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Chapter 45: Responder Safety and Health

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INTRODUCTION

An increasing number and variety of workers are being called upon to respond to disasters. In 2017 alone, 16 severe weather incidents in the United States, ranging from wildfires to hurricanes, caused more than $1 billion worth of damage. Disasters are unpredictable and can be human-induced (such as a chemical spill or radiation incident) or naturally occurring (such as a flood or an emerging infectious disease outbreak)—any of which, if severe enough, can become a public health crisis.

Like the disasters that prompt them, responses can vary from large and complex to smaller-scale efforts that do not make the news. Disaster response and recovery work require a variety of workers from first responder groups such as law enforcement, firefighters, and emergency medical services to nontraditional responders such as utility workers, construction workers, other skilled support workers, relief workers, and volunteers. Ensuring the safety and health of this diverse group of responders is a vital part of any response.

Examples of workers who commonly respond to disasters

- Traditional first responders
  - Law enforcement
  - Fire services
  - Emergency medical services
- Utility workers (such as electrical power line workers)
- Construction workers and other skilled support
- Debris removal teams
- Healthcare personnel
- Public health personnel
- Mental health teams
- Shelter workers
- Disaster relief workers
- Volunteers

After the terrorist attacks on September 11, 2001, US federal planners recognized the need for a nationwide incident management system, which led to the development of the National Incident Management System (NIMS). NIMS provides a whole-community approach for federal, state, local, tribal, and territorial government agencies as well as private sector and nongovernmental organizations to work together in planning for, responding to, and

recovering from incidents.

The Incident Command System (ICS) is a component of NIMS that grew from concepts used in the United States Forest Service in the 1970s to improve interoperability with other agencies when managing wildfire incidents. This work led to the development of ICS, a system that involves a standard approach to the command, control, and coordination of on-scene incident management. Within ICS, response assets are organized in five functional areas: command, operations, finance/administration, logistics, and planning (Figure 45–1).

Figure 45–1.

Basic Incident Command System (ICS) structure.

A flow chart of the Incident Command System.

An Incident Commander is designated and has overall incident management authority. For small, relatively straightforward responses, Incident Commanders may retain responsibility for responder safety throughout the response, but for more complex responses they may delegate this authority to a Safety Officer. The Safety Officer ensures personnel safety, monitors hazardous and unsafe situations, and prepares a site-specific safety and health plan. Online ICS training is available on the Federal Emergency Management Agency (FEMA) Training website.

Responders work in potentially hazardous environments and can face a multitude of known and novel exposures and safety hazards through the course of their work, which might result in adverse health effects. Not all hazards present in a disaster will be immediately identified at the beginning of response operations, and the hazards can change over time as work requirements progress. Table 45–1 lists common hazards by various disaster types.

Table 45–1.

Select disaster types and their potential hazards.

	Type of Disaster[a]					
Potential Hazard[a,b]	Hurricane	Earthquake	Wildfire	Infectious Disease Outbreak	Chemical Spill	Dirty Bomb
Smoke inhalation		x	x			x
Chemical inhalation	x	x	x		x	x
Chemical dermal exposures	x	x			x	x
Carbon monoxide	x	x	x			
Bloodborne pathogens				x		x
Disease transmission	x	x	x	x		
Needlesticks	x	x		x		
Mold	x					
Radiation exposures						x
Cold stress[c]		x			x	x
Heat stress[c]	x	x	x		x	x
Noise	x	x	x			
Dangerous driving conditions	x	x	x		x	x
Safety hazards associated with debris removal	x	x	x			x
Unstable structures	x	x	x		x	x
Energized power lines/cables	x	x	x			x
Slips/trips/falls	x	x	x		x	x
Insect bites	x		x			
Stray/wild animals	x	x	x			
Stressful work conditions	x	x	x	x	x	x
Long work hours	x	x	x	x	x	x
Social unrest	x	x		x		x

[a]These lists are not exhaustive. The hazards are those most commonly seen with the listed disasters.

[b]The majority of these hazards are covered in more detail elsewhere in this book.

[c]Cold and heat stress are not results of a disaster but most often are related to the outdoor temperature where the disaster occurs. An exception would be heat stress caused by the burden of working in PPE, even in moderate temperatures.

Occupational safety and health (OSH) professionals (such as Safety Officers) or other designated personnel identify OSH hazards and select protective measures based on the known hazards and other OSH-related information available at the time. As more information becomes available and additional OSH hazards are identified, these recommendations can change. The use of personal protective equipment (PPE), such as respiratory protection and gloves, is the least desirable measure within the hierarchy of controls to protect responders (Figure 45–2). However, PPE is typically the most commonly used protective measure for responders, because engineering or administrative controls are often not feasible in these settings.

Figure 45–2.

Hierarchy of controls.

An inverted pyramid represents the hierarchy of controls to protect responders.

