

Chapter 18

OCCUPATIONAL HEALTH AND THE CHEMICAL SURETY MISSION

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INTRODUCTION

Medical officers assigned to US Army arsenals, depots, or other installations that store chemical warfare agents face a number of unique challenges concerning chemical surety. The clinics supporting these installations, although frequently staffed by occupational medicine specialists, may still be managed by primary care physicians or even general medical officers with no specialty training. These providers must care for both military and civilian workers as well as master myriad additional duties unique to chemical weapons storage sites, including managing complex medical programs that support chemical surety and accident or incident response. In addition, many installations are actively demilitarizing chemical munitions. These operations run parallel with, but independent of, chemical surety operations. Chemical surety systems manage chemical agents throughout their life cycles while maintaining operational performance, which adds other challenges to chemical surety medical support program directors (CSMSPDs)—one of many titles physicians may earn as they provide medical support to employees working on tasks from storage to the final disposal of chemical agents. Providers must be on orders from their medical commanders to perform CSMSPD duties, as well as those duties outlined below, in ways that ensure accountability and responsibility for operations.

In this chapter, a chemical agent is defined as a chemical substance intended for use in military operations to kill, seriously injure, or incapacitate a person through its physiological effects. Riot control agents, chemical herbicides, smoke, and flames are not officially defined as chemical agents, but installations with chemical agents may contain varying amounts of these substances. Chemical surety (a term that encompasses both safety and security) operations employ a system of controls, procedures, and actions that contribute to the safe and secure storage, transportation, and demilitarization of chemical agents and their associated weapon systems. Chemical surety material is defined in Army Regulation (AR) 50-6, *Chemical Surety*, as “chemical agents and their associated weapon system, or storage and shipping containers that are either adopted or being considered for military use.”^{1(p43)}

Although the chemical agents discussed are unique to the military, the hazards to employees are common to many industries. Examples include acetylcholinesterase inhibitors (the operative mechanism of nerve agents) used in pesticides and carbonyl chloride (phosgene) used in the production of foams and plastics. Both are transported daily on the nation’s highways and railways. In addition to these chemical threats,

chemical storage depots carry out other operations that pose potential physical hazards similar to those found in other industries (eg, excessive noise, heat stress, and lifting). When they were being produced, military chemical munitions had different intended uses, packaging, and methods of storage than industrial chemicals (and are typically more hazardous), so they required different controls.

Military chemical agent workers can find information on chemical surety operations in a variety of resources, including ARs, which implement Army laws, and Department of the Army pamphlets (DA PAMs), which provide additional technical guidance. The most useful documents for the CSMSPD are AR 50-6, *Chemical Surety*¹; DA PAM 50-6, *Chemical Accident or Incident Response and Assistance [CAIRA] Operations*²; DA PAM 40-8, *Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX*³; and DA PAM 40-173, *Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Mustard Agents H, HD, and HT*.⁴ Safety publications AR 385-61⁵ and DA PAM 385-61⁶ also contain medical guidance. The installation medical authority (IMA) must be aware of any interim or implementation guidance or Department of Defense directives, instructions, or memoranda that affect operations. The IMA should maintain a close relationship with the installation and legal offices of the supporting medical treatment facility.

Military installations are often physically isolated and are located a considerable distance from the medical center or medical department activity responsible for providing support and consultation. The preventive/occupational medicine physicians at these hospitals are responsible for providing the necessary support and are a source of information and guidance. The level of chemical and occupational-specific medical expertise at the supporting treatment facility varies; however, the depot-level physician should be a subject-matter expert on the treatment of chemical surety exposures and perhaps even on occupational medicine. Assets and time are seldom available to train a general medical officer in the unique occupational setting of depot operations (Exhibit 18-1).

According to DA PAM 50-6,² medical officers supporting chemical surety operations are required to complete the Toxic Chemical Training Course for Medical Support Personnel (given by the US Army Chemical Materials Agency) and the Medical Management of Chemical and Biological Casualties Course (given by the US Army Medical Research

Institute of Chemical Defense [USAMRICD]). Both courses are offered at Aberdeen Proving Ground, Maryland, and provide the basic concepts needed to recognize the clinical signs and symptoms of chemical agent exposure and the appropriate therapeutic interventions for treating and managing chemical agent casualties. The Toxic Chemical Training Course also presents material on the medical challenges of supporting demilitarization operations.

Understanding patients' occupational healthcare needs is an integral part of a physician's practice. This responsibility includes identifying occupational and environmental health risks, treating disease and injury, and counseling patients on preventive behavior. Occupational health alone is time consuming; the occupational health nurse, the industrial hygienist, and other clinic staff members can help perform required tasks. Although industrial hygienists are not often assigned to health clinics, they are an essential part of the healthcare team. The industrial hygienist maintains a hazard inventory that contains

conventional hazards as well as a list of chemical agents located at the installation. They routinely design primary prevention strategies and frequently oversee hearing conservation, respiratory protection, and occupational vision programs. The information provided by the hygienist is necessary to evaluate a work environment and to determine the appropriate frequency of periodic medical examinations. Close and frequent coordination with this individual is imperative for developing knowledge of the work-site and the subsequent development of a medical surveillance program.

In addition to the industrial hygiene and safety personnel, medical personnel must work in accord with the command, supervisors, personnel officers, and employees who handle chemical agents. Maintaining these relationships is frequently difficult, but by identifying and addressing concerns of both management and individual workers, medical personnel can establish a basis for formulating appropriate preventive medical measures.

EXHIBIT 18-1

ADVISING AGENCIES FOR THE TREATMENT OF CHEMICAL AGENT INJURY

Agency	Contact Information
The preventive or occupational medicine department of the supporting medical department activity or medical center	Specific to location
US Army Center for Health Promotion and Preventive Medicine	Director, Occupational and Environmental Medicine / MCHB-TS-M 5158 Blackhawk Road Aberdeen Proving Ground, Maryland 21010-5403
US Army Chemical Materials Agency	Command Surgeon / AMSCM-RD 5183 Blackhawk Road, Bldg E-4585 Aberdeen Proving Ground, Maryland 21010-5424
Proponency Office for Preventive Medicine	Surety Medicine Consultant / DASG-PPM-NC 5111 Leesburg Pike, Suite 538 Falls Church, Virginia 22041-3258
US Army Medical Research Institute of Chemical Defense	MCMR-CDM 3100 Ricketts Point Road Aberdeen Proving Ground, Maryland 21010-5400
US Army Reserve Unit for Chemical/Biological Consequence Management	Detachment Surgeon 1309 Continental Avenue, Suite K Abingdon, Maryland 21009-2336
US Army Materiel Command	AMCSG/Deputy Command Surgeon 9301 Chapek Road Fort Belvoir, Virginia 22060

THE CHEMICAL AGENT WORKPLACE

Chemical agent operations are conducted in a variety of job settings, including storage depots, demilitarization facilities, research laboratories, and transportation units. Before a chemical agent employee can be placed in a job, a physician must consider the occupational and environmental health risks associated with the position. The physician must understand the various workplaces in which chemical agent operations are performed to effectively identify the corresponding risks.

The chemical agent worker uses different kinds of personal protective equipment (PPE) and engineering controls based on the work environment. The use of protective clothing itself can create significant hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility, and communication. The physician must understand these PPEs and engineering controls in order to select the most appropriate preplacement examination and medical surveillance for the initial and continued safety of the worker. DA PAM 385-61⁶ defines the protection levels (A through D) for chemical agent workers and lists the personal protective clothing and equipment required for each level. The following text and accompanying figures describe the various types of chemical agent workplaces.

