

# Chapter 40

## PREVENTIVE MEDICINE IN THE DEPLOYED ENVIRONMENT

LUCAS A. JOHNSON, MD, MTM&H,\* AND SHAWN M. GARCIA, MD, MPH†

---

INTRODUCTION

IMMUNIZATION

CHEMOPROPHYLAXIS

SEXUAL HEALTH

ORAL HEALTH

VECTOR CONTROL

WATER STANDARDS

FOOD STANDARDS

WASTE DISPOSAL

ENVIRONMENTAL HAZARDS

UNIT-LEVEL MEDICAL SURVEILLANCE

OUTBREAK INVESTIGATIONS

EMERGENCY PREPAREDNESS

RISK COMMUNICATION

SUMMARY

\*Lieutenant Commander, Medical Corps, US Navy; Assistant Professor of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, Maryland

†Lieutenant Commander, Medical Corps, US Navy; Assistant Professor of Preventive Medicine and Biostatistics, Uniformed Services University of the Health Sciences, Bethesda, Maryland

## INTRODUCTION

Military personnel serving in operational environments experience a variety of potentially hazardous exposures. It is well known that conflict erodes existing public health infrastructure, resulting in outbreaks of disease associated with poor hygiene, contamination of food and drinking water, and interruption of vector control measures. Because of the ubiquity of these exposures in operational settings, a variety of effective countermeasures are directed by Department of Defense (DoD) policy, as well as guidance specific to the area of operation, which should be incorporated when planning military operations. It is the responsibility of the locally assigned military leadership, in coordination with the military medical officer (MMO), to assure appropriate preventive medicine resources and risk mitigation procedures are available at the tactical and operational levels to

maximize force readiness and preserve the health of deployed forces.

Perhaps more than any other medical discipline, preventive medicine activities influence combat operations at every level of warfighting. Minimizing or mitigating potentially hazardous exposures permits the conduct of operations in environments typically inhospitable to routine tactical maneuvering. Through disease prevention activities, commanders can more easily maintain operational troop strength and lose fewer soldiers, sailors, airmen, and marines to preventable illness. Finally, in preserving and maintaining the health of service members through wellness and readiness initiatives, preventive medicine acts as a strategic force multiplier, helping to ensure a ready and capable force prepared for worldwide deployment.

## IMMUNIZATION

Immunization is recognized as one of the great public health achievements of the 20th century.<sup>1</sup> The ability to confer lasting, sterile immunity to previously immune-naïve individuals for the purpose of interrupting and preventing infection has saved countless lives; smallpox vaccination alone is estimated to have prevented 5 million deaths globally each year since its development.<sup>2</sup>

Two critical measures influence how effectively the use of a particular vaccine can prevent disease at the population level. Vaccine efficacy, the reduction in incidence of disease among those who have received vaccination as compared to those who have not, measures how well a vaccine prevents disease in exposed persons. Vaccine uptake, the proportion of individuals who have completed all recommended doses of a vaccine, measures population compliance with immunization recommendations. High vaccine efficacy combined with high vaccine uptake results in the phenomenon of herd immunity, a condition in which an infectious disease is denied a population of susceptible hosts, and can no longer be efficiently

transmitted within the largely vaccinated community. In reducing the prevalence of circulating disease, herd immunity also benefits those few individuals unable to be vaccinated due to comorbidities or contraindications. While the exact proportions for specific diseases vary, herd immunity is generally achieved once a population's vaccine uptake approaches 85%.<sup>3</sup>

Unit medical assets are responsible for ensuring attached personnel have received immunizations required by service-specific instruction as well as geographic command entry requirements. The Defense Health Agency Immunization Healthcare Branch is an excellent source of military vaccine information, including vaccine entry requirements for each geographic area of responsibility.<sup>4</sup> Ensuring appropriate vaccination is critically important when managing populations likely to experience close-quarters living (recruit training centers, barracks residents, ship's berthing); overcrowding (refugee camps, prisons, detention centers); or foreign travel.<sup>5</sup>

## CHEMOPROPHYLAXIS

While sterile immunity remains the gold standard for preventing illness, many military-relevant infectious agents do not yet have an effective vaccine countermeasure. In some instances pharmaceutical interventions (chemoprophylaxis) exist to prevent diseases for which vaccines are not yet available.

### Malaria

As early as 1768, James Lind advocated for malaria chemoprophylaxis, recommending that "every man receive a daily ration of cinchona powder" while visiting tropical ports.<sup>6</sup> In virtually every theater of

war since then, many reports have been published on the military's experience with chemoprophylaxis. From the Pacific campaign of World War II to the 2003 peacekeeping operations in Liberia, the primary lesson learned remained unchanged for the greater part of a century: enforcement of appropriate chemoprophylaxis use is a command responsibility (Exhibit 40-1).<sup>7</sup>

## EXHIBIT 40-1

### COMMAND PRESERVATION OF HEALTH

**Burma, 1943.** Lieutenant General William Slim's troop strength was severely compromised. For every soldier evacuated with combat wounds, 120 were evacuated due to illness, a rate of 12 per 1,000 per day. The annual malaria attack rate was 84%, rendering a large percentage of his force combat ineffective for months at a time. Slim recalled, "A simple calculation showed me that in a matter of months at this rate my army would have melted away. Indeed, it was doing so under my eyes."<sup>1</sup>

An effective prophylaxis for malaria, mepacrine, was available, and evidence of therapeutic compliance easily assessed on physical exam. However, unfounded rumors of the drug causing impotence resulted in poor adherence. Slim's solution was simple but effective:

I, therefore, had surprise checks of whole units, every man being examined. If the overall result was less than ninety-five percent positive I sacked the commanding officer. I only had to sack three; by then the rest had got my meaning.<sup>1</sup>

Within months, Slim's malaria forward treatment unit wards were largely empty. By 1945 illness rates plummeted 10-fold, to 1 soldier per 1,000 per day. Lieutenant General Slim recognized and leveraged a fundamental relationship in preserving the health of his forces:

Good doctors are of no use without good discipline. More than half the battle against disease is not fought by doctors, but by regimental officers. It is they who see that the daily dose of mepacrine is taken, that shorts are never worn, that shirts are put on and sleeves turned down before sunset, that minor abrasions are treated before, not after, they go septic, that bodily cleanliness is enforced.<sup>1</sup>

1. Slim W. *Defeat into Victory*. 2nd ed. London, UK: Cassell & Company Ltd; 1956.

Several highly effective agents are available for use as malaria chemoprophylaxis; each has its own considerations (Table 40-1). Chloroquine was previously used extensively across the globe, but development of resistance has restricted its utility to geographic areas known to have no chloroquine-resistant *Plasmodium* species. Currently the vast majority of US service members receive doxycycline or atovaquone-proguanil malaria chemoprophylaxis. Providers should always ensure chemoprophylaxis selection is appropriate for local resistance patterns. Mefloquine carries a "black box" warning due to well-described neurologic and psychiatric side effects and should be prescribed within the DoD only as a "drug of last resort."<sup>8</sup>

Service member compliance with malaria chemoprophylaxis is historically low. Survey data from Operation Enduring Freedom (OEF) veterans indicate compliance with daily dosed regimens approached 60%, and compliance with weekly dosed regimens was less than 40%.<sup>9</sup> Whenever possible, malaria chemoprophylaxis should be administered at the unit level as directly observed therapy (DOT). DOT increases medication compliance and appropriately empowers commanders with a means to preserve the health of their forces.

Travelers who spend prolonged periods of time (generally 6 months or more) in regions with *P vivax* and *P ovale* require presumptive anti-relapse therapy (PART) with primaquine for 2 weeks following their return. Primaquine is effective in eradicating the liver hypnozoite phase of *P vivax* and *P ovale*. However, primaquine can be used only in G6PD-normal individuals, and no agent is currently approved for PART in service members who are G6PD deficient. Such individuals should be thoroughly counseled regarding bite avoidance and prophylaxis compliance if they require travel to areas where PART would otherwise be recommended.

### Leptospirosis

*Leptospira* is a spirochete bacteria typically transmitted through soil or fresh water contaminated by animal urine. Bacterial invasion occurs through cuts in the skin or mucous membrane exposure. Historically significant leptospirosis outbreaks among service members have only occurred among participants in jungle warfare training who experience substantial amounts of untreated fresh water exposure in tropical environments. Civilian exposures typically result from flooding in the tropics as well as participation in fresh water adventure sports. Doxycycline 200 mg orally once weekly is believed to provide some protection against leptospirosis infection for individuals

**TABLE 40-1**  
**MALARIA CHEMOPROPHYLAXIS AGENTS**

Agent	Usage	Adult Dose	Start	Stop	Can be Used in Pregnancy?*	Special Considerations
Doxycycline	All areas	100 mg PO once daily	2 days before travel to malarious area	4 weeks after exit from malarious area	No	GI upset; better tolerated if taken with food. Sun sensitivity.
Atovaquone/proguanil	All areas	250 mg atovaquone/ 100 mg proguanil PO once daily	1–2 days before travel to malarious area	7 days after exit from malarious area	No	Contraindicated if creatinine clearance <30 mL/min.
Chloroquine	Chloroquine-sensitive areas only	300 mg base (500 mg salt) PO once weekly	1–2 weeks before travel to malarious area	4 weeks after exit from malarious area	Yes	Few geographic areas for use. May exacerbate psoriasis.
Mefloquine	Mefloquine-sensitive areas only	228 mg base (250 mg salt) PO once weekly	2 weeks before travel to malarious area	4 weeks after exit from malarious area	Yes	Contraindicated in patients with certain psychiatric disorders, seizures, cardiac conduction abnormalities. DoD chemoprophylaxis of last resort.
Primaquine	Presumptive anti-relapse therapy for <i>Plasmodium vivax</i> and <i>P. ovale</i> hypnozoites	30 mg base (52.6 mg salt) PO daily for 14 days	After exit from malarious area	After full 2-wk dose	No	Contraindicated in patients with depression, anxiety, psychosis, other major psychiatric disorders, seizures. Requires normal G6PD level.