In addition to the risks of direct exposure to chemical, biological, or radiological hazards, responders can encounter dangers posed by many other hazards or stressors, including structurally unstable physical environments, austere conditions, long or irregular work shifts, the physical burden of working in PPE, social conflict or unrest, inclement weather, and extremes in temperature, humidity, and altitude. Psychological stressors are also recognized as a risk to responder health. These stressors include role ambiguity, fear of the unknown, and sleep deprivation, as well as psychological trauma arising from events witnessed during a response and the impact of direct loss for local responders. Even after the immediate response activities end, responders continue to face hazardous conditions as they undertake recovery efforts. Therefore, it is important for attending physicians who are treating responders and community members impacted by a disaster to recognize the many potential health hazards these groups might encounter.

Unfortunately, little is known about responder short-term and long-term health effects associated with potential exposures during emergency response and recovery activities. After the terrorist attacks on September 11, 2001, when over 450 responders died and hundreds more were seriously injured, the World Trade Center Health Registry—one of the few, but most in-depth sources of information and support for postdisaster research studies—was created. At this time, the United States began to focus greater attention on how to protect responders before, during, and after disasters.

The National Institute for Occupational Safety and Health (NIOSH) led an interagency work group to develop the Emergency Responder Health Monitoring and Surveillance™ (ERHMS™) framework. The goal is to address the safety and health of responders across all phases of a response: predeployment, deployment, and postdeployment (Figure 45–3). The ERHMS framework, adopted by the National Response Team as a Technical Assistance Document, contains guidelines and recommendations applicable across a range of disaster types, settings, and sizes to address all aspects of protecting responders. The best way to incorporate the ERHMS framework into the ICS structure during a response is to create an ERHMS Unit. The ERHMS Unit, ideally under the purview of the Safety Officer, would comprise a group of medical and public health professionals (such as epidemiologists) who could carry out or direct responder health monitoring and surveillance for the response. The ERHMS framework and its principles will be described in this chapter.

Figure 45–3.

Three phases of disaster response and associated ERHMS activities.

An illustration depicts the three phases, with guidelines and recommendations, for disaster response.

PRE-DEPLOYMENT

Predeployment is the first phase of a response in the ERHMS framework. This phase occurs before anyone is deployed to any type of disaster. During predeployment, responders and organizations prepare for a successful response and establish the foundation for health monitoring and surveillance of responders. The predeployment phase consists of four key activities: (1) rostering and credentialing, (2) health screening, (3) safety and health

training, and (4) data management (Table 45–2).

Table 45–2.

ERHMS activities and outcomes for the three phases of disaster response.

Predeployment Phase	
Activity	**Outcome**
Rostering and credentialing	• Organization has list of qualified responders
Health screening	• Responders are physically and behaviorally fit for duty
Safety and health training	• Responders are properly trained to decrease illness and injury
Data management and security	• Data are confidential and secure

Deployment Phase	
Activity	**Outcome**
On-site responder in-processing	• Incident command has list of participating responders • Responders are identifiable by their badging • Responders receive site-specific training and personal protective equipment
Health monitoring and surveillance	• Individual responder health is monitored, if necessary • Responder population data are systematically collected and analyzed to assess trends in injury and illness
Exposure assessment, activities, and controls	• Records are created of responder exposures, tasks performed, and controls implemented for responder safety
Communication of exposure and health data	• Open lines of communication are maintained between ICS command, federal/state/local/tribal/territorial authorities, responders, media, and public

Postdeployment Phase	
Activity	**Outcome**
Responder out-processing	• Incident command has list of responders who have demobilized • Self-reported responder health and exposures are documented • Medical or behavioral health referrals are made, if necessary • Information about incident-related illnesses, injuries, and exposures is shared with responder • Short- or long-term health tracking is initiated, if necessary
Determining the need for long-term tracking	• Responders in need of long-term health tracking are identified • Type of long-term tracking is chosen

After-action review	• Successes, gaps, and lessons learned are documented and available to be applied to ERHMS activities during subsequent incidents

The purpose of conducting rostering and credentialing is to ensure all responders are properly tracked and have the appropriate training and experience to effectively accomplish the response mission. A roster should include several types of information, such as demographics (eg, age and sex), occupation, training, credentials, and licenses for each individual; it also may include background check information. Information can be self-reported or collected by authorized individuals within an organization (such as human resources personnel). This information can be collected on paper forms or electronic devices (such as tablets). Most organizations will use their own data collection systems; however, to prepare for a response involving multiple agencies, all parties involved should consider coordinating their data collection ahead of time so the information collected is in a compatible format across organizations. The ERHMS framework recommends that organizations review and update roster information for each responder on an annual basis and always verify its completeness prior to any deployment.

A health screening of all responders during the pre-deployment phase detects and documents conditions that might negatively affect responders, including physical and behavioral health, during their response work. These health screenings are important because they ensure responders are physically and mentally fit for the job they are expected to fill during an incident. The ERHMS framework recommends that both baseline and annual health screenings be conducted by a licensed medical professional and that predeployment health screenings be conducted immediately before a deployment.