The purpose of the US Army Chemical Materials Agency is to protect and safely store the nation's aging

chemical weapons. The agency works toward the effective recovery, treatment, and ultimate elimination of the nation's chemical warfare materials, and it manages a national inventory control point and national maintenance point to ensure that the stockpile is maintained safely during its remaining storage life. Chemical depot workers routinely check storage containers for potential degradation and leaks. During these inspections, the workers operate in Level A protective clothing, the demilitarization protective ensemble, which consists of a totally encapsulated, positive-pressurized suit (Figure 18-1). A mask (manufactured by Mine Safety Appliances Company, Pittsburgh, Pa) and backpack, both certified by the National Institute of Occupational Safety and Health and the Occupational Safety and Health Administration, are contained within the suit to provide a continual air supply via an umbilical cord. The suit is also equipped with a self-contained emergency breathing system in case the hose air supply is compromised. The workers wear butyl rubber boots and gloves over the ensemble as an additional layer of protection and can communicate with each other and the control station by way of a radio internal to the demilitarization protective ensemble.

Another mission of the Chemical Materials Agency is to manage the safe treatment and disposal of chemical agents and weapons. To accomplish this mission, the agency uses various technological tools, many of



Fig. 18-1. A team of chemical workers wears Level A protective clothing, the demilitarization protective ensemble, which provides the greatest level of protection against agent exposure.

Photograph: Courtesy of US Army Chemical Materials Agency, Aberdeen Proving Ground, Md. Available at <http://www.cma.army.mil/multimedialogallery>. Accessed December 2005.



Fig. 18-2. Two chemical agent operators wear Level C protective clothing and use a glovebox as they drain mustard agent from ton containers in the neutralization process at the Aberdeen Chemical and Biological Agent Disposal Facility. Photograph: Courtesy of US Army Chemical Materials Agency, Aberdeen Proving Ground, Md. Available at <http://www.cma.army.mil/multimedialogallery>. Accessed December 2005.



Fig. 18-3. Chemical agent operators wear Level C protective clothing in a professional laboratory research setting to discover and develop medical countermeasures and therapeutics to chemical warfare agents. Photograph: Courtesy of US Army Medical Research Institute of Chemical Defense, Aberdeen Proving Ground, Md.



Fig. 18-4. Soldiers from the 22nd Chemical Battalion (Technical Escort) work in Level C protective clothing to conduct a sampling mission. Photograph: Courtesy of Major Chadwick T Bauld, 22nd Chemical Battalion, Technical Escort, US Army 20th Support Command, CBRNE.

which are at least partially automated. However, the worker must handle chemical agents during other phases of the treatment and disposal process. For example, operators at the Aberdeen Biological Chemical Agent Disposal Facility drain mustard agent from ton containers using a glovebox in the neutralization process (Figure 18-2). During this procedure, workers don Level C protective clothing consisting of work coveralls, safety glasses with side shields, and M40A1 protective masks worn in the slung position.

In a research laboratory setting such as USAMRICD, chemical agent operators conduct experiments to discover and develop medical countermeasures to and therapeutics for chemical warfare agents. The experimental parameters, and therefore the working conditions, are tightly regulated to maintain a climate-controlled environment. Agent operators conduct studies in a certified chemical fume hood, and preliminary airflow measurements are taken using a worker's velometer. Operators wear several layers of PPE, as shown in Figure 18-3, and work in Level C protective clothing. The first layer of PPE is a laboratory coat and nitrile gloves. The second, outer layer of PPE consists of a 7-mm-thick butyl rubber apron and butyl rubber gloves. Many operators wear a second pair of nitrile

gloves over the butyl rubber gloves to improve dexterity. Laboratory safety glasses with side shields are worn at all times and protective masks are kept readily available or are worn in a slung position.

The mission of the 22nd Chemical Battalion is to deploy task-organized teams throughout the world to conduct technical escort and chemical, biological, radiological, and nuclear hazard characterization, monitoring, disablement, and elimination support operations. The 22nd Chemical Battalion provides emergency response to incidents involving weapons of mass destruction and chemical, biological, radiological, and nuclear hazards, homeland defense, contingency support operations to combatant commanders and lead federal agencies, and site remediation and restoration support operations for the Department of Defense. The battalion works at a high operational tempo in a wide variety of settings, including hostile and austere environments. In addition to the PPE and engineering controls described above, battalion members use specialized protective measures unique to each mission (Figure 18-4). If the members are faced with an unknown agent or unsafe oxygen level, they require a higher respiratory protection level (Level B or Level A, with self-contained breathing apparatus).

MEDICAL SURVEILLANCE FOR CHEMICAL AGENT WORKERS

Medical surveillance is the systematic collection, analysis, and dissemination of disease data on groups of workers. It is designed to detect early signs of work-

related illness.⁷ A chemical worksite medical program should provide the following surveillance: preplacement screening, periodic medical examinations (with

follow-up examinations, when appropriate), and termination examinations. Additional follow-up examinations are required if an individual has potentially or actually been exposed. An efficient medical surveil-

lance program helps determine if a relationship exists between exposure to a hazard and development of a disease, and it can identify an occupational disease at an early stage, when medical intervention can be most

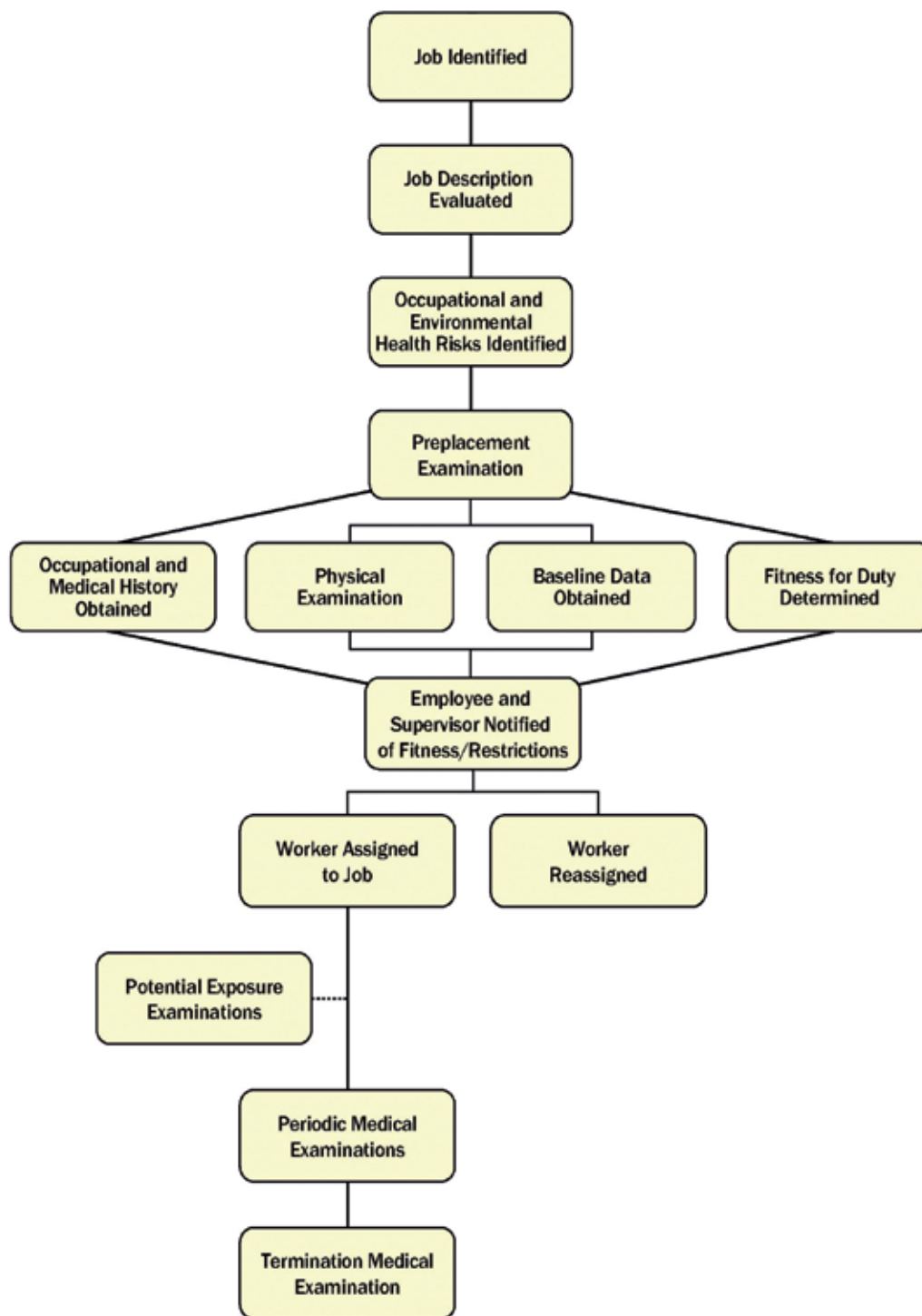


Fig. 18-5. Medical surveillance for chemical agent workers.

beneficial (Figure 18-5).