DoD: Department of Defense; GI: gastrointestinal; PO: per os (by mouth).

\*Data source for pregnancy information: Centers for Disease Control and Prevention. Choosing a drug to prevent malaria. <https://www.cdc.gov/malaria/travelers/drugs.html>. Published April 25, 2018. Accessed June 6, 2018.

with limited, discrete exposures to potentially infected water. Prophylaxis should begin 1 to 2 days before potential exposure and continue throughout the period of exposure.<sup>10</sup> The value of chemoprophylaxis for populations with continuous exposures in endemic areas is unclear.<sup>11</sup>

### Group A Streptococcus

Group A streptococcal infections are a particular challenge in the recruit setting, where crowding and inadequate hygiene can result in historically aggressive disease manifested by severe pneumonias, empyemas,

and tonsillar abscesses. Since the advent of penicillin, military recruit depots have employed chemoprophylaxis to prevent Group A streptococcal infections. Across the services, all recruit training depots engage in year-round prophylaxis, with 1.2 million units of benzathine penicillin G (PCN) administered intramuscularly (IM) during the first week of training. IM PCN protects recruits for approximately 28 days and can be re-dosed if indicated by historical surveillance or an active outbreak. Penicillin-allergic recruits may alternatively be treated with 1 g oral azithromycin weekly for 4 weeks, or 250 mg erythromycin twice daily for 4 weeks.

## SEXUAL HEALTH

The force health protection threat posed by sexual activity is an often-neglected reality of operational and deployed military settings. Despite overwhelming evidence to the contrary, some commanders believe prohibition of sexual activity alone is a sufficient intervention to prevent sexually transmitted infections (STIs) and pregnancies in operational settings. History has repeatedly demonstrated this view as fallacious, most recently during OEF and Operation Iraqi Freedom. From 2004 to 2009, over 750 cases of chlamydia and gonorrhea were identified in combat-deployed US military personnel. In some cohorts, rates of chlamydia exceeded stateside civilian age-matched rates.<sup>12</sup>

Continuous promotion of safe sexual behavior, as well as creating an environment where sexual health issues can be confidentially discussed with a medical provider, is critical for preserving force health. Condoms are essential medical supplies that should be available at every echelon of care, discretely and free of charge, regardless of geography or cultural normative behavior of host countries.

Specific expert recommendations for MMOs in-

clude (1) promoting condom use as normal protective behavior and characterizing unprotected sexual activity as unnecessarily risky and abnormal; (2) identifying and screening those at risk for STIs (providers should understand demographic factors influencing the epidemiology of specific STIs); (3) ensuring treatment (including treatment of sexual partners whenever possible) occurs in accordance with US Centers for Disease Control and Prevention recommendations; and (4) ensuring confidentiality of reported high-risk behaviors.<sup>13</sup>

Contraceptive availability is a critical component of sexual health. Female service members should be counseled on the availability and efficacy of common contraceptives. In operational or deployed settings where hygiene can become complicated, hormonal contraception that can induce reversible menstrual cycle suppression may be of interest to female service members.<sup>14</sup> Like condoms, contraception, including emergency contraception, is an essential medical supply that should be available to service members at every echelon of care with as few barriers as possible.

## ORAL HEALTH

Oral health is an essential component of combat readiness. Service members with oral disease may suffer impaired performance of their duties, poor diet, sleep disturbances, and pain. Despite being a dentally ready force, the Army recorded over 900 unique dental emergencies in service members deployed to Afghanistan each month from July 2009 to June 2011.<sup>15</sup> Research suggests the risk of a service member suffering severe dental disease increases by approximately 4.5% for every month deployed.<sup>16</sup> Proper screening creates a dentally ready force that is

one-third as likely to experience a dental emergency requiring care as compared to an unscreened force.<sup>17</sup> Certain cohorts of service members have demonstrated increased risk for a dental emergency in deployed settings; in comparison to the active component of the Army, members of the Army National Guard and Army Reserve demonstrated a 50% increased risk of dental disease during OEF.<sup>16</sup> Assuring appropriate and timely treatment and follow-up after screening prevents impediments to dental readiness prior to and during deployment.

## VECTOR CONTROL

Vector-borne disease is a substantial force protection threat in operational and deployed settings. Climate change increases the spread of vector-borne disease to novel areas, making threats more likely in environments previously inhospitable to arthropod vectors.<sup>18</sup> While certain diseases have effective vaccines or chemoprophylaxis measures, minimizing exposure remains the cornerstone of all vector-borne illness prevention.

Minimizing vector exposure begins with avoidance. Both the lifecycle and preferred feeding time of many arthropod vectors follow well-established seasonal, rainfall, and diurnal patterns. Minimizing outdoor

exposure during peak biting periods (if tactically permissible) can substantially decrease the likelihood of bites. Similarly, when locations are chosen for habitation in the field, the surrounding vector habitat should be considered. Whenever possible, sites for human habitation should be open, dry, and positioned away from local settlements, animal pens, or rodent burrows.

Reducing the exposed biting surface available to an arthropod is a critically important practice for service members. Proper wear of a long-sleeve military uniform reduces exposure to potential vectors. Sleeves should be worn down and pant leggings should be properly bloused or tucked into the boot in the field

environment. At night, bed nets are an additional measure of protection against arthropods. Chemical repellants further augment bite avoidance. Permethrin, the DoD standard repellent used to treat clothing, opens voltage-dependent sodium channels in arthropod nervous systems to cause paralysis and death. In high-transmission environments, bed nets should be utilized and treated with permethrin. The exterior of canvas tents can also be treated with permethrin. Many services now issue uniforms factory-treated with permethrin, which protect for 50 wash cycles or more. While each uniform contains specific wash and re-treatment instructions, factory-treated uniforms generally remain effective for 12 months.<sup>19</sup> Uniforms can be treated professionally or using a field expedient method (aerosol spray, individual dynamic absorption, air compressed spray). The Armed Forces Pest Management Board is an excellent resource for information about treatment methods and service-specific uniform considerations.

DEET (*N,N*-diethyl-*m*-toluamide or *N,N*-diethyl-3-methylbenzamide) has been the US military skin repellant of choice for over 60 years. When applied to exposed skin at concentrations over 20%, DEET is effective in repelling a variety of arthropods.<sup>20</sup> Picaridin (1-piperidinecarboxylic acid 2-(2-hydroxyethyl)-1-methylpropylester) is a newer repellant that appears to have a repellant profile at least equivalent to DEET while also being less irritating to skin and less corrosive to plastics.<sup>21</sup> DEET or picaridin should be applied to any exposed skin not covered by a permethrin-treated uniform as part of the DoD insect repellent system. A variety of DEET and picaridin products are approved for military use, assigned a National Stock Number (NSN), and available for unit-level procurement.

The 2012 death of a US soldier from rabies and, in 2014, the largest-ever military rabies contact investigation, illustrate the continued threat animal bites pose to service members.<sup>22,23</sup> Rabies virus is transmitted through the blood, saliva, and nervous tissue of infected mammals. While preexposure and postexposure

regimens are highly effective at preventing human rabies, avoidance remains the primary mechanism of rabies protection for the vast majority of service members. With the exclusion of US working dogs, all mammals encountered in the operational or deployed setting are potential rabies threats. Adoption of stray animals as unit mascots represents an unacceptable risk and should be prohibited by commanders.

DoD guidance outlines indications for specific individuals (veterinarians, laboratory workers, military working dog handlers, etc) to receive preexposure rabies vaccine due to their elevated risk of coming in contact with rabies virus.<sup>24</sup> Rabies virus preexposure vaccination consists of three doses of immunization delivered on days 0, 7, and 21.<sup>25</sup>

Rabies postexposure prophylaxis becomes necessary when individuals have blood or mucous membrane exposure to the saliva, blood, or central nervous tissue of potentially rabid animals. Bat bites may leave little, if any, evidence of puncture wounds and may not be noticed by a sleeping person. If there is any chance that physical contact with a bat occurred, the bat should be tested for rabies. If the bat is not available for testing, then rabies postexposure prophylaxis should be administered. Clear documentation of an animal having received appropriate rabies vaccination or an examination by a veterinarian familiar with rabies are the only acceptable means of verifying an animal as being free of rabies. In all other mammalian bite cases, MMOs should strongly consider rabies postexposure prophylaxis due to the near 100% fatality rate of human rabies once a person becomes symptomatic. Postexposure prophylaxis consists of cleaning the wound, administering 20 IU/kg body weight of rabies immunoglobulin injected as proximal to the bite site as possible, and four doses of rabies vaccine, on days 0, 3, 7, and 14, administered in the contralateral deltoid.<sup>26</sup> Previously vaccinated individuals should generally not receive immunoglobulin; instead, they should receive a truncated two-dose vaccine schedule on days 0 and 3.