Baseline and annual health screenings are generally more complete than predeployment screenings, which can be focused for a specific incident or concentrate on recent changes from a baseline or annual health screening. Here are examples of information that should be gathered during a predeployment health screening:

- Preexisting physical, medical, and behavioral conditions

- Allergies

- Prior toxic and traumatic exposures

- Medications

- Immunizations

- Functional or access needs, such as wheelchairs and hearing aids

At the beginning of health screening, physicians should obtain information about the responder's anticipated deployment activities, deployment setting (eg, office or field assignment), weather conditions (such as extremely hot or cold temperatures), and any other characteristics of the deployment environment that might put the responder in harm's way or cause adverse health effects. Additional medical screening can be required if a responder will be working in an area with contaminated floodwaters, infectious disease vectors, hazardous materials, or radiation; will be required to wear a respirator; or has a chronic illness or recent injury. Fitness for deployment should be determined on the basis of the most strenuous anticipated activities. Additional factors to consider include the following:

- Type of medication a responder is already taking or might need specifically for the deployment

- Sufficient supplies of medications to last throughout deployment

- Need for electricity to operate medical devices (such as a continuous positive airway pressure machine) or for refrigeration of medication

- Appropriate vaccinations required to travel to a particular location or enter a worksite

Ideally, the organization to which each responder belongs will also keep historic, incident-specific exposure, injury, and illness data for those responders. Maintaining accurate records allows tracking of repeated exposures over multiple disaster responses and facilitates monitoring of long-

term health issues or surveillance for the delayed onset of illnesses within the organization's responder population. More information on monitoring and surveillance is found in the Deployment section. Organizations should document health screening information on paper or electronically in an employee's record (eg, a medical record or health questionnaire) and update it annually or as conditions change.

Why health screening is necessary during the predeployment phase of a response

In April 2010, an explosion on the Deepwater Horizon oil rig led to the largest oil spill in US history, requiring tens of thousands of workers to support response and clean-up efforts. In reaction to concerns that exposure to the spilled crude oil or the chemical dispersants was making cleanup workers ill, British Petroleum (BP) requested that NIOSH conduct an evaluation of the responders' infirmary visit records as part of their worker health surveillance program. Review of these records by NIOSH revealed a majority of these admissions were for heat-related illnesses, medical conditions exacerbated by working in a hot and humid environment, or both. Further review of patient and contracting-employer records showed that (1) workers were not screened in the predeployment phase for medical conditions that would increase their risk for heat-related illness, (2) no acclimatization program for workers brought in from cooler geographic regions was in place, and (3) no heat stress management policies were in place at the worksites. As a result of NIOSH's findings, BP required all contracting employers to implement these important activities. A NIOSH follow-up assessment showed the efficacy of these recommendations, as cleanup worker hospitalizations dropped off sharply. For more information on the NIOSH evaluation, see Gibbins et al. (2010).

Safety and health training is important to ensure responders learn how to properly conduct the job tasks they will be expected to perform during a response and how to prevent injuries and illnesses. Some responders, such as law enforcement officers and firefighters, will already have specific training or certifications that are required to perform their duties during an incident. However, many new responders will not begin their career already equipped with the necessary knowledge, experience, and training for the roles and responsibilities they will be asked to perform.

Safety and health training is the responsibility of the response organization. These trainings should include fundamental topics such as preparing for disasters, understanding ICS, recognizing hazards, and practicing self-care. Training topics will also depend on specific duties and may include site operations, hazard communication, PPE, management of responder exposures, and decontamination. Conducting safety and health training not only ensures responders have the appropriate skill set but also allows managers to track which responders are trained, monitor training effectiveness by assessing illness and injury rates, and determine what training will be beneficial for future responses. Safety and health training can be conducted online or in the classroom and should be documented by the response organization at least annually.

To track the safety and health of responders, personally identifiable information (PII) will need to be collected. PII is data that can be used to determine an individual's identity, either alone or when combined with other personal or identifying information. It is critical to secure and properly maintain this information. Specifically, PII should be collected only under these circumstances:

- It can remain confidential, accurate, and complete.

- It is made available only to authorized personnel.

- It is standardized so it can be shared securely with partner response organizations when needed.

An organization should follow its internal rules and the laws of the country in which it resides to safeguard PII properly. Methods of protecting PII include limiting data collection to only the data absolutely necessary for organizational operations, deidentifying data as soon as possible (ie, removing PII), and using role-based permissions for access to data (ie, only properly trained personnel in authorized roles can access certain data).

The details of how to implement a data management system during a response and the required security components need to be established in the predeployment phase, prior to an incident. This will ensure PII and critical health data can be securely and confidentially collected during all three phases of a response and analyzed to determine if responders have developed acute, delayed, or long-term adverse health effects.

One example of an electronic data system that can be used to store data in all three phases of ERHMS is ERHMS Info Manager™ (Figure 45–4). NIOSH developed this no-cost, custom-built software as an option for emergency response organizations to use in implementing the ERHMS framework. ERHMS Info Manager uses Epi Info™, data collection and analysis software developed by the Centers for Disease Control and Prevention (CDC), to construct data collection tools, make calculations, and conduct analyses. ERHMS Info Manager allows users to manage responder readiness by

collecting information on rostering, training, and medical screening. This information improves organizations' preparedness prior to a disaster and enables them to make decisions by analyzing exposure data collected during a response. NIOSH has also developed a user guide and training videos to accompany the software and has collaborated with Epi Info to ensure technical support is available to all users at no cost.