"Screening" is defined as the search for a previously unrecognized disease or pathophysiological condition at a stage when intervention can slow, halt, or reverse the progression of the disorder. Medical surveillance is considered a type of screening because it seeks to identify work-related disease at an early stage.⁷ Screening for medical and physical standards, a practice distinct from yet related to medical surveillance for occupational exposure to toxic chemicals, is sometimes necessary for a worker to be placed, or remain in place, in a particular position. In addition to this duty, another related function of the CSMSPD is to provide medical support for the administrative chemical personnel reliability program (CPRP). An officially designated physician or other qualified medical staff member (physician's assistant, dentist, or dental assistant) must screen personnel for medical aspects of reliability for the CPRP. When making medical recommendations related to reliability, the CSMSPD may offer guidance to a non-medically trained certifying or reviewing official, whereas the treating provider has complete discretion and authority (as allowed by his or her current clinical privileges) in the medical evaluation and treatment of chemical injuries. Additional examinations, independent of medical surveillance, may also be required. These include evaluating a potential worker's fitness for PPE and ability to meet the functional requirements of the job.

Administrative and engineering controls, followed by individual protective measures such as PPE, are the primary disease prevention methods; medical screening is an adjunct method. The importance of this hierarchy must be continually stressed. An individual who shows signs or complains of symptoms of occupationally related illness should be identified as a possible sentinel case. Not only must the individual be treated, but the cause of the complaint must also be thoroughly investigated by the IMA, the industrial hygienist, and safety personnel. The cause may be related to improper work practices of the affected individual or to a failure of engineering devices or personal protective measures. In the latter case, further morbidity can be avoided if the problem is promptly identified.

The IMA (usually the CSMSPD) or contract physician is responsible for establishing and supervising the medical surveillance system for toxic chemicals, including nerve and mustard agents. Not all individuals working at the installation, or even in a particular work area, need to be on the same surveillance program. The type of work, work area, and required PPE are factors that determine the type and frequency of surveillance. Determining the level of medical surveillance is an important step, usually achieved with input from medical

and safety personnel. In accordance with DA PAM 40-8³ and DA PAM 40-173,⁴ the ultimate determination of appropriate medical surveillance categories is the responsibility of surety or safety personnel.

The distinction between medical surveillance and personnel reliability is often overlooked. The level of medical surveillance is determined by the occupational hazards of the job, whereas the placement of a worker in the CPRP is a function of the level of responsibility and critical functions of his or her job. A worker may be in a medical surveillance program, a personnel reliability program, in both, or in neither. For example, a locksmith working at an office far from a chemical storage area may not require medical surveillance, but his or her position is critical to safe chemical operations. Therefore, the locksmith must be included in the CPRP. When making medical recommendations regarding chemical surety issues, providers are referred to as the competent medical authority.

For additional information on occupational medicine programs, the installation medical authority (IMA) should seek advice from the regional medical center or medical department activity. The Occupational and Environmental Medicine Division of the US Army Center for Health Promotion and Preventive Medicine at the Edgewood Area of Aberdeen Proving Ground, Maryland, may also be of assistance. Moreover, the Code of Federal Regulations, title 5, part 339⁸ contains detailed guidance on determining physical and medical requirements and conducting medical examinations. Medical personnel should have at least a basic working knowledge of the Americans with Disabilities Act⁹ to ensure that their programs do not discriminate based on a disability.

Preplacement Examination

Before evaluating a worker's history and completing a physical examination, physicians should acquire an accurate and current job description listing the specific tasks the worker will be required to do. The civilian personnel office can usually provide this information. The type of respiratory protection and protective clothing required must also be ascertained, because these will affect an individual's ability to perform the job. Position descriptions with physical requirements should be viewed carefully; supervisors are responsible for ensuring that position descriptions are current and accurate.

Not all individuals are required to wear protective clothing all the time. Frequency of use, exertion level, and environmental conditions have a dramatic influence on how well an individual performs in PPE. For example, a worker in a temperate desert climate such

as the American Southwest may be very comfortable in protective clothing during winter but unable to tolerate the same level of protection in the heat of summer. Therefore, it is very important to observe work–rest cycles.

Preplacement examination has two major functions: (1) to determine an individual's fitness for duty, including his or her ability to work while wearing PPE; and (2) to provide baseline medical surveillance for comparison with future medical data.¹⁰ Chemical agent workers must be evaluated to ensure that they are not predisposed to physical, mental, or emotional impairment that may result in an increased vulnerability to chemical warfare agent exposure. This examination is performed at no cost to the applicant. Abnormalities identified during the course of the preplacement examination, however, need to be followed up by the applicant, at his or her expense, with a private physician.

The first step in acquiring necessary information from a prospective worker is an occupational and medical history questionnaire. The medical officer is required to conduct a thorough review to identify past illnesses and diseases that may prevent satisfactory job performance. It is particularly important to inquire about skin, lung, cardiovascular, and psychiatric disease to evaluate the ability of an individual to work in protective ensemble. Questions concerning shortness of breath or labored breathing on exertion, asthma or other respiratory symptoms, chest pain, high blood pressure, and heat intolerance provide helpful information, as do questions about hypersensitivity to rubber products and cold-induced bronchospasms. The medical officer should also take a brief psychiatric history to determine the individual's ability to be encapsulated in PPE; questions about panic attacks, syncopal episodes, or hyperventilation can supply valuable information.

A potential employee's physical examination should follow the medical history questionnaire. It should be comprehensive and focus on the skin and the cardiovascular, pulmonary, and musculoskeletal systems. Obesity, lack of physical strength, and poor muscle tone are indicators of increased susceptibility to heat injury, a condition that is amplified by working in chemical protective clothing. Factors that restrict the wearing of protective clothing include (a) the inability to obtain a seal with the protective mask, (b) an allergy to protective clothing and equipment, (c) any medical condition that precludes correct wear of protective clothing, and (d) poor visual acuity that requires the use of glasses unless mask optical inserts are used. Facial hair, scarring, dentures, and arthritic hands or fingers can affect a worker's ability to wear a respirator and protective clothing. Acne scarring and pseudofol-

liculitis barbae are common facial skin conditions that may interfere with proper mask seal. Mask fit testing should be used to augment fitness determination in these cases.