## WATER STANDARDS

Ample quantities of safe water are necessary for preservation of health, hygiene, and force readiness. Improperly treated drinking water can transmit a variety of bacterial, viral, protozoan, and parasitic diseases. All potential water sources generated in field conditions (including water from municipal host nation water systems) should be considered unsafe for consumption unless evaluated and approved by trained preventive medicine personnel.<sup>27</sup>

The majority of drinking water produced from field sources is generated by a portable reverse osmosis water purification unit (ROWPU) or procured from commercial sources. After initial purification and treatment to remove dissolved solids and contaminants, all drinking water must be disinfected. Chlorination is the preferred method for water disinfection in the field because it has a measurable residual, which both continues to kill organisms after initial treatment, and also serves as a sentinel for potential contamination

TABLE 40-2

## MINIMUM FREE AVAILABLE CHLORINE (RESIDUAL CHLORINE) LEVELS FOR VARIOUS FIELD APPLICATIONS

Application	Minimum FAC (mg/L or ppm)	Corrective Action
ROWPU production	2	FAC < 2 mg/L: Do not issue water, rechlorinate to FAC of 2 mg/L, ensure FAC of 2 mg/L after 30 minutes prior to issue
Distribution /secondary storage	1	FAC 0.2–1 mg/L: rechlorinate, ensure FAC of 1 mg/L, okay to issue FAC < 0.2 mg/L: do not issue water, rechlorinate to 1 mg/L, ensure FAC of 1 mg/L after 30 minutes prior to issue
Unit-level storage (eg, water buffaloes, 5-gallon containers)	1	FAC 0.2–1 mg/L: rechlorinate to 1 mg/L, okay to issue FAC < 0.2 mg/L: do not issue water, rechlorinate to 1 mg/L, ensure FAC of 1 mg/L after 30 minutes prior to issue
Canteens, personal hydration systems	1	FAC < 0.2 mg/L: rechlorinate to 1 mg/L, ensure FAC of 1 mg/L after 30 minutes
Surface water (emergency only, no other treatment available)	5	N/A
Ground water approved by preventive medicine staff	2	N/A
Nonpotable water for hygiene/showers	1	FAC < 1.0: rechlorinate to 1 mg/L

FAC: free available chlorine; N/A: not applicable; ROWPU: reverse osmosis water purification unit

Data source: Departments of the Army, Navy, and Air Force. *Sanitary Control and Surveillance of Field Water Supplies*. Washington, DC: DA; 2010. TB Med 577.

when levels fall below acceptable thresholds. Chlorine requires a minimum of 30 minutes of contact time to disinfect water for drinking. Manufacturer information can provide specific dosing recommendations depending on the product used and the volume of water to be treated; however, concentration of dissolved solids, pH, and temperature can affect the volume of chlorine required to safely kill pathogens. The free available chlorine (FAC) indicates the amount of biologically active chlorine available to disinfect water intended for drinking. Table 40-2 outlines minimum FAC concentrations for various water systems and uses.

In operational or deployed settings, water quality measurements including FAC, coliform testing, and a variety of other parameters should be regularly tested and recorded in accordance with tri-service

recommendations. Table 40-3 outlines minimum FAC and testing periodicity for a variety of water systems commonly used in field conditions. Any concerns regarding water quality should be immediately reported to engineering personnel for remediation.

Commercial bottled water is increasingly available in modern military operations. All bottled water products require testing and approval by trained US Army Veterinary Services (VS) personnel prior to use. VS maintains an up-to-date list of approved bottled water sources, published in the Worldwide Directory of Sanitarily Approved Food Establishments for Armed Forces procurement.<sup>28</sup> Preventive medicine personnel can extend expiration dates of bottled water in 30-day increments after testing to ensure continued potability.

## FOOD STANDARDS

Foodborne illness imposes a substantial burden of morbidity, mortality, and time lost from work in both garrison and deployed settings. The most common factors contributing to foodborne illness include food from unsafe sources, poor personal hygiene, inadequate cooking, and inadequate holding temperatures.<sup>29</sup> Specific interventions and best practices addressing

each of these factors can minimize the likelihood of foodborne illness.

Assuring a safe food supply begins with procuring food from safe sources. Installation commanders are ultimately responsible for ensuring food and beverages on installations are served only through establishments inspected and approved by the relevant

**TABLE 40-3**  
**RECOMMENDED WATER QUALITY TESTING FREQUENCIES**

Application	Residual Chlorine	Coliform	pH	Total Dissolved Solids
ROWPU	Every 30 minutes during production operations	Weekly	Weekly	Weekly
Distribution/storage	With every receipt and distribution	Monthly	Monthly	-
Unit-level storage (eg, water buffaloes, 5-gallon containers)	Twice daily	Weekly	Daily	-
Bottled/packageged field water	-	Monthly	-	-
Field showers	Time of delivery and twice daily	-	-	-
Food services	With each meal	-	-	-

ROWPU: reverse osmosis water purification unit; -: not applicable  
Data source: Departments of the Army, Navy, and Air Force. *Sanitary Control and Surveillance of Field Water Supplies*. Washington, DC: DA; 2010. TB Med 577.

service-specific regulatory authority. While Meals, Ready-to-Eat (MREs) are specifically engineered to provide safe nutrition in unforgiving environments, service members frequently consume high-risk food from unapproved sources when given the opportunity. Frequent counseling as well as increased availability of additional approved and inspected on-installation food sources (if tactically feasible) are potential countermeasures to discourage high-risk consumption from unapproved food sources.

Inadequate hygiene, particularly hand hygiene, is frequently identified as a factor contributing to outbreaks of foodborne illness. Food handlers are required to receive specific training in hand hygiene techniques, as well as actions or events throughout the food preparation and serving process that require repeated washing. Hand hygiene is similarly important for food consumers. MMOs are strongly encouraged to ensure handwashing stations or hand sanitizer dispensers are available and promoted for use at installation dining and toileting facilities.

Food handlers must be free of communicable diseases and are required to report symptoms of potential illness (such as vomiting, diarrhea, nausea, jaundice, skin lesions, or sore throat with fever) to their supervisor. A low threshold for exclusion from work should be applied to food handlers to minimize the possibility of foodborne illness resulting from a

communicable disease. Food handlers with diagnosed norovirus, hepatitis A, shigellosis, enterohemorrhagic or Shiga toxin-producing *Escherichia coli*, or *Salmonella typhi* must be excluded from work and reported to the service-specific regulatory authority. Similarly, food handlers with known or suspected contact with individuals diagnosed with these conditions should also be reported and evaluated by medical personnel.

Proper cooking temperatures destroy pathogenic organisms and minimize potential for foodborne illness. Raw animal foods must be cooked to a temperature and for a time period that comply with the Tri-Service Food Code<sup>29</sup> based on the type of food product as well as method of preparation. Temperatures must be verified with a thermometer; visual inspection is not an adequate means of determining compliance with minimum temperature recommendations.

To facilitate feeding large numbers of service members in a fixed amount of time, large dining facilities rely on stored food products prepared in bulk earlier in the day. Once cooked to a proper temperature, food must be stored hot or cold at an appropriate temperature to prohibit growth of pathogenic organisms. Maximum holding times vary by food product, holding temperature, and preparation style. Improper holding temperature or excessive holding time has been linked to countless foodborne illness outbreaks in cafeteria-style dining settings.

### WASTE DISPOSAL

Military field operations generate large amounts of waste products. Waste products may contain infectious agents such as cholera or typhoid, attract vermin

capable of spreading zoonotic disease, or serve as breeding grounds for many vectors of human disease. As tactical conditions permit, waste should be collected



and disposed of in accordance with local, federal, or host nation law. Increasingly, modern military operations rely on contracted services for collection and disposal of waste; however, such services may not be available for geographically isolated forward operating positions. As a result, MMOs must be familiar with basic principles of human, solid, and liquid waste management in operational settings and ensure waste management is addressed in the planning stages of any operation.

Methods employed for the disposal of human waste are influenced by material availability, soil conditions, source and location of drinking water, and environmental regulations. Positioning of toilet facilities should reduce or minimize the transmission of disease by vermin, vectors, or direct human contact. In general, field toilet facilities should be located at least 100 feet from natural water sources, 100 yards from food service areas, and 50 feet from berthing.<sup>30</sup> All attempts should be made to create handwashing stations at the exit of any human waste facility; hand washing with soap and water is ideal, but hand sanitizer is an acceptable alternative. While contracted chemical toilets are generally preferred whenever possible, logistic and geographic realities of conflict sometimes necessitate field-expedient solutions to managing human waste.

Pit latrines are the simplest form of human waste disposal; however, their practicality is influenced by soil conditions and water table depth. Hard or rocky soil can make digging pit latrines difficult. A shallow water table can result in contamination of natural water sources and restrict the maximum depth to which a latrine can be dug. Pit latrines also require periodic treatment with appropriate insecticides to prevent vector breeding. Once the contents of the latrine reach 1 foot from ground level, pit latrines should be closed and filled in with earth.<sup>30</sup>

Burn-barrel latrines utilize 55-gallon drums cut in half to collect and burn human waste. Prior to use or

re-use, a barrel is primed with approximately 3 inches of diesel fuel to ensure more efficient burning of solid waste; the fuel also serves as an insect repellent. Barrels must be burned when more than half full. A mixture of four parts diesel to one part gasoline should completely cover the barrel contents. Occasional stirring of the ignited contents is necessary (although less so with use of priming fuel). Minimizing the urine content of burn barrels greatly improves the efficiency of the burn and reduces fuel requirements.