Figure 45–4.

ERHMS Info Manager start screen.

The start screen of the E R H M S Info Manager.

ERHMS Info Manager is for use by anyone involved in the deployment and protection of responders, such as incident management leadership and health, safety, and medical professionals. Data are collected on the users' computers and servers and are not collected by or available to CDC.

Response organizations can also use other customizable data collection tools (such as Microsoft Excel®, Microsoft Access®, or organization-specific platforms) to store this information, as long as a data management and security plan is in place.

DEPLOYMENT

Deployment is the second phase of a response in the ERHMS framework. This phase encompasses responders' safety and health while they are actively participating in an incident response. The deployment phase consists of these key activities: (1) On-site responder in-processing; (2) Responder health monitoring and surveillance; (3) Exposure assessment, activities, and controls; and (4) Communication of health and exposure data (Table 45–2).

The goal of on-site responder in-processing is to ensure there is an accurate account of all responders who are working on-site in response to a disaster. Although a roster of an organization's response personnel is created during the pre-deployment phase, the responders who arrive on location may represent a subset of the entire predeployment roster. Additionally, responders from multiple organizations can deploy, as well as volunteers wanting to provide response support. Therefore, the first step in the deployment phase is to create an on-site responder roster to track the personnel who are deployed for the incident and to confirm that they were qualified to be dispatched. Ideally, each responder selected to participate in the response during predeployment was chosen to fulfill a specific role or to use their expertise to complete various tasks. The Logistics Section within the ICS structure typically checks in the arriving responders. Its staff should work with the Safety Officer and the supporting ERHMS Unit to make sure the on-site roster contains the following information for each responder:

- Anticipated role

- Education and training history

- Relevant physical or behavioral history and limitations

- Certifications (such as confined space entry or hazardous materials)

- Respirator fit testing results (if required)

- Site-specific training received

- PPE received

Additional information may be included in the on-site roster, as determined by the implementing organization. The on-site responder roster creates a repository of information from which Command Staff and the appropriate General Staff can be formally notified that additional personnel with specific training, skill sets, and subject matter expertise are now available to fulfill the roles and tasks that initially justified their selection. Policies and procedures regarding access, security, storage, and entry of new information into these deployment personnel files should have been addressed during the predeployment phase.

Once on-site responders are rostered, the second step is to issue them response ID badges. Badging provides a method to clearly identify a responder's role on-site. For small, local incidents, a badge might include only basic information, such as the responder's name and organization. More advanced badging systems are useful for complex, highly hazardous, or larger responses with hundreds or thousands of responders who might be needed for a prolonged period. These more advanced systems can more easily maintain accountability of responder movement and tasks during

the response and ensure that only individuals who have the required training and security access are allowed into certain locations.

Regardless of the method, badging serves as a basis for vital deployment functions such as these:

- Tracking responder access on-site

- Rapid accounting of responders in case of emergency

- Managing responder PPE distribution

- Alerting staff about approaching PPE change-out requirements

- Tracking staff training

ID badges can be used to limit access to an area with a newly identified exposure or safety hazard until a responder's supervisor within the chain of command has received documentation that necessary training was completed and that any additional PPE necessitated by the nature of the newly identified hazard has been issued. Additionally, unique responder identification can assist in tracking completion of hazard-specific medical preexposure testing or enrollment in ongoing medical monitoring indicated by a responder's risk of exposure to the new hazard.

Site-specific training is the third step in responder in-processing. This training occurs once the responder arrives at the incident location and is often referred to as "just-in-time" or "toolbox" training. The responders receive a general response orientation on site-specific rules, logistics, and emergency procedures, in addition to hazard-specific training they might not have had the chance to receive in the pre-deployment phase. New or unique hazards identified during the course of an incident response also should be included in this training. Then, completion of the new hazards training and receipt of appropriate PPE before working in or around the new hazards should be documented in the responders' deployment personnel files.

On-site responder in-processing also could include information on the demobilization process, so responders are aware of the documentation they must submit prior to leaving the response and understand how all the information collected about them during the response will be protected and stored once the incident response is completed.

Responder health monitoring, surveillance, and exposure assessment are done concurrently during the deployment phase. Just as the Incident Command Staff use an iterative assessment and planning process to make adjustments in personnel and resource management as the response unfolds, repeated assessments of workers and their potential exposures are also needed. This process will identify which responders might benefit from targeted medical monitoring during their participation in a response.