Baseline data acquired during the preplacement screening can be used following an exposure event to determine the extent of the exposure. This data can also be used to verify the engineering controls in effect, and it may be used to determine if the worker has been adversely affected by exposure. Red blood cell cholinesterase (RBC-ChE) baseline levels are essential for workers assigned to areas in which nerve agent munitions are stored. Workers are categorized by the area they are assigned to and how frequently they are in a chemical environment, and the frequency of follow-up examinations is determined by this category. These categories are in a state of flux; the current regulatory guidance is discussed in the following section. As of the date of this writing, RBC-ChE baseline levels must be determined every 3 years by a two-draw series, with the draws taking place within 10 days of each other. This test may be performed at the installation level or at the cholinesterase reference laboratory of the US Army Center for Health Promotion and Preventive Medicine. This reference laboratory serves as a central repository of RBC-ChE baseline values and provides enhanced quality control and record management. RBC-ChE measurement is necessary throughout a worker's employment to monitor for nerve agent exposure. The surety officer, safety officer, and IMA are jointly responsible for determining who will be monitored and how often. Certifying officials and other supervisors are responsible for supplying information about the worker's duties, and an accurate job description is essential.

Periodic Medical Examinations

Periodic medical examinations should be used in conjunction with preplacement screening examinations.¹⁰ Comparing the data obtained through periodic monitoring with the baseline data is essential for identifying early signs of occupationally induced diseases. The periodic medical examination is intended to identify any conditions for which early intervention can be beneficial.

The frequency and extent of the periodic medical examination should be determined by the toxicity of the potential or actual exposures, frequency and duration of the contact, and the information obtained in the preplacement history and physical examination. The data obtained from these periodic examinations can guide the future frequency of physical examinations or tests. Data consistently within acceptable limits for

several months may indicate that the frequency of medical examinations can be safely decreased, provided the work situation remains constant.

The interval medical history and physical should focus on changes in health status, illness, and possible work-related signs and symptoms. To effectively identify occupational conditions or disease, the examining physician must be aware of the work environment and potentially hazardous exposures; if chemical surety workers show a change in health status in the periodic evaluation, it is necessary to evaluate the worksite. Depending on the identified conditions, additional workers may require examination. At a minimum, examining physicians should communicate with industrial hygiene personnel to determine whether there has been a change in the work environment that could be causally related.

Previously, DAPAM 40-8, modified November 2007, *Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX*,³ dictated that four categories of personnel are required to have RBC-ChE measured (Exhibit 18-2).^{3,11} As of 2006 installations with chemical surety missions are required to adhere to the *Implementation Guidance Policy for Revised Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT*.⁴ RBC-ChE baseline

monitoring is one significant change in these documents; using soap and water in place of dilute bleach for personnel decontamination is another. Currently, an individual in category I must have a monthly measurement of the RBC-ChE level; an individual in category II must have an annual RBC-ChE measurement.

Termination Examinations

At the termination of employment or duty in a chemical surety position, all employees must have a medical examination. Unless otherwise specified by a local regulation, this examination may be done up to 30 days before or after termination of employment. If an employee is exposed after the termination examination, it will be necessary to thoroughly document and evaluate that specific exposure. In most cases, such exposure is unlikely; completing the termination examination within the 30 days before departure is advisable so that the employee does not have to return to the worksite. Employees have the right to refuse any examination, but the provider should encourage those terminated to undergo the final examination before separation.

Workers whose surveillance category changes as a result of a job change must receive a medical exami-

EXHIBIT 18-2

CATEGORIZATION OF WORKERS BASED ON THEIR LIKELIHOOD OF EXPOSURE TO CHEMICAL AGENTS

Category	Includes
I (formerly Category A)	Personnel with a high risk of potential exposure due to the nature of the agent operations being conducted. Examples of such operations might include (but are not limited to) storage monitoring inspections of M55 rockets, periodic inspections, toxic chemical munitions maintenance operations that involve movement of munitions from storage locations, work in known contaminated environments, and first-entry monitoring. Personnel may be routinely required to work for prolonged periods in areas with high levels of nerve agents where the use of either toxicological agent protective ensembles or protective ensembles with a self-contained or supplied-air breathing apparatus may be required.
II (formerly Category B)	Personnel with both a low risk or infrequent potential exposure to nerve agents in routine industrial, laboratory, or security operations. Examples of such operations might include (but are not limited to) daily site security checks and accident/incident response by initial response force members. Prolonged wear of protective ensembles during training and emergency responses may be required.
III (formerly Category C)	Personnel with minimal probability of exposure to nerve agents, even under accident conditions, but whose activities may place them in close proximity to agent areas.
IV (formerly Category D)	Transient visitors to agent areas where a potential for exposure exists and who are not included in the medical surveillance program for nerve agents at the visited installation.

nation appropriate for their new category. In general, employees who move up or down in category must be treated as though they are entering initial surveillance or terminating surveillance. In addition, workers may move into and out of surveillance categories without actually leaving employment. These transitions, often overlooked, are a difficult aspect of managing chemical surety. Overall, there is growing interest in simplifying medical surveillance categories. Meanwhile, the surety officer must ensure that the IMA is aware of changes in employment duties that may affect medical surveillance. Inaccurately categorizing workers can result in inadequate surveillance as well as excessive cost and effort.

Potential Exposure Evaluations

Any agent exposure, suspected exposure, agent spill or release, or other abnormal situation that may result in personnel injury must be reported to supervisory personnel immediately after emergency action is taken. Personnel with possible agent exposures must report for medical evaluation as soon as possible. The scope and frequency of examination and the retention of physical examination records should follow the guidance of DA PAM 40-8³ and DA PAM 40-173.⁴ All personnel exposed or potentially exposed to nerve agent must have a cholinesterase level drawn the day prior to release from duty. All personnel working with chemical agents should be given an off-duty telephone number to report suspected exposures. Employees who have been in areas of possible chemical agent exposure (for example, downwind of an agent release or in known areas of agent contamination) must remain at the installation for at least 30 minutes after leaving the contaminated area, during which the supervisor or designated representative will observe them for symptoms of agent exposure. If signs of agent exposure are noted, the worker will be immediately referred to the medical facility.

Respirator Clearances

Once workers have passed the medical history and physical exams, the medical officer must determine their ability to function in respiratory protective equipment. This check can be done by either pulmonary function testing or a “use” test. Both tests are easily performed in an occupational health clinic, and each provides important data. The pulmonary function test provides vital information about lung capacity and may expose underlying clinical disease, such as early chronic obstructive pulmonary disease. However, pulmonary function tests may be subject to operator

error and depend on patient cooperation, and they do not predict how well employees will actually perform their duties. A use test, on the other hand, is highly subjective but provides a real-world measure of performance. Although it is impractical to simulate every possible job function and level of PPE in the clinic, an innovative provider can devise physical performance measures that simulate actual employee tasks. For example, a worker can don PPE and carry objects around the clinic while staff records signs and symptoms of cardiovascular or pulmonary stress. The physician must be available during such tests to provide advanced care if the worker does not tolerate the testing. If testing tolerance is in doubt, it should be deferred until a more controlled testing environment can be provided, or omitted altogether. For example, a worker with a questionable history (eg, with angina or a previous myocardial infarction) should not be required to complete a use test prior to pulmonary function testing. Input from industrial hygienists and supervisors concerning the employee’s required tasks will produce more useful results than a generic use test. The outcome of either test must be documented in the individual’s medical record.

Screening for Substance Abuse and Dependency

Substance abuse is inconsistent with the high standards of performance, discipline, and attention to detail necessary to work with chemical agents. The Army Substance Abuse Program¹² promotes healthy life choices, quality of life, and Army values through substance abuse prevention and risk-reduction education and training. All soldiers receive a minimum of 4 hours of alcohol and other drug awareness training per year, and Army civilian employees receive a minimum of 3 hours of such training per year.

All active duty soldiers are randomly drug tested at least once a year. Civilian drug abuse testing is conducted according to statutory and applicable contractual labor relations. However, Army civilian employees must refrain from alcohol abuse or using drugs illegally, whether on or off duty. Supervisors must refer any civilian employee found violating the rule to the installation employee assistance program coordinator.

