins, pails, cans, and similar receptacles intended for reuse which have a potential for becoming contaminated with blood or other body fluids shall be inspected, cleaned with an approved detergent and water, and disinfected with a phenolic disinfectant or a 1:10 solution of bleach immediately or as soon as possible after visible contamination. Routine cleaning of these items will be done monthly.

(7). Reusable items contaminated with blood or other body fluids shall be washed with an approved detergent and water. If an item is to be returned to the CMS, it will be placed into a plastic bag for transport (the bag must be labelled IAW the Labels and Signs section of this plan). If the item remains in the area, it will be wiped down with a phenolic disinfectant or a 1:10 solution of bleach.

(8). Broken glassware which may be contaminated will not be picked up directly with the hands. It will be cleaned up using mechanical means, such as a brush and dust pan, tongs, or forceps.

(9). Routine Cleaning Schedule:

LOCATION	FREQUENCY	CLEANERS AND DISINFECTANTS USED
Patient Room	Daily	Approved quaternary ammonium disinfectant
Patient Bathroom	Daily	Approved quaternary ammonium disinfectant
Exam Room	Daily	Approved quaternary ammonium disinfectant
Procedure Room	Between procedures	Approved quaternary ammonium disinfectant
Operating Room	Between cases	Approved phenolic disinfectant
Delivery Room	Between deliveries	Approved phenolic disinfectant
Dialysis	Between patients	Approved detergent and 1:10 bleach solution
Laboratory	When contaminated and/or daily	Approved phenolic disinfectant

e. Regulated Medical Waste.

(1). Regulated medical waste (RMW), including sharps, will be disposed of IAW WRAMC Reg 40-92 and section 5.11, Collection and Handling of Regulated Medical Waste, of the Infection Control Policy and Procedure Guide (Appendix D). Saliva-soaked gauze and cotton rolls in dental clinics and items caked with dried blood and capable of releasing the blood during normal handling procedures will be managed as RMW NLT 6 Jul 92.

(2). When moving containers of contaminated sharps from the area of use, the containers will be closed immediately prior to removal or replacement to prevent spillage or protrusion of contents during handling, storage, transport, or shipping. If leakage is possible, the container will be placed in a secondary container that is closable, constructed to contain all contents and prevent leakage during handling, storage, transport, or shipping and labelled or red in color IAW the Labels and Signs section of this plan.

(3). Other regulated medical waste is placed in plastic bags that line cardboard boxes which are labelled IAW the Labels and Signs section of this plan. When ¾ full, the bags are closed, the box is sealed, and labelled with a burn tag on the side of the box. If outside contamination of the box occurs, the waste is placed in a second bag inside another labelled box.

f. Laundry.

(1). All soiled linen will be handled using universal precautions. Personnel handling linen soiled with blood or other body fluids will use appropriate PPE as described in the Personal Protective Equipment Section. These practices are currently in place.

(2). Soiled linen will be collected in white or green laundry bags at the location where it was used. If linen is excessively wet, place it in a clear or black plastic bag before putting it in the laundry bag.

(3). Soiled linen will not be sorted or rinsed in patient care areas.

11. HEPATITIS B VACCINATION, POST-EXPOSURE EVALUATION AND FOLLOW UP.

a. Vaccination Program.

To protect employees as much as possible from the possibility of Hepatitis B infection, WRAMC implemented a vaccination program. This program is available, at no cost, to all employees who have occupational exposure to blood-borne pathogens. The vaccination program consists of a series of three inoculations over a 6-month period. As part of their blood-borne-pathogens training, our employees have received information regarding hepatitis vaccination, including its safety and effectiveness. Occupational Medicine in conjunction with Allergy/Immunology is responsible for setting up and operating our vaccination program. Vaccinations are performed under the supervision of a licensed physician or other healthcare professional. To ensure that all employees are aware of our vaccination program, it is thoroughly discussed in our blood-borne pathogens training. A record of the vaccination status of all employees will be maintained by the Occupational Medicine Program. Any exposed civilian declining to be vaccinated will sign the following declination statement (Appendix E). This statement will be maintained in the employee's medical record.

b. Post-exposure evaluation and follow up.