Medical monitoring is the ongoing systematic assessment of an individual responder's health as it relates to actual or potential hazardous exposures (such as lead, carbon monoxide, or heat). Monitoring involves medical evaluation of the responder for signs and symptoms that could result from the hazardous exposures of interest and biological testing (when applicable). The decision to include a responder in a medical monitoring program is based on their roles, activities, and documented exposures that occurred during the response. An occupational health practitioner (such as a physician, nurse practitioner, or registered nurse) with knowledge and experience in health monitoring should perform or supervise this task. For example, if a responder is deployed to work in an environment containing pulmonary irritants or sensitizers, on-site medical staff may perform periodic monitoring of their respiratory health, including asking questions about asthma-like symptoms, conducting a physical examination with lung auscultation to listen for wheezing, or performing a pulmonary function test (PFT) to look for evidence of an obstructive pattern that is characteristic of bronchoconstriction or asthma. Ideally, the responder's home organization would have record of predeployment PFTs and biological testing to serve as a baseline for interpretation of mid- or postdeployment results.

As an incident evolves, the following data should be entered into the responder's deployment personnel records:

- Medical monitoring results

- Other medical examination and test results

- Exposures to on-site hazards

- Personal and environmental sampling results verifying on-site exposures

- Documentation of adverse health effects or traumatic injuries occurring during the response

These records should also be updated whenever new hazards are found in responders' work areas during deployment. Updates for new hazards should include the following information: environmental area sampling results that identified new hazards, additional site-specific training and PPE requirements, and documentation that the necessary responders completed the additional training and received the appropriate PPE.

When a responder is demobilized, the responsible entity within the ICS structure should provide a copy of the responder's deployment personnel file to the responder and his or her organization if requested. Responders should share these records with their healthcare providers if delayed-onset symptoms occur that could be related to exposures documented during their participation in the response. Results of medical monitoring of responders, along with their associated environmental exposure data, may also lead to their postdeployment medical monitoring. This is especially true if they had documented exposure to a substance known to have a long latency period.

Responder health surveillance is the ongoing systematic collection, analysis, interpretation, and dissemination of the responder population's illness and injury data during the deployment phase to provide objective information on which to base future OSH actions involving an incident's responders. Responder health surveillance can be either active or passive. Active surveillance involves deliberate, regular outreach to collect exposure- or illness-specific information, test results, or other healthcare encounter data. Passive surveillance relies on responders or healthcare practitioners to initiate the submission of data regarding health effects believed to be related to a responder's participation in the response.

Surveillance data sources and variables are chosen to capture information about the physical and behavioral illnesses and injuries experienced by the responder population. Response-related sources to consider include response-related records (eg, administrative injury and illness records, such as Occupational Safety and Health Administration logs) and response-run first aid stations, medical stations, and clinics. Local area clinics, urgent cares, emergency departments, and hospitals should also be considered. Additionally, periodic surveys of responders can generate data for surveillance. The variables collected include demographics (such as age, sex, and race/ethnicity), signs and symptoms, diagnostic codes, laboratory results, weather conditions, environmental sampling results, level of training, PPE used, and location, duration, and type of work. This information can be collected on paper forms, on handheld electronic devices (such as tablets), or via electronic system transfers of data (such as electronic medical records). Electronic devices and electronic systems can automatically download data into a database for processing. This capability provides the benefit of bypassing manual data entry, saving time, and reducing errors. The challenges to using electronic devices and systems can include their cost, technical complexity, and need for an adequate power supply to function.

Implementation of responder surveys

In 2016, during the Hurricane Matthew response, the Georgia Department of Public Health (GA DPH) used the ERHMS framework and a web-based survey tool to quickly develop a novel responder health monitoring system called Responder Safety, Tracking, and Resilience (R-STaR). This enabled daily health checks (ie, the collection of self-reported information regarding duties, exposures, illnesses, and injuries) on 128 deployed GA DPH responders. This activity allowed GA DPH to identify and follow up on seven reported illnesses or injuries. The use of R-STaR was so successful that GA DPH also used it during Hurricane Irma, where they identified 48 illnesses, injuries, or exposures among the 472 daily health checks received. GA DPH continues to build upon and use R-STaR during all three phases of responses. For more information on GA DPH's implementation of R-STaR, see Grippo et al. (2018).

Scenario: Identifying a trend in responder health using medical visit data

The ongoing systematic review of response first aid station records for predetermined symptoms of concern by the ERHMS Unit indicates an increase in station visits for headache and nausea but no fever or upper respiratory infection symptoms in a group of responders working in the same location operating forklifts to transfer supplies. Rapid follow-up by response medical staff reveals the responders have elevated carboxyhemoglobin levels and/or sudden resolution of symptoms upon leaving the enclosed work area as the first indication that carbon monoxide (CO) from vehicle exhaust is reaching dangerous levels at the worksite. The healthcare provider arranges for further medical evaluation and treatment of the responders, and the Safety Officer suspends activities in the area where the affected responders worked. After the suspension of activities, an assessment of CO levels and ventilation in that work area would be conducted to find the cause of elevated CO levels in the environment and steps would be taken to mitigate the issue. The Safety Officer could then provide refresher "on the spot" training to responders working in the affected area and similar locations on the risks of CO exposure when operating gasoline-powered equipment in enclosed areas without adequate ventilation.