Army Substance Abuse Program policies are designed to fully support the CPRP. Both military and Army civilian employees undergo drug screening prior to placement in the CPRP. Thereafter, CPRP military personnel are drug tested at least once in a 12-month period. Army civilian employees enrolled in the CPRP serve in sensitive positions called testing-designated positions. By Executive Order 12564, *The Drug-free*

Workplace,¹³ these employees are also subject to random drug testing.

The physician who reviews positive urine drug tests for the Army is currently a certified medical review officer. If the IMA fills this position, it is important for the physician to review drug tests independently of his or her surety duties. The IMA is legally bound to perform an impartial review of the medical evidence for a federally mandated positive test and then release the results only through proper channels. This task may be difficult, given the responsibility of surety duties; the physician must always use sound medical judgment backed by legal advice.

Heat Stress Physiologic Monitoring

Heat stress is a constant and potentially severe health threat to employees wearing toxicological protective clothing. The combination of exposure to solar radiant energy or enclosed areas with high temperatures, metabolic heat production, and the use of impermeable clothing (which prevents evaporative cooling) places the chemical worker at high risk for heat injury.

Encapsulating uniforms increase the heat strain associated with most environments and work rates by creating a microenvironment around the worker. The suit's impermeability to vapor (the characteristic that makes it protective) creates high local humidity, restricting evaporative cooling and conductive/convective cooling. In effect, the suit creates an environment at the body surface hotter and wetter, under almost any circumstances, than the environment outside the suit. Moderating the heat strain associated with an encapsulating ensemble is accomplished in the following ways:

- microclimate cooling by direct removal of heat, water vapor, or both from the worker's microenvironment;
- heat sinks in the suit, such as ice vests;
- increasing the temperature gradient across the suit by shielding workers from radiant heat sources, cooling the work space, or, in dry environments, wetting the surface of the suit; and
- work-rest cycles to permit cooling and rehydration.

Heat-induced occupational injury or illness occurs when the total heat load from the environment and metabolism exceeds the cooling ability of the body. The resulting inability to maintain normal body temperature results in heat strain (the body's response to total heat stress).¹⁴

Adverse health effects can be reduced by training and acclimatization, measuring and assessing heat stress, medical supervision, heat-protective clothing and equipment, and properly applying engineering and work-practice controls.¹⁴ Training and adequate supervision are basic requirements that need constant reinforcement. The occurrence of heat-induced illness or injury is an indication that (a) the worker has engaged in an act that should have been avoided by adequate training and supervision, (b) the individual's medical status has changed and requires further or more frequent evaluations, or (c) supervisory enforcement of work-rest cycles or adequate hydration is lacking. In all cases, the healthcare provider must investigate the cause. If the individual's health status has changed, further medical evaluation is needed. The worker may require temporary duties commensurate with his or her present health status or a permanent change of duties. If the injury appears to be the result of carelessness or lack of attention to changing environmental conditions, further training is needed. Eliciting the worker's support may be necessary to acquire the appropriate cooperation of intermediate supervisors.

Numerous textbooks and other sources discuss thermoregulation and physiological responses to heat, and healthcare providers may benefit from a review of these subjects. This chapter, however, will address the evaluation of heat stress and preventive measures.

The preplacement physical examination is designed for workers who have not been employed in areas exposed to heat extremes. It should be assumed that such individuals are not acclimatized to work in hot climates. Therefore, the physician should obtain the following information¹⁴:

- A medical history that addresses the cardiovascular, respiratory, neurological, renal, hematological, gastrointestinal, and reproductive systems and includes information on specific dermatological, endocrine, connective tissue, and metabolic conditions that might affect heat acclimatization or the ability to eliminate heat.
- A complete occupational history, including years of work in each job, the physical and chemical hazards encountered, the physical demands of these jobs, the intensity and duration of heat exposure, and any nonoccupational exposures to heat and strenuous activities. The history should identify episodes of heat-related disorders and evidence of successful adaptation to work in heat environments as part of previous jobs or in nonoccupational activities.

- A list of all prescribed and over-the-counter medications used by the worker. In particular, the physician should consider the possible impact of medications that can affect cardiac output, electrolyte balance, renal function, sweating capacity, or autonomic nervous system function. Examples of such medications include diuretics, antihypertensive drugs, sedatives, antispasmodics, anticoagulants, psychotropic medications, anticholinergics, and drugs that alter the thirst (haloperidol) or sweating mechanism (phenothiazines, antihistamines, and anticholinergics).
- Information about personal habits, including the use of alcohol and other social drugs.
- Data on height, weight, gender, and age.

The direct evaluation of the worker should include the following¹⁴:

- physical examination, with special attention to the skin and cardiovascular, respiratory, musculoskeletal, and nervous systems;
- clinical chemistry values needed for clinical assessment, such as fasting blood glucose, blood urea nitrogen, serum creatinine, serum electrolytes (sodium, potassium, chloride, and bicarbonate), hemoglobin, and urinary sugar and protein;
- blood pressure evaluation; and
- assessment of the ability of the worker to understand the health and safety hazards of the job, understand the required preventive measures, communicate with fellow workers, and have mobility and orientation capacities to respond properly to emergency situations.

A more detailed medical evaluation may be required. Communication between the physician performing the preplacement evaluation and the worker's private physician may be appropriate and is encouraged.

TRAINING AND EDUCATION FOR CHEMICAL AGENT WORKERS

All personnel who work with or have some association with chemical agents and munitions, or who have a potential for exposure, must receive enough training to enable them to work safely and to understand the significance of agent exposure. Employees must know the procedures necessary to help a coworker and to summon assistance in the event of a chemical accident. Moreover, visitors who enter an area where chemical munitions are stored must be briefed on basic procedures that will enable them to visit safely, including

The phenomenon of heat acclimatization is well established, but for an individual worker, it can be documented only by demonstrating that after completion of an acclimatization regimen, the person can perform without excessive physiological heat strain in an environment that an unacclimatized worker could not withstand. Follow-up evaluations may be warranted during the acclimatization period for selected workers, and the IMA must be intimately involved in developing the acclimatization program for the installation.

Annual or periodic examinations should monitor individuals for changes in health that might affect heat tolerance and for evidence suggesting failure to maintain a safe work environment. Education of workers and supervisors, however, is the single most important preventive measure in avoiding heat casualties.

Personnel required to wear toxic agent protective clothing are also at high risk for dehydration, which is a contributing factor for developing heat injury. A worker may lose as much as a liter of water per hour in sweat, and the thirst mechanism is not adequate to stimulate this much water consumption. If an individual loses 1.5% to 2.0% body weight, heart rate and body temperature increase while work capacity (physical and psychological) decreases.¹⁵ Workers should be required to consume at least 8 oz of cool water at each break period; for moderate work in greater than 80°F wet-bulb-globe temperature, the average fluid replacement recommendation is 1 quart per hour. More water may be required depending on the ambient temperature, humidity, and the physical size and exertion level of the worker. Workers should not exceed 1½ quarts per hour or 12 quarts per day.¹⁶

The average US diet provides adequate salt intake for an acclimatized worker, but an unacclimatized worker may excrete large amounts of salt. Individuals on medications that further deplete sodium, such as diuretics, need even closer monitoring and medical follow up. The judicious use of sodium replacement may be required during the acclimatization period.

how to properly wear a mask.

Training programs for chemical agent workers should make them aware of potential hazards and provide the knowledge and skills necessary to work with minimal risk. At the very least, chemical agent workers are required to demonstrate proficiency in the following areas before being assigned to operations:

- knowledge of operating procedures, including safety requirements;

- recognition of hazards involved in the operation;
- recognition of signs and symptoms of agent exposure;
- administration of first aid and self/buddy aid, including CPR;
- knowledge of personnel decontaminating procedures;
- execution of emergency procedures; and
- donning and doffing of protective clothing and equipment (such as self-contained breathing apparatus).