Solid waste generated in operational environments is disposed of through burial, incineration, or commercial hauling. Burial is suitable only for short-term activities (1 week or less) involving small numbers of persons. While commercial hauling and disposal is greatly preferred, tactical or host nation limitations often necessitate incineration of waste on site. Open burn pits are convenient for use when establishing bases; however, they should be replaced with incinerators as soon as practical due to the inherent health risks associated with unimproved combustion of solid waste.<sup>31</sup>

Waste water generated from field or operational activities must be disposed of in accordance with applicable local, federal, and host nation laws. Use of municipal sanitary sewers is preferred, but sewers are often unavailable in austere settings. When necessary, soakage pits and evaporation beds may be used to dispose of waste water without attracting vermin or serving as breeding pools for vectors. Soakage pits are simply pits filled with a coarse medium such as crushed gravel. Pits may become clogged or saturated over time, requiring the construction of additional pits. Evaporation beds are contained fields of earth groomed into rows of depressions and ridges similar to agricultural beds. The field is flooded to the top of the ridges and waste water is allowed to penetrate the soil and evaporate. A series of evaporation beds are used on a rotating basis to allow approximately 3 days of evaporation prior to next use.

## ENVIRONMENTAL HAZARDS

Environmental exposures present a variety of public health challenges, particularly in the field environment. Extremes of temperature, altitude, precipitation, and sun exposure are routinely experienced in operational settings. For deployed forces, the need to maintain a combat-ready posture further exacerbates

environmental stressors common to austere environments. Chapter 22, *Environmental Extremes: Heat and Cold*, discusses environmental hazards specific to military operations, as well as potential countermeasures available to MMOs for ensuring the health of military forces.

## UNIT-LEVEL MEDICAL SURVEILLANCE

Medical surveillance, the continuous and systematic collection of health-related data, performs several critical functions. Medical surveillance is descriptive;

that is, it provides an objective description of a population's health at a point in time and thus identifies the basic epidemiology of a particular health problem.

**APPENDIX B TO ENCLOSURE C**

**DISEASE AND INJURY RATES**

**D&I Reporting Form for Joint Deployments**

Period Covered (Dates): \_\_\_\_\_ (Sunday 0001Z) through (Saturday 2359Z)  
 Medical Unit Name: \_\_\_\_\_ UIC: \_\_\_\_\_ Unit and/or Command Supported: \_\_\_\_\_  
 Total Population Supported: \_\_\_\_\_  
 Latitude and/or Longitude or Grid Coordinates: \_\_\_\_\_ Country: \_\_\_\_\_  
 Location Name (if available): \_\_\_\_\_ Individual Preparing Report: \_\_\_\_\_  
 Telephone number: \_\_\_\_\_ E-Mail: \_\_\_\_\_

CATEGORY	INITIAL VISITS	RATE	LOCAL REFERENCE RATE	DISPOSITION (RTD, LD, SIQ, HOSP, EVAC)	ESTIMATED LOST WORK DAYS
Fever and Unexplained Infections					
Influenza-like Illness					
Rash					
Localized Cutaneous Lesion					
Hemorrhagic Illness					
Gastrointestinal, Infectious					
Botulism-like					
Neurological					
Shock/Coma/Death due to Infection					
Combat/Operational Stress Reactions					
Dermatologic					
Ophthalmologic					
Psychiatric, Mental Disorders					
Respiratory Illness, Upper					
Reactive Airway Disease/Asthma					
Reportable Medical Events					
Heat/Cold					
Injury, Recreational/Sports					
Injury, Motor Vehicle					
Injury, Work/Training					
Injury, Other (Non-hostile)					
Injury, Other Hostile Action					
All Other					
Definable					
<b>TOTAL D&amp;I</b>					

Problems Identified: \_\_\_\_\_ Corrective Actions: \_\_\_\_\_

Figure 40-1. Sample disease and injury reporting worksheet.  
 Reproduced from: Office of the Chairman, Joint Chiefs of Staff. *Procedures for Deployment Health Surveillance*. Washington, DC: JCS; November 2, 2007: C-B-1. <https://www.dcms.uscg.mil/Portals/10/CG-1/cg112/cg1121/docs/pdf/MCM-0028-07.pdf>. Accessed June 8, 2018.

Surveillance is also predictive; that is, it helps explain variation in population health based on historical patterns and can serve as an early warning system for impending population health emergencies. Surveillance is informative; that is, the information obtained allows MMOs to provide commanders with specific preventive recommendations based on demonstrable trends in disease. Finally, surveillance is evaluative; when implementing a disease control measure, an ongoing surveillance system affords the opportunity to critically evaluate the impact of an intervention, track progress, and identify population health priorities for policy makers.<sup>32</sup>

The simplest form of operational medical surveillance occurs at the individual provider level. All services require mandatory disease reporting for

specific conditions via appropriate service-specific channels.<sup>33-35</sup> Additionally, state-mandated reportable medical conditions must also be reported to local health departments in accordance with service-specific instruction.<sup>36</sup>

Historically, unit-level surveillance was most frequently accomplished in weekly reporting of disease and injury (D&I) information. Pen and paper D&I reporting has largely been replaced by automatic mining of electronic health records and laboratory data for conditions of significance in the majority of deployed and operational settings. In the most austere environments where electronic health records are unavailable, weekly pen and paper D&I reporting is still employed, using a reporting form such as that shown in Figure 40-1.

## OUTBREAK INVESTIGATIONS

An outbreak is the occurrence of disease at a rate that exceeds expected baseline values. Every outbreak represents a systematic breakdown of public health infrastructure that warrants investigation. Outbreak investigations are performed to identify and treat those exposed, expose gaps in public health measures, and identify interventions to interrupt transmission and prevent further cases. Outbreak investigations are often complex and multidisciplinary, and can involve multiple agencies or organizations. In deployed or operational settings, military providers may be tasked to perform outbreak investigations with little specialized training or logistic assistance.

While no two outbreaks are the same, employing a systematic method for investigation substantially increases the likelihood of successfully interrupting transmission of disease. In general, outbreak investigations consist of the following components:

- Identify team and resources.
- Establish existence of an outbreak.
- Construct a case definition.
- Systematically find cases and develop a line listing.
- Perform descriptive epidemiology.
- Evaluate transmission hypothesis.
- Implement control measures.
- Communicate findings.
- Maintain surveillance.

Each component is discussed below. While these components are often presented in a stepwise manner, investigators are not required to rigidly perform an outbreak investigation one step at a time. It is often necessary (and advisable) to perform several tasks

simultaneously to ensure expeditious interruption of disease as well as alleviate public fears surrounding an outbreak.

### Identify Team and Resources

At first notification of a potential outbreak, an investigator must assess the personnel and material resources at their disposal to provide an adequate response. Personnel with specific outbreak investigation and public health training or prior experience are particularly valuable resources to consider when assembling a team. Local and regional civilian health departments are a wealth of knowledge and experience when conducting outbreak investigations. When the magnitude of the outbreak clearly indicates locally available resources are not sufficient, service-specific public health assistance may be available from the regional Navy environmental preventive medicine unit, the US Army Public Health Command, or the US Air Force School of Aerospace Medicine.

### Establish the Existence of an Outbreak

Routine disease surveillance provides the historical context for helping public health officials determine the rates of disease that constitute expected baseline values. Geography, seasonal weather variation, animal migratory patterns, and movement of human populations are some factors that influence expected values of disease incidence. Certain diseases are considered outbreaks based on a single occurrence (inhalational anthrax, human rabies, smallpox), while others may require dozens or hundreds of cases prior to exceeding expected background levels (gastroenteritis, upper respiratory infections).

On occasion investigators may be notified of a spurious increase in the number of reported cases of disease that initially appears to represent an outbreak. "Pseudo outbreaks" typically occur as the result of changing surveillance methodology (such as a new, more sensitive case definition) or other factors unrelated to the disease in question.