These surveillance data are collected to assess the responder population at regular intervals (usually hours to days) and are analyzed for unusual or unexpected patterns or trends in response-related illnesses and injuries. The empirical data are used to make evidence-based decisions regarding responder occupational safety and health, to assess the effectiveness of interventions, and to inform postdeployment decision-making. This information can also be used to keep the responders, leadership, and public informed about how the response is affecting the safety and health of responders.

Even a small incident can necessitate the handling of tremendous amounts of PII for participating responders. At each step of data collection, analysis, interpretation, and storage, procedures should be in place to provide confidentiality and protect PII during the deployment phase of the response. A data security plan should define which response personnel have access to responders' PII and which personnel can enter PII into the responders' files (eg, a report of an injury incurred while working on the response, recommended follow-up care for a specific injury, or a responder's need to be discharged from the response due to behavioral health concerns). Additionally, it should be decided what entities will be responsible for archiving responder data, how long the data will be retained, and who will be responsible for giving responders copies of their deployment personnel records. Responders should give these deployment records to their primary healthcare providers for inclusion in their medical records.

During the deployment phase, ongoing data collection and analysis, interpretation of results, and recommended actions based on these results should be communicated to more than just the Safety Officer and the Incident Commander. Newly identified health, exposure, or safety issues should be shared immediately with the responders themselves. The Public Information Officer, a communications specialist who develops outward-facing, audience-specific messaging for the response, should provide briefings at regular intervals to all appropriate stakeholders about any relevant updates on the response. It is vital that the Public Information Officer works in conjunction with the appropriate subject matter experts to ensure scientific accuracy while creating plain-language messages for the media, elected officials, and the public. Public Information Officers can also lend their technical expertise to create concise talking points for Incident Command leadership on the immediate concerns arising from the response.

POSTDEPLOYMENT

Postdeployment is the third phase of a response in the ERHMS framework. The postdeployment phase of the deployment lifecycle begins when responders are preparing to leave response or recovery operations (ie, demobilizing). They could be returning to their nonresponse duties with no plans to return to the response or with the intention to redeploy later. Preparation for postdeployment activities should begin immediately after the decision to deploy responders to an incident, because demobilization of responders will take place throughout the entire course of the response and recovery phases. Demobilization can happen sooner than expected because of an injury or other health concerns or at the planned completion of a responder's deployment. The postdeployment phase consists of the following three key activities: (1) responder out-processing, (2) determining the need for health tracking, and (3) after-action reporting (Table 45–2).

Responders should complete out-processing during demobilization, in addition to returning equipment and any other administrative requirements. Responder out-processing is an activity typically led by the Safety Officer within the ICS structure or their designated representative. The Safety Officer or designee gathers information on the self-reported physical and behavioral health and exposure experiences of the responder during deployment and the physical and behavioral health status of the responder at demobilization. During out-processing, long-term contact information, ideally

accurate for one or more years, is obtained from the responder. This information can be used to contact responders in the future to gather from them or provide to them further information regarding their health and the incident to which they responded.

The best way to conduct out-processing for an individual responder is face to face and on-site at the time of their demobilization, because this is the ideal time to maximize participation, assess the responder's physical and behavioral state, and ensure the most accurate recall of events. Depending on the hazards present during the response, it might be necessary to have healthcare professionals conduct the medical and behavioral assessments at out-processing. If it is not possible to conduct on-site, in-person out-processing, alternatives include a survey on paper or via the web or phone preferably within 2 weeks after demobilization. The timing would depend on any known need for postdeployment health monitoring.

There are many benefits to conducting responder out-processing, and the greatest benefits are realized when the activity is completed as soon as possible during the demobilization process. If a responder is in urgent need of additional medical or behavioral evaluation, then the interviewer can make an immediate referral. Additionally, information gathered during out-processing about self-reported health status and exposures during deployment and current health status at demobilization can be crucial for identifying ongoing physical and behavioral health trends within the responder population. This information can be used to determine the need for changes to job tasks or PPE for responders coming into or still deployed to the incident and can be added to the data used to make health-tracking decisions. Eliciting responder feedback about response-related problems they encountered or issues that could be addressed will also assist in improving current or subsequent responses.

ERHMS implementation during the postdeployment phase

The Roseburg, Oregon, mass shooting incident at Umpqua Community College in 2015 occurred when a 26-year-old student entered his classroom and began shooting. Nine people were killed (eight students and one faculty member) and nine students were injured before the shooter engaged with police and then took his own life. Recognizing that this tragedy called for more behavioral health services for the community and responders than the small city of Roseburg could provide, the Oregon Health Authority (OHA) deployed additional behavioral health clinicians who were part of the State Emergency Registry of Volunteers in Oregon (SERV-OR) to provide surge support. The SERV-OR volunteer clinicians stood up and staffed the Umpqua Wellness Center, a free counseling center for community members and responders affected by the incident. The SERV-OR organization, managed by OHA, follows ERHMS framework principles and serves as an example of good pre- and postdeployment practices. Although organizations often have well-developed practices for predeployment, they might not have the same for postdeployment. After the Roseburg mass shooting incident, the SERV-OR organization excelled in the area of postdeployment practices. Shortly after deploying the SERV-OR volunteers, OHA staff began creating their demobilization plan. Upon demobilization, SERV-OR volunteers participated in an out-processing session that consisted of a facilitated group discussion and individual debriefs with a clinician to assess their behavioral health and determine any need for additional resources at their home base. As a result of gaps identified in the after-action report, OHA developed an improvement plan and continues to exercise that plan with its SERV-OR behavioral health team. For more information on SERV-OR's implementation of the ERHMS framework, see Saito (2018).