Refresher training should be conducted at least annually, and the IMA must review and approve the courses' contents and the training personnel.

Training programs may focus on chemical warfare agents, but they should also address any additional physical and chemical hazards. One example of these hazards is heat stress caused by wearing butyl protective gear, as discussed earlier in this chapter. The level of training should be commensurate with employees'

job functions and responsibilities. When feasible, the training program should consist of both classroom instruction and hands-on practice. Dry runs of operational and emergency procedures are often an effective training tool.

During training, emphasis must be given to the first rule of protection—to protect oneself from injury. Workers should also know the procedure for requesting medical assistance and should be aware of any predetermined format for reporting emergencies that will expedite the report and response time. Teaching employees a logical system in which to present this information is extremely helpful. Their reports should include the nature of the accident or incident as well as what has been done for the victims (for example, the number of Mark I kits [Meridian Medical Technologies Inc, Bristol, Tenn] administered). Support personnel can request additional information as the situation progresses. The installation will greatly benefit from active involvement of the IMA and clinic staff in this training.

MEDICAL SUPPORT OF THE CHEMICAL PERSONNEL RELIABILITY PROGRAM

The CPRP is a management tool used within the Army to identify chemical surety duty positions and to manage the personnel assigned to these positions, as discussed earlier. It also provides a way to assess the reliability and acceptability of employees who are being considered for or assigned to chemical duty positions.

The program was established to ensure that personnel assigned to positions involving access to, or responsibility for, the security of chemical surety material are emotionally stable, loyal to the United States, trustworthy, and physically fit to perform assigned duties. The certifying official is the commander's representative for the CPRP and is ultimately responsible for its administration. This official, with input from the personnel officer and medical personnel, decides whether to qualify or disqualify personnel for CPRP duties. He or she must also help determine the appropriate medical surveillance category for each worker (see above) based on the worker's potential for exposure.

During each part of the screening process, evaluators look for evidence of potentially disqualifying factors that may affect personnel reliability or suitability for CPRP duties. Disqualifying factors of medical relevance include alcohol abuse, drug abuse, inability to wear protective clothing and equipment required by the assigned position, or any significant physical or mental condition that might be prejudicial to the reliable performance of CPRP duties.

The examining physician must notify the certifying

official orally and in writing of any medical conditions, including the use of any prescribed medications, that may detract from an individual's ability to perform assigned chemical surety duties. In addition, the physician must provide a recommendation on the employee's suitability to continue CPRP duties. Information that may affect reliability is referred to as potential disqualifying information. These communications should be documented on Standard Form 600. As in all healthcare, documentation is extremely important and, in this case, subject to examination during a chemical surety inspection (Exhibit 18-3).

Simply supplying a diagnosis or excerpt from the medical record is not enough to enable the certifying official to make an informed decision; the competent medical authority must provide a sound medical interpretation and recommendation. The recommendation and supporting documents must be succinct and decisive, and should also note any lack of potential disqualifying information. The recommendation should state one of the following: (a) no restriction, (b) restrictions or limitations on duties, (c) temporary disqualification, or (d) permanent disqualification. Potentially disqualifying information must be provided in a sealed envelope marked "EXCLUSIVE FOR" the certifying official. Temporarily disqualified personnel remain in the CPRP, and their medical records must be treated in the same manner as the medical records of other employees in the program.

A chemical-duty position roster lists all individuals

EXHIBIT 18-3

ADMINISTRATIVE DOCUMENTATION TO SUPPORT A CHEMICAL SURETY INSPECTION

Army Regulations

AR 11-34, 15 Feb 90	<i>The Army Respiratory Protection Program</i>
AR 40-3, 18 Oct 07	<i>Medical, Dental and Veterinary Care</i>
AR 40-5, 25 May 07	<i>Preventive Medicine</i>
AR 40-13, 1 Feb 85	<i>Medical Support—Nuclear/Chemical Accidents and Incidents</i>
AR 40-63, 1 Jan 86	<i>Ophthalmic Services</i>
AR 40-66, 21 Jun 06	<i>Medical Record Administration and Health Care Documentation</i>
AR 40-68, 26 Feb 04	<i>Clinical Quality Management</i>
AR 40-400, 13 Oct 06	<i>Patient Administration</i>
AR 50-6, 26 Jun 01	<i>Chemical Surety</i>
AR 385-10, 23 Aug 07	<i>Army Safety Program</i>
AR 385-40, 1 Nov 94	<i>Accident Reporting and Records</i>
AR 385-61, 12 Oct 01	<i>The Army Chemical Agent Safety Program</i>
AR 385-64, 1 Feb 00	<i>US Army Explosives Safety Program</i>
AR 600-85, 24 Mar 06	<i>Army Substance Abuse Program (ASAP)</i>

Department of the Army Pamphlets and Technical Bulletins Medical

DA PAM 40-8, 4 Dec 90	<i>Occupational Health Guidelines for the Evaluation and Control of Occupational Exposure to Nerve Agents GA, GB, GD, and VX</i>
DA PAM 40-173, 03 Jun 03	<i>Occupational Health Guidelines for the Evaluation and Control of Occupational Exposures to Mustard Agents H, HD, and HT</i>
DA PAM 40-501, 10 Dec 98	<i>Hearing Conservation Program</i>
DA PAM 50-6, 26 Mar 03	<i>Chemical Accident or Incident Response and Assistance (CAIRA) Operations</i>
DA PAM 385-61, 27 Mar 02	<i>Toxic Chemical Agent Safety Standards</i>
TB MED 502, 15 Feb 82	<i>Respiratory Protection Program</i>
TB MED 507, 7 Mar 03	<i>Heat Stress Control and Heat Casualty Management</i>
TB MED 509, 24 Dec 86	<i>Spirometry in Occupational Health Surveillance</i>

Field Manuals

FM 3-11.5, Apr 06	<i>CBRN Decontamination</i>
FM 40-285, Sep 07	<i>NBC Decontamination</i>
FM 4-02.7, 2004	<i>Health Service Support in a Nuclear, Biological, and Chemical Environment</i>

Personnel Documents

- Table of Distribution and Allowances with mission statement for medical treatment facility or activity
- Intraservice support agreement between tenant health clinic and the host installation
- Job descriptions with performance standards (or support forms for active duty)
- Scopes of practices
- Individual or categorical credentials for health care practitioners
- Current certificates of licensure for physicians and nurses
- Advanced Trauma Life Support/ Advanced Cardiac Life Support certification for physicians (nurses optional)
- Basic life support certification for all personnel with patient care responsibilities
- Certificate of completion of Medical Management of Chemical and Biological Casualties Course for physicians

Memoranda of Understanding and Mutual Aid Agreements

- With local civilian hospitals or ambulance services
- With the supporting medical center or medical department activity
- Between Army Medical Command and Army Medical Research and Materiel Command (or other major Army commands, if appropriate)

Standing Operating Procedures

- Spirometry
- Audiometry
- Vision screening

(Exhibit 18-3 continues)

(Exhibit 18-3 continued)

- Optical insert program for protective masks
- Medical surveillance examination (agent-specific)
- Pregnancy surveillance/reproductive hazards
- Medical screening of CPRP records
- Illness absence monitoring via CPRP records
- Incorporation of air monitoring results into the medical record
- Interface with alcohol and drug control officer
- Ambulance operation and stockage
- Preparation and review of first aid briefings
- Chemical accident and incident response
- Handling contaminated casualties at the clinic

Medical Directives

- Administration of nerve agent antidotes in the clinic
- Administration of intravenous solutions
- First aid for minor illnesses or injuries

Other Documents

- *Medical Management of Chemical Casualties Handbook*, July 2007. Available from Chemical Casualty Care Division, US Army Medical Research Institute of Chemical Defense, Aberdeen Proving Ground, Maryland 21010-5400.
- US Department of the Army. *Implementation Guidance Policy for Revised Airborne Exposure Limits for GB, GA, GD, GF, VX, H, HD, and HT*. Washington, DC: DA; 2004.