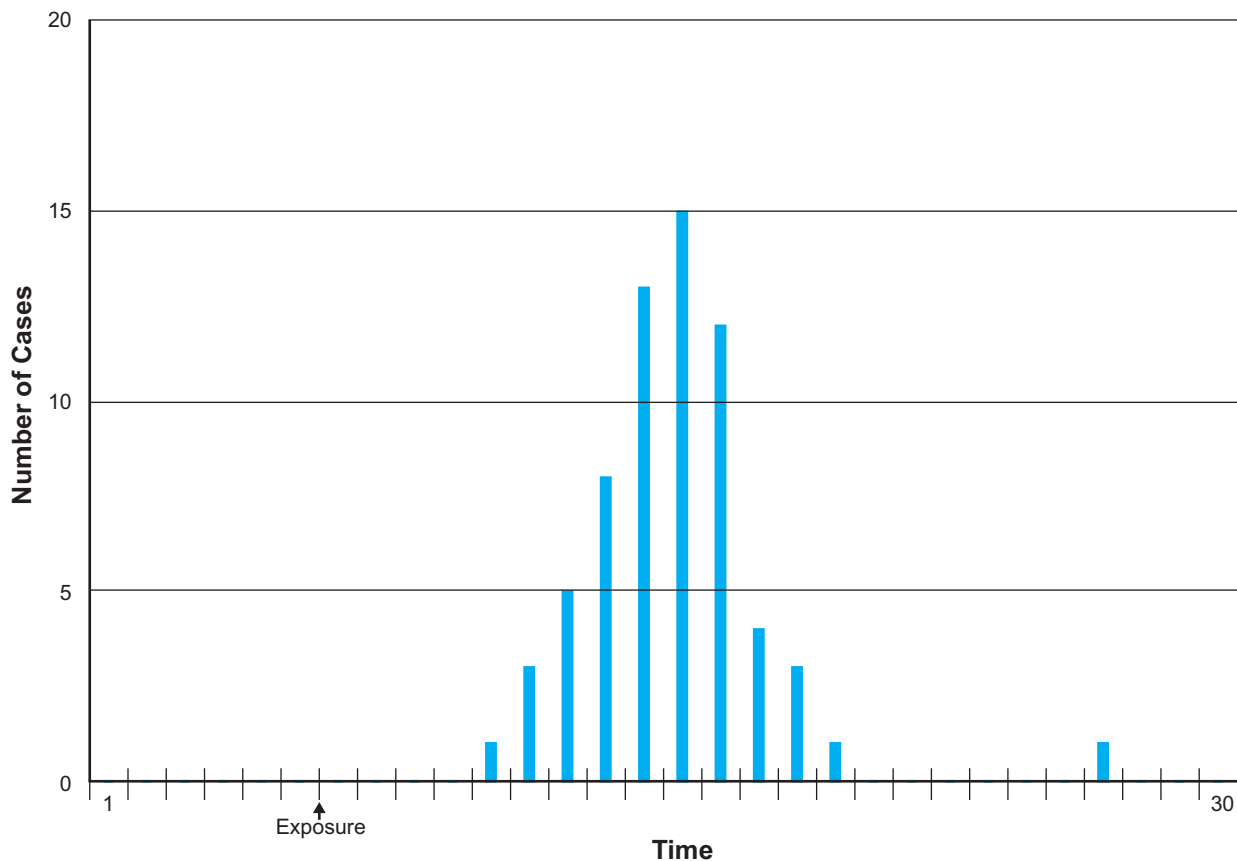
**Construct a Case Definition**

Crafting a meaningful case definition is a critical step in conducting an outbreak investigation. Case definitions that are too restrictive will lack sensitivity in identifying persons with the condition of interest. Conversely, case definitions that are too broadly defined will result in inefficient use of resources as investigators identify and interview more individuals than necessary. A good case definition contains aspects of exposure, symptoms, and temporality to

focus investigation efforts on those individuals most likely to represent people truly affected by the disease or illness in question. As the investigation progresses and patterns of exposures and symptoms become more apparent, the team may choose to modify the case definition to be more or less inclusive.

**Systematically Find Cases and Develop a Line Listing**

Once a case definition is developed, the team is tasked with systematically collecting information from potentially affected persons. Investigators often develop a standardized questionnaire or data collection sheet to survey potential cases for information regarding exposures, symptoms, and temporality pertinent to the case definition. Using standardized questionnaires helps minimize information bias and allows for the same information to be collected from all potential contacts.



**Figure 40-2.** Point source outbreak epidemiologic curve with hypothetical data. Point source outbreaks are characterized by a single common exposure and rapid resolution. Incubation period can be determined by calculating the time elapsed from exposure to the majority of cases developing symptoms. Outliers can be helpful in further establishing causative etiology, particularly in outbreaks of foodborne illness when consumption of leftovers results in individual cases occurring outside the bulk of those affected.

Individual contact questionnaire or interview data are most often transcribed into a line listing, which is a comprehensive database detailing patient identification, demographic, exposure, symptom, laboratory, and outcome data. In cases of known diseases with historically well-described risk factors and symptoms, the line listing may be truncated to include only the most relevant data needed to perform an investigation. For investigations of an unidentified agent, exposure, or cluster of seemingly unrelated symptoms, line listings will often contain far greater amounts of information.

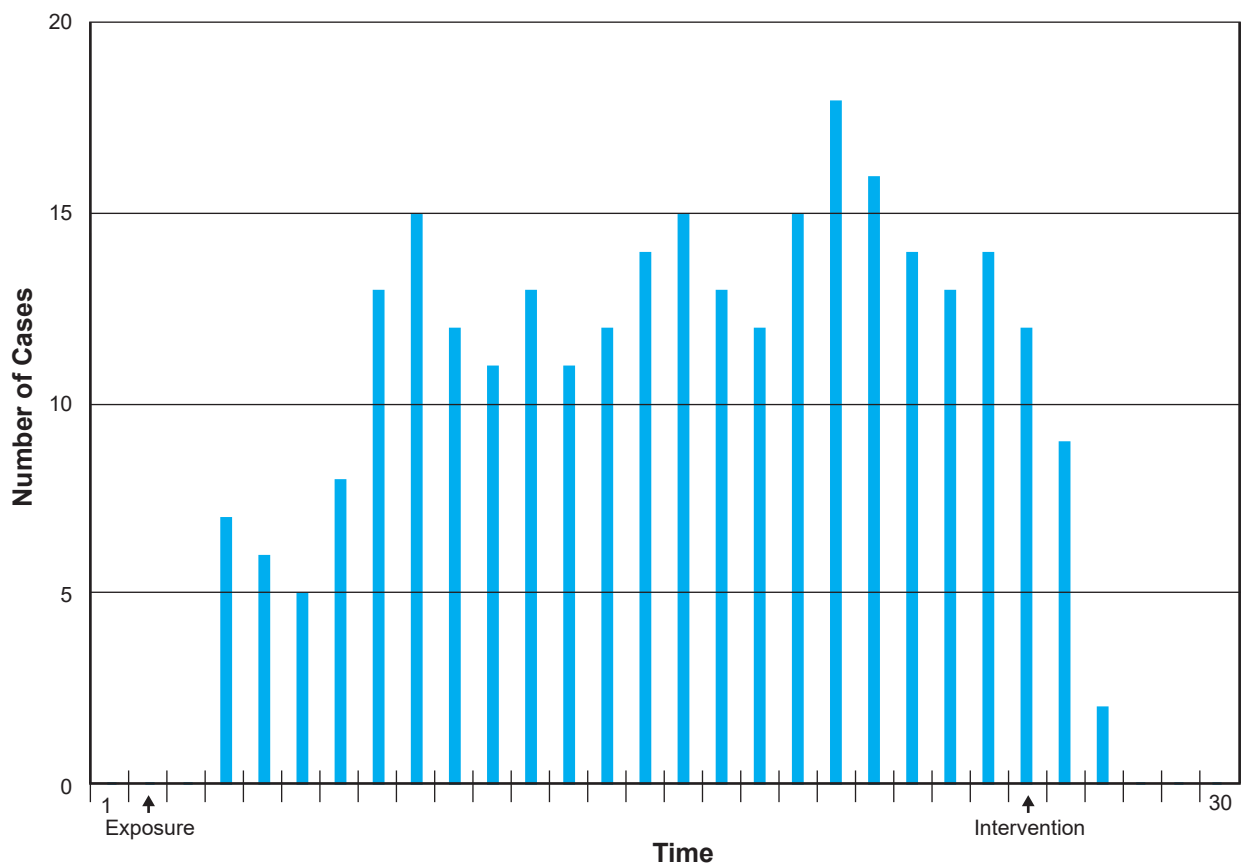
### Perform Descriptive Epidemiology

Information contained in a line listing allows investigators to explore how particular demographics and exposures influence disease status. In investigations in which the etiology of illness is unknown, describing basic demographic information about the

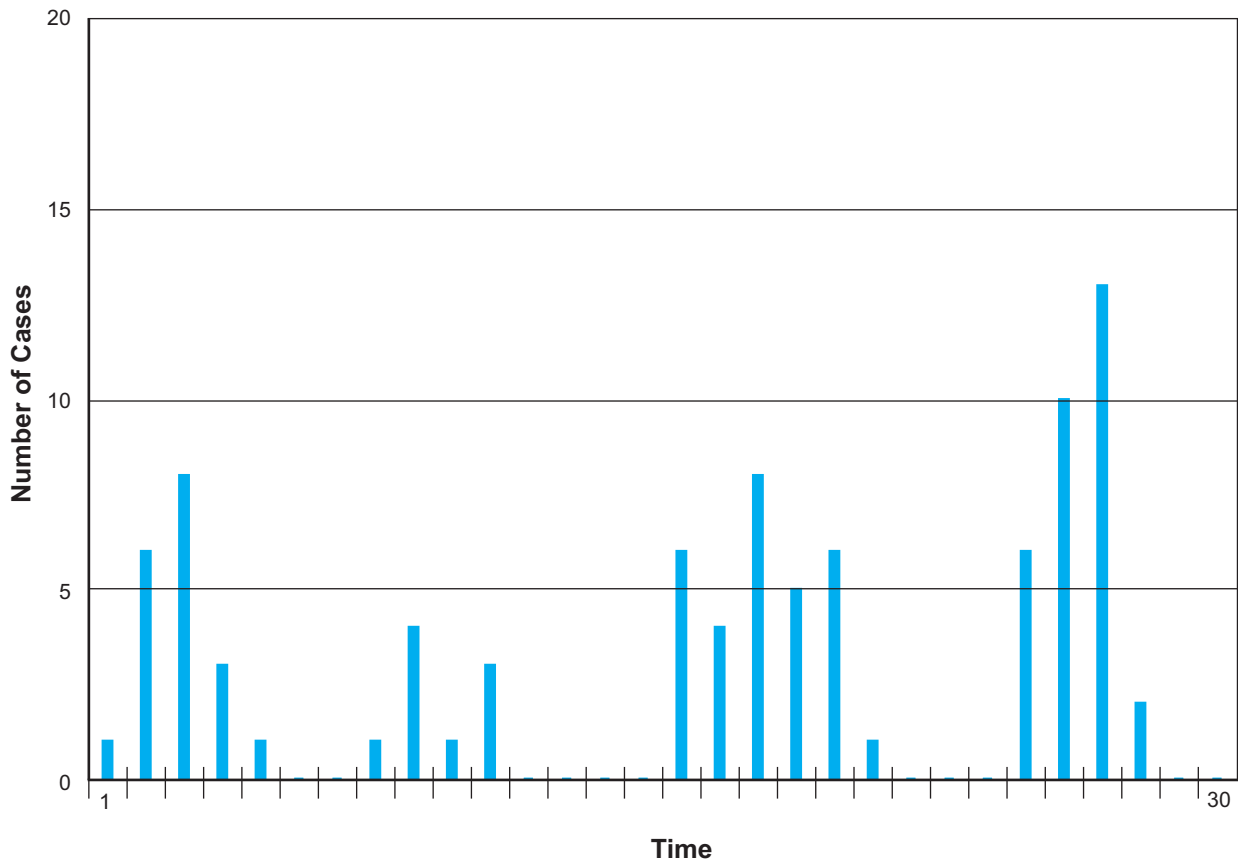
population or cohort demonstrating an increased risk of becoming ill is a crucial first step in identifying the causative agent of disease. Line listings also afford investigators the opportunity to calculate attack rates (the percentage of individuals who become ill after a discrete exposure). Calculating the attack rate ratio (the attack rate in exposed persons divided by the attack rate in unexposed persons) for each exposure allows investigators to identify exposures most strongly associated with disease. Focusing further laboratory and epidemiologic investigation on exposures with the largest attack rate ratios most efficiently utilizes the limited time and resources available to investigators.