The out-processing interview is also a good time to share written materials containing postdeployment resources. The information could include behavioral self-care and reintegration techniques, available postdeployment support programs, workers' compensation claim filing processes for response-related health issues, the potential for ongoing contact with incident staff, possible opportunities to participate in research studies about responders, and how the responder information collected during the response will be protected and stored once the incident response is completed. Providing a welcome-home letter to all responders who are demobilized is often an effective way to share that information. This letter may also include a short summary of the disaster (event description, duration, documented hazards, etc.), so healthcare providers can better understand the context of any documented exposures to potentially hazardous substances and biological testing responders may have had during their participation in the response. Figure 45–5 is a basic letter template that can be customized to address any situation or include additional information. In addition to sharing resources and a welcome-home letter, during demobilization is an opportune time for out-processing staff to provide the responder with his or her deployment personnel file and assure them that their information will be treated securely and confidentially, no matter the phase of deployment. The deployment personnel files should contain documentation and sampling results of exposures encountered during deployment as well as tailored recommendations for medical monitoring follow-up, if appropriate. It is also important to impress on responders how essential it is to participate in postdeployment surveillance or monitoring (if necessary) after they return home.

Figure 45–5.

Welcome-home letter template.

A template for a welcome-home letter for those returning from deployment.

The need to monitor responders postdeployment will vary from no need to self-reported monitoring to monitoring by a healthcare or public health professional as part of a health-tracking program. The level of monitoring needed is based on the hazards present, a responder's documented or potential exposures during response, and the potential for adverse health effects associated with exposure hazards. If self-reported monitoring is required, then responders should receive information during out-processing on how to self-monitor for behavioral or physical signs and symptoms and how to report them if they occur. If it is necessary to establish health tracking, then responders can be given information on how to enroll in a short- or long-term health-tracking program.

Determining the need for health tracking and how long the tracking should be conducted is one of the critical decisions made during the postdeployment phase. Tracking can last for varying amounts of time, weeks to years, depending on the exposures experienced by a responder. The information gathered as part of responder out-processing during the postdeployment phase is combined with information collected during the predeployment and deployment phases (eg, demographics, predeployment health status, hazards and exposures encountered during deployment) to determine the length of time responders should be tracked. Short-term health tracking is typically used to follow responders for the incubation period of infectious diseases, such as avian influenza or Ebola virus disease. Though it can also be used to monitor short-onset behavioral health issues, environmental exposures causing short-lived conditions, and progress of injuries or illnesses that are expected to quickly resolve. Long-term health tracking is used to follow long-term adverse health effects or identify the delayed onset of health effects that could develop because of a responder's deployment experience. Some examples of adverse health effects that are long-term and/or can have delayed or variable onset are allergies, asthma, silicosis, specific cancers, and posttraumatic stress disorder.

To determine the need for postdeployment responder health tracking, the exposure and health data from all responders are analyzed. Often medical professionals (such as occupational physicians) work with statisticians and epidemiologists to analyze and interpret the data to determine if any responders might benefit from short-term or long-term health tracking. If the data are insufficient for this purpose, a gap analysis can determine what additional information is needed, and then that data should be sought. With enough information, a conclusion will be reached that health tracking will benefit no responders, a subset of responders, or all responders. If health tracking is needed, the duration (short- or long-term) will also be determined using the parameters previously mentioned.

Long-term health tracking can involve one or more of the following types of programs: medical surveillance, medical monitoring, responder research, and periodic health surveys. When long-term tracking is determined to be necessary, sometimes a registry is created. In the context of the ERHMS framework, a registry is a database of the select group of responders determined to need long-term tracking. Ideally, the decision to create a registry is made shortly after an incident has occurred; however, more often, this determination is made late in the response or recovery periods of a disaster, after many responders have been deployed or have completed their deployment. For this reason, the on-site responder roster, work tasks, and location information from the deployment phase and the long-term contact information collected during postdeployment are useful resources for determining who should be included in a registry.

The information usually collected as part of a registry can be used to provide postdeployment information (and sometimes care) to responders and others. It also can be used to conduct research to learn more about the effects of occupational and environmental exposures and to determine disease characteristics and risk factors. Though registries are challenging and can require a considerable amount of resources, when successfully implemented they have provided a wealth of information to the responders and the scientific research community. The World Trade Center Health Registry is a well-known example; it was created to track the long-term health and gaps in care of recovery workers and responders to the terrorist attacks of September 11, 2001, as well as people who lived, worked, or went to school in lower Manhattan. Registries should be undertaken only if necessary, because they are resource intensive regarding personnel, administrative oversite, participant privacy and confidentially, funding, and data storage, security, and management.