CBRN: chemical, biological, radiological, and nuclear

CPRP: chemical personnel reliability program

NBC: nuclear, biological, and chemical

assigned to chemical-duty positions in the CPRP by name, social security number, and job title. This roster also contains the name of the certifying official, the organization, and the medical surveillance exposure category of each worker. The roster must be periodically reviewed to verify that changes in duty position

resulting in changes in category are incorporated into medical records and that periodic surveillance is changed to match. Medical records for personnel in the CPRP must be identified in accordance with AR 40-66, *Medical Record Administration*,¹⁷ and segregated from records of personnel not in the CPRP.

MEDICAL ASPECTS OF A CHEMICAL ACCIDENT OR INCIDENT RESPONSE AND ASSISTANCE

Each installation with a chemical surety mission is required to develop detailed plans and procedures to be implemented by the emergency actions community in response to a chemical (surety material) accident or incident (CAI). Health services support during chemical accident or incident response and assistance (CAIRA) involves personnel with a wide range of medical expertise who will be involved in providing emergency care. When functioning as the medical leader in response to a CAI, the provider is referred to as the medical response team (MRT) leader. The MRT leader, an installation-level asset, is supported at the medical department activity or medical center level by a medical augmentation team composed of additional personnel to supplement or replace the MRT as needed. The composition of these teams and their training must be clearly documented and maintained. At the regional and national levels,

there are special medical augmentation response teams composed of subject-matter experts as well as a service response force surgeon, a non-Army Medical Department asset, who supports the Chemical Materials Agency and the Army Materiel Command. There is also a chemical casualty site team deployed from USAMRICD.

The planning phase is essential to any successful medical operation; however, the plan is useless if the personnel involved are not familiar with their responsibilities or if the plan is not kept current. A routinely scheduled review and update of the clinic's standard operating procedures, in addition to maintaining current documentation, ensures that healthcare personnel review the plan and reacquaint themselves with operating procedures.

In addition to producing viable internal standard operating procedures, external coordination dictates

memoranda of agreement with local agencies. The nature of the chemical agents being stored or demilitarized requires that preparations be made for receiving and treating casualties beyond the capability of the installation clinic. Although stabilization may be handled at the clinic, hospitalization will require outside facilities. Local hospitals may be reluctant to accept chemical casualties even after decontamination, and existing memoranda of agreement should facilitate the transfer and encourage the hospitals to do preaccident planning and training. Ultimately, the MRT leader is responsible for certifying that a patient as decontaminated.

Much of the coordination required for outside agreements is managed through command channels. The medical officer and medical administrator can accomplish much, however, through contact with the medical facilities and emergency medical personnel who will respond to an installation emergency. Coordination and interaction between civilian and military medical resources should be a continuous process. The IMA must take the lead to ensure that limited post resources are adequately augmented by off-post medical facilities. The staffing and treatment capabilities of off-site emergency medical facilities should be verified to ensure that appropriate resources are available. Although an IMA has limited time to coordinate with local healthcare providers and administrators, such communication is extremely valuable.

The IMA, having completed the Toxic Agent Training Course and the Medical Management of Chemical and Biological Casualties Course prior to reporting for duty, is responsible for training enlisted personnel and civilian healthcare providers. Evacuation plans, coordination with off-post civilian medical facilities, memoranda of agreement, and periodic inventories (with restocking of supplies and equipment) are also the responsibility of the IMA. In addition to individual training, collective training in the form of drills should become a routine part of the clinic schedule. Training of civilian resources is coordinated through the Chemical Stockpile Emergency Preparedness Program, centered at the Edgewood Area of Aberdeen Proving Ground, Maryland. Only the successful completion of all these types of planning and training ensure readiness for proper management of a chemically contaminated patient. Clinics at depots with a chemical surety mission should have an area designated for the decontamination of exposed patients; this area is necessary to provide early medical care that will limit the degree of the casualty's exposure. Generally, the treatment area for these patients is separate from the normal patient treatment areas. Although these facilities are rarely used for an actual chemically contaminated patient,

an ongoing effort must be made to keep these rooms at 100% operational capability. To maintain this capability, the medical staff must develop comprehensive and detailed standard operating procedures.

In the event of a CAI, emergency medical care will initially be provided by nonmedical workers responsible for removing casualties from the site of injury through a personnel decontamination station and to the waiting medical team. Further evacuation may be required, either to the installation medical facility or to an off-post medical treatment facility. The fundamental pathophysiological threats to life (namely, airway compromise, breathing difficulties, and circulatory derangement) are the same for chemical casualties as they are for casualties of any other type, but all personnel treating chemical injuries require additional training. At the least, nonmedical workers require training in self/buddy-aid. The installation response force is responsible for providing the immediate safety, security, rescue, and control at the CAI site to save lives and reduce exposure to hazards. The IMA must approve the training program for both workers and the installation response force and must review their lesson plans for accuracy and completeness. The essentials of this training include recognizing signs and symptoms of agent exposure, first aid, self/buddy-aid, individual protection, personnel decontamination (including decontamination of a litter patient), and evacuation of casualties.

To develop appropriate emergency medical plans, it is necessary to know the chemical agents included, number of personnel involved in the incident, location of the work area, a summary of work procedures, and the duration of the operation. This information is available through the installation commander or the certifying official. In addition, the most probable event (MPE) and maximum credible event (MCE) must be defined to determine the anticipated casualty loads in either situation. When dealing with large amounts of dangerous agents, an MPE is the worst potential event likely to occur during routine handling, storage, maintenance, or demilitarization operations that results in the release of agent and exposure of personnel. An MCE is the worst single event that could reasonably occur at any time, with maximal release of agent from munitions, bulk container, or work process as a result of an accidental occurrence. The Office of The Surgeon General is developing guidance for installations to estimate the chemical agent casualties expected from an MPE or an MCE. For planning purposes, medical staffing requirements are based on the MPE for the installation. Because an MCE is expected to exceed the capabilities of the installation medical facility, medical contingency plans and coordination with local, state, and federal emergency medical authorities

are essential.

The procedure for the decontamination of litter patients can be found in FM 4-07.7, *Health Service Support in a Nuclear, Chemical and Biological Environment*.¹⁸ The installation response force decontaminates patients and passes them across a hotline to the MRT. At that point, the casualty should be completely clean. Civilian officials may require a casualty to be “certified clean” before moving the patient off the military installation. This requirement may be addressed through coordination and training prior to an exercise or an actual CAI. Coordination with the civilian sector through education and communication is essential to providing a rapid and adequate medical response.

CAIRA encompasses actions taken to save lives and to preserve health and safety. This support involves a continuum of medical care, ranging from self/buddy aid in the field to treatment at a tertiary care facility. Because of the nature of some chemical warfare agents, proper care and adequate decontamination must be provided early to avoid serious injury or death. CAIRA includes the following levels of medical care:

Level I: composed of installation response force nonmedical installation personnel. The local commander appoints the incident response force members and ensures they are provided initial and ongoing training as described in DA Pamphlet 50-6, *Chemical Accident or Incident Response and Assistance (CAIRA) Operations*.² The Office of The Surgeon General and the US Army Medical Department Center and School are developing a list of essential medical tasks for this group. Additional tasks may be added at the discretion of the IMA or the local commander.