### Evaluate Transmission Hypothesis

Line listings are also valuable in compiling data on the symptoms of those affected by the disease in ques-



**Figure 40-3.** Continuous common source outbreak epidemiologic curve with hypothetical data. Continuous common source outbreaks are characterized by a persistent exposure. Rapid accumulation of cases after initial exposure and large numbers of new cases throughout the outbreak suggest a common community source of exposure (eg, contaminated water or manufactured food product). If an intervention to interrupt transmission of disease is successful, abrupt cessation can be expected approximately one incubation period after last exposure.



**Figure 40-4.** Propagated spread epidemiologic curve with hypothetical data. Propagated spread outbreaks are characterized by clusters of new cases temporally segregated by approximately one incubation period. This pattern of disease outbreak strongly suggests human-to-human transmission of disease.

tion. In creating a basic epidemiologic (or “epi”) curve (a bar graph depicting the number of cases by the date or time of symptom onset), investigators can develop a hypothesis about how the illness is transmitted. Point source outbreaks result when a single common exposure is responsible for transmitting illness during a restricted period of time, such as food poisoning resulting from *Salmonella* contained in a dish at potluck luncheon (Figure 40-2). Continuous common source transmission occurs when persons are exposed to the same source over a prolonged period of time. Illness resulting from environmental exposures or from widely distributed manufactured food products are examples of continuous common source outbreaks (Figure 40-3). Propagated spread outbreaks occur as a result of human-to-human transmission and are typically characterized by clusters of patients separated by the incubation time required for a particular illness. Investigations involving vaccine-preventable illnesses are classic examples of propagated spread outbreaks (Figure 40-4).

Epi curves contain a wealth of additional information. By examining the lag between time of exposure and onset of symptoms, or by investigating the lapse of time between clusters of cases, investigators can estimate incubation periods and therefore narrow the list of potential causative agents. Epi curves graphically display the current trajectory or magnitude of the outbreak. Epi curves also allow for easy identification of outliers—potential sentinel cases standing apart from the remaining population.

### Implement Control Measures

Investigators need not wait for definitive identification of a causative agent prior to implementing meaningful control measures. Suspected outbreaks of gastrointestinal or respiratory illness warrant immediate public health messaging to increase hand hygiene and social distancing of ill or coughing persons, respectively. Similarly, if a toxic or harmful exposure is suspected to be the root cause of an outbreak, efforts

to mitigate exposure should be implemented as soon as practical instead of waiting for final confirmation of the exact substance responsible.

Implementation of control measures goes beyond simple removal of the offending agent. Because outbreaks represent a systematic breakdown of public health infrastructure, it is necessary to reevaluate existing systems or develop new systematic processes to assure public health. The epi curve can be a helpful tool for visualizing the potential impact of an intervention because the trajectory of cases is anticipated to decline after implementation of a meaningful control measure.

### Communicate Findings

Good risk communication is paramount to the successful interruption of disease transmission and should occur at all stages of the outbreak investigation. It is not enough for investigators to swiftly interrupt transmission of disease, they must also strive to keep faith with relevant stakeholders in providing timely and factual information to maintain public trust. Providing early and sustained risk communication alleviates

fears and supports partnership between investigators, authorities, and the general public. Such partnerships often result in greater cooperation and more speedy resolution of outbreaks. The value of regularly communicating findings throughout all stages of the contact investigation cannot be over-emphasized. Specific principles and strategies for risk communication are provided later in this chapter.

### Maintain Surveillance

After successfully implementing control measures, monitoring for additional cases remains necessary. Outlier populations may continue to experience exposure to the offending agent and serve as additional opportunities to eliminate transmission. Surveillance remains a critical component of outbreak investigations long after the final cases are identified. By its most basic definition, an outbreak is the occurrence of disease at a rate that exceeds expected baseline values. Continued disease surveillance provides baseline values to determine if future occurrences constitute an outbreak.

## EMERGENCY PREPAREDNESS

Though emergency preparedness is ultimately the responsibility of the commander, all personnel must take an active ownership role in ensuring their unit remains prepared for an emergency. Medical departments play a critical role in developing, testing, and executing a commander's emergency preparedness plan. Comprehensive emergency planning is not restricted to active duty military forces; catastrophic events also affect service member families, host nation personnel, and displaced populations. Properly conducted emergency management includes identification of all potentially affected individuals in the area of operations, as well as coordination of planning and response efforts with local, county, state, or national stakeholder organizations. The complexity of such relationships dictates the frequency and scale of planning exercises that should be performed prior to a disaster. The importance of stakeholder rehearsal exercises for preserving life in disasters cannot be overstated. No substitute exists for drilling side-by-side with stakeholder partners to identify strengths and vulnerabilities of a potential unified disaster response.

### Preparation and Planning: "All Hazards" Approach

Successful emergency plans are scalable for any size of event and flexible enough to effectively address any variety of disaster. "All-hazards" disaster

planning is the most widely used approach because it is sufficiently scalable and flexible. The all-hazards approach identifies four phases of disaster management operations to simplify the planning process: mitigation, preparedness, response, and recovery.<sup>37</sup>

**Mitigation** actions create lasting risk reductions from hazardous events by reducing known or potential vulnerabilities. Examples of mitigation measures range from maintaining a medically ready and vaccinated force to prevent the spread of communicable disease, to ensuring a medical treatment facility's generators are housed in a location unlikely to be subjected to water damage from a flood or debris damage from an earthquake. Mitigation measures by their very nature build resilience into populations, communities, and the built environment to lessen potential damage from catastrophic events.

**Preparedness** involves establishing authorities and responsibilities for emergency actions and adequately maintaining the necessary assets to support such actions. During the preparedness phase of disaster response, support staff roles are clearly defined and assigned, physical supplies are procured and maintained, and contingency operations for day-to-day activities are developed and rehearsed. Critical but often neglected tasks during the preparedness phase include cross-training responders to perform the tasks of missing or injured team members and developing

alternative physical work spaces in the event a primary workspace is compromised.

The **medical response** to a disaster is frequently the most time-sensitive component of an emergency preparedness plan. Communication is critically important during the response phase of disaster management; MMOs should have direct communication to the disaster command and control team or the emergency operations center (EOC). Through the EOC, medical departments receive casualty information, request transportation and supplies, and provide command with information critical for tasking precious resources.

The **recovery** phase transitions a community back to normal daily functioning. Documentation and surveillance of unique exposures from the disaster, long-term care for the injured, and assessment of successful and unsuccessful actions performed during the disaster occur in the recovery phase. It is absolutely necessary to use the recovery phase to reflect on the actions and results of the emergency response. Recovery should be used to recognize and incorporate future mitigation measures and response improvements based upon the successes and challenges of the disaster response.

### **Military-Specific Emergency Management Resources**

Commanders and MMOs have a variety of assets available to assist with planning, executing, and managing disaster response and public health emergencies. Within the continental United States, every military installation commander has designated a public health emergency officer (PHEO) by name. PHEOs have specialized training and expertise to provide commanders and MMOs with guidance and recommendations on preparing for, declaring, responding to, mitigating, and recovering from public health emergencies. Installations outside the continental US have a PHEO at each geographic combatant command headquarters.

The military treatment facility emergency manager (MEM) is a uniformed or civilian employee with spe-

cialized training and expertise essential to medical emergency management. MEMs are responsible for executing all-hazards emergency management activities on behalf of the commander, serving as the facility's lead for military-civilian emergency management coordination as well as the primary point of contact to the installation emergency manager.<sup>38</sup> The MEM is the primary advocate for ensuring appropriate resource needs are identified to execute the mission of the medical department in an emergency.

VS personnel are a vital and sometimes overlooked asset in public health emergency planning, training, and response. VS provides subject matter expertise for DoD installations and military commands for food safety and security, certain associated laboratory diagnostics, biosecurity, wildlife management, and vector control. Additionally, VS provides field operations support services including prevention and eradication of zoonotic disease, identification of potentially affected animals, animal quarantine implementation, euthanasia, carcass disposal, cleaning and disinfection, and strategic vaccinations and treatments for animals.<sup>38</sup>

### **Training and Exercise Participation**

Training is essential for emergency response personnel to become familiar with their responsibilities, acquire the skills necessary to perform assigned tasks, and identify potential vulnerabilities of a response plan. The MEM, PHEO, and regional health departments are often repositories of excellent planning resources for MMOs tasked with developing a departmental or unit emergency response plan. Regional health departments routinely offer workshops and training courses to promote and develop coordinated regional emergency response planning. At the national level, the Federal Emergency Management Agency supports state training efforts through its Emergency Management Institute, offers a variety of free online courses, and publicly releases major publications relating to planning for specific functions and hazards.