How one registry has benefited responders, survivors, and the research community

The World Trade Center (WTC) Health Registry, based in the New York City Department of Health and Mental Hygiene, tracks 71,431 enrolled responders and survivors of the terrorist attacks in the United States on September 11, 2001 (9/11). The Registry has been able to communicate a wealth of information to responders, survivors, researchers, policy makers, and the public. It shares research findings and information on resources, such as the WTC Health Program that provides medical monitoring and treatment, with enrollees and the public. These resources help those affected by 9/11 make informed decisions about their health. Information is disseminated via multiple channels, including a comprehensive website, annual reports, e-newsletters, social media, targeted mailings, press announcements, and stakeholder meetings.

Communications with enrollees are designed to keep them engaged with the Registry for the long term and to obtain enrollees' updated contact information. This in turn enhances enrollees' participation in follow-up health surveys and nested studies to track and understand long-term changes in physical and mental health, quality of life, and gaps in care. Through such studies, it has been proven that select respiratory diseases, mental health disorders, cancers, and other conditions are associated with exposure to the events of 9/11.

The Registry works with community, labor, and other stakeholders to keep them informed and to acquire input on various research studies and surveys. Registry researchers disseminate findings at scientific conferences and through peer-reviewed journals. For over 15 years, Registry findings have helped to inform health and compensation policy for survivors and responders affected by 9/11. Additionally, the Registry helps thousands of enrollees and their families by linking them to healthcare through the WTC Health Program. More information about this Registry can be found on the WTC Health Registry website.

For any type of long-term health tracking of responders, additional considerations are program type, purpose, management, desired overall outcomes, and long-term funding. Other factors important to the success of these long-term programs must also be established:

- Duration and scope of data collection

- Clear ownership of data

- Data use policies

- Database management processes

- Rules for participant privacy and confidentiality

- Data security protocols

- Member and stakeholder communications

Regardless of the duration of use, all information and data collected in the postdeployment period should be handled with the same level of security and confidentiality mentioned for the previous phases of predeployment and deployment, ensuring that the rules surrounding PII and confidentiality are adhered to closely. Further considerations are long-term database ownership, management, and storage of the data collected during postdeployment. Small, local-level responses sometimes involve few data, only one or two response organizations, and a clearly established, standard data disposition protocol. However, for larger responses involving multiple or more complex exposures, a large amount of data, and numerous organizations, data-sharing agreements ideally should be established in advance of potential incidents or shortly after an incident has begun.

After a response has concluded, it is important to conduct a review and create an after-action report (AAR). More information on AARs can be found in the U.S. Department of Homeland Security document entitled *Homeland Security Exercise and Evaluation Program (HSEEP)*. An AAR will document successes, challenges, gaps, and lessons learned and establish recommendations for improving processes for subsequent responses. The individual or group within the response that conducts ERHMS activities should complete an internal AAR to create a detailed assessment of ERHMS activities. More than one AAR may be necessary to capture all of the information to make impactful recommendations for future responses. Overarching details of how an organization responded to a disaster and how the ERHMS activities related to the overall response should be included in the larger, response-wide AAR. The successes, gaps, and lessons learned can then be used to adjust how ERHMS activities are operationalized moving forward.

SUMMARY

Disasters vary in size and intensity, but response and recovery always involve a variety of workers to ensure success. These workers often operate in unstable environments with multiple OSH hazards. The ERHMS framework provides recommendations and tools that can help organizations ensure the safety and health of their responders when preparing for, responding to, and recovering from a disaster. The framework is scalable and flexible, so it can be implemented by both large and small organizations, and the activities listed in the framework are suggestions that organizations can adjust to fit their needs (Table 45–2). Figure 45–6 gives a brief description of the ERHMS activities that CDC conducted during all three phases of its response to the 2014 Ebola outbreak.

Figure 45–6.

ERHMS activities implemented during the Centers for Disease Control and Prevention response to the 2014 Ebola outbreak.*

*For more information on how CDC used ERHMS during this response, see Funk (2017).

An illustration depicts the three phases, with guidelines and recommendations, for protecting responders to the 2014 Ebola outbreak.

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ADDITIONAL RESOURCES

NIOSH Emergency Preparedness and Response Program Website at: https://www.cdc.gov/niosh/programs/epr/.

Online course FEMA IS-930: Emergency Responder Health monitoring and Surveillance (ERHMS) Training.

U.S. Department of Homeland Security's Homeland Security Exercise and Evaluation Program at https://www.fema.gov/emergency-managers/national-preparedness/exercises/hseep.

U.S. Federal Emergency Management Agency (FEMA) Training Website at: https://www.fema.gov/training-0.

World Health Organization Occupational safety and health in public health emergencies: A manual for protecting health workers and responders at https://www.who.int/occupational_health/Web_OSH_manual.pdf.

World Trade Center Health Registry website at: https://www1.nyc.gov/site/911health/about/wtc-health-registry.page.

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