(1). Employees involved in an incident where exposure to blood-borne pathogens may have occurred will immediately report to the Emergency Room.

(2). The supervisor will immediately investigate the circumstances surrounding the exposure incident while making sure that our employees receive medical consultation and treatment (if required) as expeditiously as possible.

(3). Treatment will be in accordance with the Emergency Room's Needle Stick Protocol (Appendix F).

(4). The Safety Office will investigate every exposure incident that occurs in our facility. This investigation is initiated within 24 hours after the incident occurs and involves gathering the following information:

- When the incident occurred. Date and time.
- Where the incident occurred. Location within the facility.
- What potentially infectious materials were involved in the incident. Type of material (blood, amniotic fluid, etc.).
- Source of the material.
- Under what circumstances the incident occurred. Type of work being performed.
- How the incident was caused. Accident/Unusual circumstances (such as equipment malfunction, power outage, etc.).
- Personal protective equipment being used at the time of the incident.
- Employee decontamination/cleanup/notifications made.

After this information is gathered it is evaluated, a written summary of the incident and its causes is prepared, and recommendations are made for avoiding similar incidents in the future (Appendix G).

(5). In order to make sure that our employees receive the best and most timely treatment if an exposure to blood-borne pathogens should occur, our facility has set up a comprehensive post-exposure evaluation and follow-up process (Appendix H). We verify that all the steps in the process have been taken correctly. This process was implemented on or before July 6, 1992, and is overseen by the Occupational Safety and Health Committee.

c. Information provided to the healthcare professional.

Civilian employees have the right to choose a civilian physician for treatment. WRAMC, however, has the right to evaluate employees who are injured on the job. Therefore, personnel who suspect they have been exposed to a blood-borne pathogen are to report to the Emergency Room for evaluation. After the evaluation should the employee wish to be seen by their private physician they may do so. To assist the civilian employee's personal healthcare professional, we forward a number of documents to them, including the following (Appendix I):

(1). A copy of the Blood-borne Pathogens Standard.

(2). A description of the exposure incident.

(3). The exposed employee's relevant medical records.

(4). Other pertinent information.

d. Healthcare professionals written opinion.

Whether the employee is evaluated and treated within WRAMC or chooses to seek care in the private sector, the following information will be obtained by the treating physician and provided to WRAMC's Occupational Medicine Physician. After the consultation, the healthcare professional provides our facility with a written opinion evaluating the exposed employee's situation. The Occupational Medicine Physician, in turn, will furnish a copy of this opinion to the exposed employee. In keeping with this process' emphasis on confidentiality, the written opinion will contain only the following information:

(1). Whether Hepatitis B Vaccination is indicated for the employee.

(2). Whether the employee has received the Hepatitis B Vaccination.

(3). Confirmation that the employee has been informed of the results of the evaluation.

(4). Confirmation that the employee has been told about any medical conditions resulting from the exposure incident which require further evaluation or treatment.

(5). All other findings or diagnoses will remain confidential and will not be included in the written report. An employee fact sheet will be provided to the employee describing the symptoms of HIV and HBV infection (Appendix J).

e. Medical recordkeeping.

To make sure that we have as much medical information available to the participating healthcare professional as possible, our facility maintains comprehensive medical records on our employees. The Occupational Medicine Physician is responsible for setting up and maintaining these records, which include the following information:

(1). Name of the employee.

(2). Social security number of the employee.

(3). A copy of the employee's Hepatitis B Vaccination status. Dates of any vaccinations.

(4). Medical records relative to the employee's ability to receive vaccination.

(5). Copies of the results of the examinations, medical testing, and follow-up procedures which took place as a result of an employee's exposure to blood-borne pathogens.

(6). A copy of the information provided to the consulting healthcare professional as a result of any exposure to blood-borne pathogens.

(7). As with all information in these areas, we recognize that it is important to keep the information in these medical records confidential. We will not disclose or report this information to anyone without our employee's written consent (except as required by law).

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Source: Waxdahl, KA, LTC, AN, Chief, Infection Control Service; Phillips, KG, MAJ, MC, Chief, Occupational Medicine Program. *Exposure Control Plan*. Washington, DC: Walter Reed Army Medical Center. 4 May 1991: 16–31.