## **RISK COMMUNICATION**

Communicating complex health information to lay persons is an essential skill for all MMOs. While most MMOs are comfortable providing discrete clinical counseling to individual patients, effective risk communication can be challenging due to multiple stakeholder involvement, presence of media, and the high-visibility nature of events requiring intervention. In many operational settings, junior MMOs are routinely relied upon as the subject matter expert for all issues

pertaining to unit health. The ability to effectively communicate complex health information factually, reliably, and empathetically has a significant impact on mission success.

Routine health promotion is an ideal opportunity for MMOs to develop risk communication skills. Whether combating tobacco use, low vaccination uptake, or high sexually transmitted infection incidence, the cognitive process employed to reach a vulnerable



audience remains the same. To change an unhealthy behavior, an audience must: (1) receive information, (2) understand the information, (3) understand the message applies to them, (4) understand they are at risk if they do not take protective action, (5) decide they need to act on information, (6) understand what actions need to be taken, and (7) be able to take action.<sup>39</sup> Effective risk communication increases the chance an audience will listen and adhere to sound recommendations (Exhibit 40-2).

### Principles of Health Risk Communication

The occurrence of an outbreak, disaster, or other event with the capacity to affect significant numbers of people creates an urgent demand for information among the population affected. Effective risk communication builds upon the health belief model, a framework for explaining and predicting health behaviors by directly addressing an audience's perception of susceptibility, severity, benefits of taking action, barriers to taking action, cues to action, and self-efficacy.<sup>40</sup> Risk messaging should be simple, credible, and consistent. Messages should be repeated often through multiple communication and media avenues and conveyed by a variety of credible sources (subject matter experts, commanders, elected officials, community leaders). The six key principles of risk communication provide a systematic approach to conveying factual information and increasing the likelihood of positively impacting the health of the public.<sup>41</sup>

#### *Be First*

Good risk communication occurs early and often. Technology has vastly expanded the availability and speed at which audiences can obtain information. MMOs should be prepared to communicate risk information quickly and often, or they can expect their target audience to receive information elsewhere. Identification and inclusion of all stakeholders when communicating is essential; groups left out of initial risk messaging may feel forgotten or purposefully ignored, resulting in a substantially greater amount of future efforts required in order to regain their trust.

#### *Be Right*

The content of a risk communication message must be factual and verifiable. Good risk communication openly acknowledges when data are uncertain or unknown. Speculation is strongly discouraged; messages instead should clearly state what is known and what steps are being taken to investigate current gaps in knowledge.

#### *Be Credible*

Honesty and integrity serve as the foundation on which a trusting relationship is built. Audiences accept limitations of knowledge but are wholly unforgiving of deception. Experienced risk communicators defer

## EXHIBIT 40-2

### RISK COMMUNICATION EXAMPLES

Even brief risk communication statements conveying factual information have the potential to convey unintended content. Consider the following responses to a hypothetical scenario in which two sailors have been hospitalized and diagnosed with Middle East respiratory syndrome coronavirus (MERS-CoV) while on overnight liberty in a foreign port.

**Example A.** *“Regretfully, arrival of MERS-CoV in your town was probably not preventable. We are evacuating our sailors from your hospital to prevent further exposures. We have cooperated with local health officials and provided them our sailors’ itineraries so exposed local nationals can be identified.”*

**Example B.** *“We are very sorry the community has been exposed to this virus; had there been any indication our sailors were sick we would not have granted liberty. We are working closely with local public health officials to identify those in the community who were exposed and limit further spread of this virus in the community.”*

Example A somewhat dismisses the importance of the event, conveys a sense the military will leave as quickly as possible, and strikes a somewhat defensive tone. While the factual content conveyed is the same, the message conveyed in example B expresses empathy, stresses the value of working together as partners, and reinforces the idea of community.

to subject matter experts to answer questions beyond their area of expertise, and in doing so, bolster their credibility as an honest communicator.

### ***Express Empathy***

A crisis generates physical as well as psychological harm. Openly acknowledging the suffering of those impacted and those who remain in potential danger builds trust and rapport. Expressing empathy engages an audience so they are more receptive to hear a message and provides an opportunity to communicate those common threads of humanity that bind communities together.

### ***Promote Action***

Effective risk communication empowers audiences with actionable knowledge. Providing easily implemented recommendations gives the public something to do, calms anxiety, and restores a sense of personal control. A message as simple as, “Avoid handshakes and use hand sanitizer frequently,” contains evidence-based, factual information that allows the public to be part of the solution.

### ***Show Respect***

Individuals within a community will demonstrate substantial variability in how they perceive the same risk. Some individuals will be deeply affected by a crisis and feel vulnerable and wronged. Showing respect through communicating in a way that acknowledges perceptions of vulnerability builds trust and promotes cooperation.

### ***Perception of Risk***

Perception of risk is highly subjective and intensely personal; however, certain characteristics of risk substantially influence how a particular threat is perceived by the public at large. Recognizing historical patterns in how individuals and communities assess risk can help planners anticipate the response expected from the public and aid in shaping a risk communication message.<sup>41</sup>

### ***Familiarity***

Populations exposed to a recurrent risk often become desensitized despite the continued threat posed from exposure. “Routine” risks are far more readily accepted than the exotic. While seasonal influenza is widely circulated among the public and is responsible

for thousands of deaths in the United States on an annual basis, many choose not to be immunized. In contrast, a single case of an exotic virus in a healthcare worker confined to isolation has the ability to evoke an incredible amount of public concern and demand for government intervention.

### ***Natural Versus Manmade***

Populations are generally far more tolerant of natural disasters than those resulting from human activities, even though the former are no less traumatic. Communities often accept the risk of living and building in disaster-prone geographic areas; however, mishaps resulting from an industrial process or failed product of engineering are widely viewed as entirely preventable.

### ***Distribution***

People generally are more accepting of a risk that is equally distributed among the population at large versus exposures disproportionately concentrated to a defined group or population. Concentrated risks can evoke feelings of inequality and injustice, particularly when such exposures result entirely from an anthropogenic process or involve already disadvantaged or vulnerable communities.

### ***Reputation***

Prior performance is the strongest predictor of future performance. Institutions that have built social capital with a populace have reputations affording substantially greater leeway in responding to a crisis in comparison to untrusted or frankly unpopular institutions. Disreputable institutions suffer an additional burden of past transgressions (perceived or genuine) when responding to a crisis.

### ***Adults Versus Children***

Communities worldwide are rightly protective of their children. Exposures or illnesses disproportionately concentrated in pediatric populations can evoke a particularly volatile reaction, necessitating a robust and empathetic response to preserve public trust.

### ***Avoiding Pitfalls***

Risk communication requires practice. Mistakes are often public, and recovery is difficult. The single greatest mistake an MMO can make in performing risk communication is attempting to accomplish the

task alone. Vetting risk communication messages through multiple stakeholders creates a much stronger product, protects against misinterpretation or misrepresentation of information, contributes to unity of effort in ensuring the right message is conveyed, and minimizes opportunities for public disagreement among leadership and subject matter experts. At an absolute minimum, DoD regulations mandate public statements to be cleared for release by the command public affairs officer (PAO). PAOs receive specialized training on communicating with the media and the public. They have a wealth of practical knowledge to assist in crafting and delivering a message that is effective and in accordance with the values represented by the armed forces.

The importance of selecting an appropriate spokesperson to deliver a risk communication message is equally important as the message itself. An expertly crafted message is irrecoverably compromised when delivered by a spokesperson of dubious credentials or questionable character, or who lacks empathy

or expresses inappropriate humor. The selection of stakeholder and subject matter expert partners also sways public opinion; many communities will form an initial assessment of the competence of a crisis response based on who they see sitting next to the risk communication spokesperson before a single word of a message is delivered.<sup>41</sup>

While the psychological damage of an event or exposure may not manifest as readily as physical destruction, emotional trauma significantly influences an audience's receptiveness to information, and outrage should not be dismissed. For this reason specifically, humor has no place in risk communication because its use is nearly always interpreted as callousness and disrespect.<sup>41</sup> Lastly, overtly expressing desired outcomes is acceptable; however, promises should be confined to areas within absolute control.<sup>39</sup> A promise to "ensure no further spread of the disease" is likely impossible; instead, assurances such as "the team will work nonstop to slow further spread of this disease" are reasonably accomplishable.

## SUMMARY

Countless examples are found throughout history when communicable disease profoundly influenced the effectiveness of military forces. Maintaining the health and readiness of service members by preventing illnesses common in the deployed environment is critical for preserving force strength and accomplishing the mission. Medical staff must be able to

recognize public health threats and be prepared to implement meaningful control measures. Additionally, medical staff must be prepared to respond to public health emergencies by effectively communicating disease risk and mitigation strategies to all stakeholders, from the command staff to individual service members.

## REFERENCES

1. Centers for Disease Control and Prevention. Ten great public health achievements—United States, 1900–1999. <https://www.cdc.gov/mmwr/preview/mmwrhtml/00056796.htm>. Published 1999. Accessed June 6, 2018.
2. UNICEF. Vaccines bring 7 diseases under control. <http://www.unicef.org/pon96/hevaccin.htm>. Accessed April 13, 2015.
3. Centers for Disease Control and Prevention. History and epidemiology of global smallpox eradication. <https://stacks.cdc.gov/view/cdc/27929>. Published 2014. Accessed June 6, 2018.
4. Defense Health Agency Immunization Healthcare Branch. Vaccine recommendations by AOR. <https://health.mil/Military-Health-Topics/Health-Readiness/Immunization-Healthcare/Vaccine-Recommendations/Vaccine-Recommendations-by-AOR>. Published 2018. Accessed June 6, 2018.
5. Departments of the Army, Navy, Air Force, and Coast Guard. *Immunizations and Chemoprophylaxis for the Prevention of Infectious Diseases*. Washington, DC: DoD; October 7, 2013. Army Regulation 40–562, BUMEDINST 6230.15B, AFI 48–110\_IP, CG COMDTINST M6230.4G.
6. Magill AJ. For the record: a history of malaria chemoprophylaxis. In: Brunette GW, Kozarsky PE, Cohen NJ, et al, eds. *CDC Health Information for International Travel 2014*. New York, NY: Oxford University Press; 2014.