Level II: the MRT (composed of installation medical personnel). The MRT leader is a physician and is responsible for training the team in triage, treatment, stabilization, and evacuation of casualties from the accident site to the appropriate medical treatment facility. The MRT must have adequate personnel, supplies, and

equipment to provide healthcare to casualties generated by an MPE. The specific tasks for the MRT leader and members are specified in DA PAM 50-6, Tables 6-3 and 6-4.² One MRT member should be issued toxicological agent protective gear so he or she may cross the hotline and provide emergency medical care to casualties. The remaining members should be available on the clean side of the hotline to perform triage and to provide immediate care. Current guidance requires forward medical personnel to be trained in advanced airway skills such as intubation. For military medics, these skills should be (but are not always) taught during advanced individual training. Ambulances should be staffed with at least one paramedic, a level of training more advanced than a military medic.

Level III: the medical augmentation team, provided by the medical department activity or the medical center to an installation with a chemical surety mission. This team must have the capability to augment the MRT in the event of an MCE. The medical augmentation team leader’s responsibilities are also outlined in DA PAM 50-6, Table 6-5.²

Level IV: the chemical casualty site team, provided by USAMRICD, which provides clinical consultation and subject-matter experts in chemical casualty care. A veterinarian may also be a designated member of this team. During the initial phases of an exercise, concern is primarily for casualties. In previous service response force exercises, however, questions have been asked about the safety of livestock, pets, and wildlife. The veterinarian has proven to be a valuable source of information and an asset to this team.

The installation commander looks initially to the IMA for medical support and advice. If the CAI exceeds the installation’s capability, a service response force is provided to assume control of the situation. The service response force surgeon assumes operational control of the MRT, the medical augmentation team, and the medical chemical advisory team at the accident site.

DEMILITARIZATION OF CHEMICAL WARFARE AGENTS

The United States has produced and stored a stockpile of chemical warfare agents since World War I. These projectiles, rockets, mines, and ton containers have been maintained at eight depots in eight states: Aberdeen Proving Ground, Maryland (demilitarization completed); Anniston Army Depot, Alabama; Blue Grass Army Depot, Kentucky; Newport Chemical Depot, Indiana; Pine Bluff Arsenal, Arkansas; Pueblo Chemical Depot, Colorado; Deseret Chemical Depot, Utah; and Umatilla Chemical Depot, Oregon. In the event of a large release of agents, two neighboring states, Washington and Illinois, might also be affected.

The majority of chemical agents are stored in bulk containers that do not have explosive components, and leaking chemical agents have not presented a health threat to areas surrounding these depots. However, continuing to store the aging munitions may present a risk of chemical agent exposure. Of the chemical munitions, the M55 rocket is the most hazardous; under certain accidental circumstances, it could deliver its chemical payload into the community.

In 1985 Congress initiated a program to dispose of the entire US stockpile of lethal chemical agents. There were multiple reasons for destroying these chemical warfare agents:

- Ratification of the multilateral Chemical Weapons Convention treaty in April 1997 required the destruction of the weapons by April 2007, with an extension to April 2012, if necessary.
- The need for the stockpile no longer exists.
- The stockpile is slowly deteriorating with age.
- The stockpile is a potential target for terrorism.

In 1988 the US Army chose incineration as the method of destruction for the stockpile because it allows safe treatment of all the components of a chemical weapon, including the agent, fuses, bursters, explosives, motors, metal parts, and metal bodies. The prototype incineration destruction plant for lethal agents, the Johnston Atoll Chemical Agent Destruction System, was erected on Johnston Island in the South Pacific. The plant completed its mission in 2000 after destroying more than 2,000 tons of chemical agents and 410,000 chemical munitions. Incineration is currently in use at four of the storage depots: Deseret, Anniston, Umatilla, and Pinebluff. All destruction facilities were engineered with redundant safety features designed to prevent the release of agent. The US Public Health Service reviews plans and monitors operations of these chemical destruction plants. The appropriate state environmental authorities must issue permits before incineration can begin.

During the incineration process, the agent and all metal parts are destroyed at 2,700°F. Exhaust gases are passed through extensive, state-of-the-art pollution control systems, including a pollution abatement filtration system. Personnel dismantle the weapons in explosive containment rooms designed to withstand detonation. Explosives are separated from the liquid agent and metal parts with each waste stream and destroyed in separate furnaces. Unconfined explosives are consumed in the fire. The solid residue remaining from ash, fiberglass, and wooden dunnage is evaluated for contamination and transported to approved landfills. Brine (a by-product waste) is packaged and also sent to approved landfills. There is no water discharge resulting from the incineration process. Stack effluent must meet all requirements of the Clean Air Act,¹⁹ especially the amendments passed in 1970,²⁰ 1977,²¹ and 1990²² (these last three versions were codified in the US Code in 1990²³). Special precautions have been taken to reduce and eliminate the formation of furans and dioxans from the incineration process. Discharges from the stack are continuously monitored to ensure that the Clean Air Act requirements are met. Even though the possibility of an event leading to the contamination of an

area surrounding a community is remote, extensive planning and preparation have been accomplished. The US Army and the Federal Emergency Management Agency have jointly enhanced the emergency preparedness of these communities.

Despite the extensive precautions in building the destruction plants, the Chemical Stockpile Emergency Preparedness Program and the Federal Emergency Management Agency are working with emergency responders to enhance their capabilities. Through the Chemical Stockpile Emergency Preparedness Program, first responders and emergency management officials are trained to manage chemical casualties specific to the installation. Extensive security and safety measures have been adopted to avoid accidents or incidents involving chemical agents and chemical surety. Some containers are transported in large overpack containers (a container within a heavier container) designed to withstand an explosion and stored in an igloo (a storage building topped with, for example, 3 to 4 ft of earth and concrete). These measures have been strengthened against acts of terrorism since the attacks on the United States on September 11, 2001.

The US Army has also investigated and developed alternatives to incineration. The Alternative Technologies and Approaches Project developed and implemented neutralization disposal technologies of bulk container stocks of the nerve agent VX in Newport, Indiana, and the blister agent HD (mustard gas) at the Edgewood Area of Aberdeen Proving Ground. Destruction of VX was carried out with sodium hydroxide and hot water. Destruction of HD was accomplished by neutralization followed by biotreatment involving the microbial destruction of biodegradable organic material, such as thiodiglycol found in the hydrolysate. As of fall 2006, the Army has neutralized 100% of the stockpile at the Aberdeen Proving Ground facility and as of May 2008, 90% of the stockpile at the Newport facility. The Aberdeen facility was officially closed in June 2007.²⁴

The Assembled Chemical Weapons Alternatives Program is responsible for the safe destruction of chemical weapons stockpiles at Pueblo, Colorado, and Blue Grass, Kentucky. Neutralization followed by biotreatment was selected for the Pueblo stockpile; neutralization followed by supercritical water oxidation will be used to destroy the Blue Grass stockpile. Construction of full-scale pilot test disposal facilities is underway in both states.

Critics of the Army's high-temperature incineration believe that the method is undesirable. The disagreement among scientific experts and the concerns of people surrounding the eight US depots have created numerous debates over the chemical agent destruction

program, presenting a risk communication challenge for the Army. This communication challenge has led to the development of active public outreach offices staffed with knowledgeable teams to answer questions

and provide informational materials. These outreach teams have fostered an environment of trust and cooperation among the Department of Defense and the citizens that it serves.

SUMMARY

The unique challenges of handling chemical warfare agents and aging munitions while protecting the health of chemical workers requires thorough knowledge of occupational medicine and of chemical agents. It also involves the interaction of multiple professional groups, such as physicians, industrial hygienists, safety officers, surety officers, and certifying officials.

Lack of communication between these groups and the community can pose significant risk, especially in the chemical demilitarization process. Healthcare providers can play an important role in reducing this risk by providing information to communities and building confidence in the US Army's ability to safely destroy chemical agents.

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