7. Whitman TJ, Coyne PE, Magill AJ, et al. An outbreak of *Plasmodium falciparum* malaria in U.S. Marines deployed to Liberia. *Am J Trop Med Hyg.* 2010;83(2):258–265. doi:10.4269/ajtmh.2010.09-0774.
8. Pellerin C. DOD mefloquine policy mirrors FDA Update on malaria drug. <http://archive.defense.gov/news/newsarticle.aspx?id=120857>. Published September 26, 2013. Accessed May 30, 2018.
9. Brisson M, Brisson P. Compliance with antimalaria chemoprophylaxis in a combat zone. *Am J Trop Med Hyg.* 2012;86(4):587–590.
10. Takafuji ET, Kirkpatrick JW, Miller RN, et al. An efficacy trial of doxycycline chemoprophylaxis against leptospirosis. *N Engl J Med.* 1984;310(8):497–500.
11. Brett-Major DM, Lipnick RJ. Antibiotic prophylaxis for leptospirosis. *Cochrane Database Syst Rev.* 2009;(3):CD007342.
12. Aldous WK, Robertson JL, Robinson BJ, et al. Rates of gonorrhea and chlamydia in U.S. military personnel deployed to Iraq and Afghanistan (2004–2009). *Mil Med.* 2011;176(6):705–710.
13. Garges E, Holmes K, MacDonald M. Emerging issues in sexually transmitted diseases: focus on the treatment of STDs in military populations. Webinar presented March 27, 2013. <http://www.cdc.gov/std/treatment/2010/military-webinar-slides.pdf>. Published 2013. Accessed April 13, 2015.
14. Christopher LA, Miller L. Women in war: operational issues of menstruation and unintended pregnancy. *Mil Med.* 2007;172(1):9–16.
15. Colthirst PM, Berg RG, DeNicolò P, Simecek JW. Operational cost analysis of dental emergencies for deployed U.S. Army personnel during Operation Iraqi Freedom. *Mil Med.* 2013;178(4):427–431. doi:10.7205/MILMED-D-12-00431.
16. Wojcik BE, Szeszel-Fedorowicz W, Humphrey RJ, et al. Risk of dental disease non-battle injuries and severity of dental disease in deployed U.S. Army personnel. *Mil Med.* 2015;180(5):570–577. doi:10.7205/MILMED-D-14-00364.
17. Mahoney GD, Coombs M. A literature review of dental casualty rates. *Mil Med.* 2000;165(10):751–756. <http://www.ncbi.nlm.nih.gov/pubmed/11050872>. Accessed April 24, 2015.
18. Githeko AK, Lindsay SW, Confalonieri UE, Patz JA. Climate change and vector-borne diseases: a regional analysis. *Bull World Health Organ.* 2000;78(9):1136–1147. doi:10.1590/S0042-96862000000900009.
19. Armed Forces Pest Management Board. *Personal Protective Measures Against Insects and Other Arthropods of Military Significance*. Silver Spring, MD: AFPMB; 2015. Technical Guide No. 36. <https://www.acq.osd.mil/eie/afpmb/docs/techguides/tg36.pdf>. Accessed June 6, 2018.
20. Nasci RS, Wirtz RA, Brogdon WG. Protection against mosquitoes, ticks, & other arthropods. In: *CDC Health Information for International Travel 2016*. New York, NY: Oxford University Press; 2016.
21. Scheinfeld N. Picaridin: a new insect repellent. *J Drugs Dermatol.* 2013;3(1):59–60. <http://www.ncbi.nlm.nih.gov/pubmed/16040419>.
22. Imported human rabies in a U.S. Army soldier—New York, 2011. *MMWR Morb Mortal Wkly Rep.* 2012;61(17):302–305. <http://www.ncbi.nlm.nih.gov/pubmed/22552206>. Accessed April 13, 2015.
23. Webber BJ, Ayers KJ, Winterton BS, et al. Assessment of rabies exposure risk in a group of U.S. Air Force basic trainees—Texas, January 2014. *MMWR Morb Mortal Wkly Rep.* 2014;63(34):749–752. <http://www.ncbi.nlm.nih.gov/pubmed/25166925>. Accessed April 13, 2015.
24. Woodson J. *Human Rabies Prevention During and After Deployment*. Washington, DC: Assistant Secretary of Defense for Health Affairs; November 14, 2011.
25. Centers for Disease Control and Prevention. Rabies, preexposure vaccinations. [http://www.cdc.gov/rabies/specific\\_groups/travelers/pre-exposure\\_vaccinations.html](http://www.cdc.gov/rabies/specific_groups/travelers/pre-exposure_vaccinations.html). Published April 22, 2011. Accessed April 13, 2015.

26. Rupprecht CE, Briggs D, Brown CM, et al. Use of a reduced (4-dose) vaccine schedule for postexposure prophylaxis to prevent human rabies: recommendations of the advisory committee on immunization practices. *MMWR Recomm Rep.* 2010;59(RR-2):1–9. <http://www.ncbi.nlm.nih.gov/pubmed/20300058>. Accessed April 13, 2015.
27. Departments of the Army, Navy, and Air Force. *Sanitary Control and Surveillance of Field Water Supplies*. Washington, DC: DA; 2010. TB Med 577.
28. US Army Public Health Center. Worldwide directory of sanitarily approved food establishments for armed forces procurement. <http://phc.amedd.army.mil/topics/foodwater/ca/Pages/DoDAApprovedFoodSources.aspx>. Updated March 15, 2018. Accessed May 30, 2018.
29. Department of the Army. *Tri-Service Food Code*. Washington, DC: HQDA; April 30, 2014. TB MED 530, NAVMED P-5010-1, AFMAN 48-147 IP. <http://www.med.navy.mil/directives/Pub/5010-1.pdf>. Accessed May 20, 2015.
30. Navy Bureau of Medicine and Surgery. Preventive medicine for ground forces. In: *Manual of Preventive Medicine*. Washington, DC; BUMED; 1991: Chap 9. NAVMED P-5010-9. <http://www.med.navy.mil/directives/Pub/5010-9.pdf>. Accessed May 20, 2015.
31. US Central Command. *CENTCOM Contingency Environmental Guidance*. Macdill Air Force Base, FL: CENTCOM; 2012. Regulation 200-2. [https://www.cemml.colostate.edu/cultural/09476/pdf/CENTCOM\\_ITTR\\_CCR\\_200-2-1.pdf](https://www.cemml.colostate.edu/cultural/09476/pdf/CENTCOM_ITTR_CCR_200-2-1.pdf). Accessed June 6, 2018.
32. World Health Organization. Public health surveillance. [http://www.who.int/topics/public\\_health\\_surveillance/en/](http://www.who.int/topics/public_health_surveillance/en/). Updated 2018. Accessed May 30, 2018.
33. Navy Bureau of Medicine and Surgery. *Medical Surveillance and Medical Event Reporting*. Washington, DC: BUMED; September 27, 2011. BUMED Instruction 6220.12C. <http://www.med.navy.mil/directives/ExternalDirectives/6220.12C.pdf>. Accessed May 20, 2015.
34. Department of the Air Force. *Surveillance, Prevention, and Control of Diseases and Conditions of Public Health or Military Significance*. Washington, DC: DAF; July 15, 2014. Air Force Instruction 48-105.
35. Department of the Army. *Preventive Medicine*. Army Regulation 40-5. Washington, DC: DA; May 25, 2007. Army Regulation 40-5.
36. Armed Forces Health Surveillance Center. *Armed Forces Reportable Medical Events Guidelines and Case Definitions*. Washington, DC: DHA; 2017. <https://www.health.mil/Military-Health-Topics/Health-Readiness/Armed-Forces-Health-Surveillance-Branch/Reports-and-Publications>. Accessed June 6, 2018.
37. Federal Emergency Management Agency. *Guide for All-Hazard Emergency Operations Planning*. Washington, DC: FEMA; 1996: 1-96.
38. Department of Defense. *Public Health Emergency Management within the Department of Defense*. Washington, DC: DoD; October 2, 2013. DoD Instruction 6200.03.
39. Glik DC. Risk Communication for public health emergencies. *Annu Rev Public Health.* 2007;28:33–54.
40. Janz NK, Champion VL, Stretcher VJ. The health belief model. In: Glanz K, Rimer BK, Lewis FM, eds. *Health Behavior and Health Education: Theory, Research, and Practice*. 3rd ed. San Francisco, CA: Jossey-Bass; 2002: 45–66.
41. Reynolds B, Seeger M. *Crisis and Emergency Risk Communication*. 2nd ed. In: Cox J, Gaines-McCollom M, Grimsley N, et al, eds. Atlanta, GA: Centers for Disease Control and Prevention; 2014. [https://emergency.cdc.gov/cerc/resources/pdf/cerc\\_2014edition.pdf](https://emergency.cdc.gov/cerc/resources/pdf/cerc_2014edition.pdf). Accessed April 17, 2015.

