World Health Organization

International Labour Office

Occupational safety and health in public health emergencies:

A manual for protecting health workers and responders

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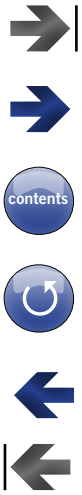

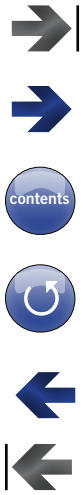
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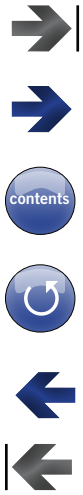
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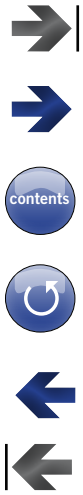
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Abbreviations

ARD	Acute respiratory disease
BSS	Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources
ERHMS	Emergency Responders Health Monitoring and Surveillance
ERW	Ebola response worker
EVD	Ebola virus disease
HBV	Hepatitis B virus
HCV	Hepatitis C virus
HIV	Human immunodeficiency virus
IAEA	International Atomic Energy Agency
IASC	Inter-Agency Standing Committee
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ICS	Incident Command System
IFRC	International Federation of Red Cross and Red Crescent Societies
IHR	International Health Regulations
ILO	International Labour Organization
IPC	Infection prevention and control
MERS-CoV	Middle East respiratory syndrome – coronavirus
NGO	Nongovernmental organization
NIOSH	(United States) National Institute for Occupational Safety and Health
OSH	Occupational safety and health
PEP	Post-exposure prophylaxis
PPE	Personal protective equipment
PTSD	Post-traumatic stress disorder
SARS	Severe acute respiratory syndrome
SCBA	Self-contained breathing apparatus
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme

UNFPA	United Nations Population Fund
UNMEER	United Nations Mission for Ebola Emergency Response
USCDC	United States Centers for Disease Control and Prevention
WFP	World Food Programme
WHO	World Health Organization

Introduction

In its Emergency Response Framework, the World Health Organization (WHO) has defined an emergency as a situation that has an impact on the lives and well-being of a large number of people or a significant percentage of a population and requires substantial multisectoral assistance *[1]*. For a WHO response, there must be clear public health consequences. In addition, under the International Health Regulations (IHR), adopted by the World Health Assembly in 2005, a public health emergency of international concern is defined as "an extraordinary event which is determined, as provided in these Regulations: (i) to constitute a public health risk to other States through the international spread of disease and (ii) to potentially require a coordinated international response" *[2].* Such events may include, inter alia, outbreaks of infectious diseases, hazardous chemical spills or releases of radiation.

During the last five decades, the world has witnessed a wide range of natural and man-made disasters and emergencies. These emergencies included outbreaks of infectious diseases – such as severe acute respiratory syndrome (SARS), H1N1 influenza, Ebola virus disease, cholera, Zika virus – that occurred from time to time in different parts of the world. Apart from infectious disease outbreaks, other key emergencies included radiation emergencies (e.g. Chernobyl, Fukushima), and chemical emergencies (e.g. the Bhopal toxic gas leak, Deepwater Horizon oil spill). In addition, a large number of natural disasters have occurred across the world, such as the Indian Ocean tsunami, and earthquakes, floods and cyclones in Haiti, Pakistan and Philippines *[3].*

Current environmental, economic and political developments and trends suggest an increase in the future severity and frequency of disasters. Phenomena that support this assumption include increased energy use, climate change and pollution, population growth, dispersal of industrialization around the globe, expansion of transportation facilities, and the growing spread of terrorism. Severe drought and associated food insecurity, flooding, rains and temperature rises due to El Niño in 2015-2016 caused a wide range of health threats, including disease outbreaks, malnutrition and disruption of health services *[4]*.

The worldwide risk of chemical incidents is increasing with the global rise in the production, trade and use of chemicals (e.g. in agriculture). This is particularly the case in developing countries and those with economies in transition, where chemical production, extraction, processing and use are closely tied to economic development, and where production is projected to increase six-fold by 2050 *[5]*.

Management of such outbreaks and emergencies involves close coordination and cooperation between a large number of diverse organizations. The emergency response personnel associated with such organizations comprise professional groups that include fire-fighters, police officers, emergency medical staff (paramedics, emergency medical technicians, doctors and nurses) and psychologists. In major disasters, rescue workers, technicians from large relief

organizations, additional medical staff, military personnel, antiterrorist forces, corpse-handlers, clean-up workers, construction workers and numerous volunteers are also involved. Each of these categories of workers have specific roles in managing an emergency response that may expose them to various health and safety hazards while carrying out their duties.

Many events in recent years have posed a high risk of injuries and infections, and in some cases have resulted in fatalities among emergency health and response workers. Incidence of infections among health workers were observed during outbreaks of SARS and Middle East Respiratory Syndrome – coronavirus (MERS-CoV). However, during Ebola virus disease outbreaks in West Africa, the high morbidity and mortality among health workers in the most affected countries led to serious negative impacts on the overall functioning of health services *[6]*.

Further to these events, many countries are currently facing humanitarian crises and conflicts that increasingly involve the disturbing trend of attacks on health facilities. Such attacks not only affect the health and safety of health providers but also seriously affect the capacity of health systems to deal with humanitarian emergencies. According to a WHO report, during the two-year period from January 2014 to December 2015 there were 594 reported attacks on health-care workers that resulted in 959 deaths and 1561 injuries in 19 countries with emergencies *[7].*

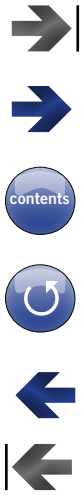
In view of all these events, the need for better occupational safety and health (OSH) protection for emergency workers is increasingly being recognized as a major priority.

Purpose of the manual

This manual provides an overview of the main OSH risks faced by emergency responders during disease outbreaks and other emergencies, such as natural disasters, chemical incidents, radiological emergencies and emergencies involving conflicts. The intent is to assist organizations and workplaces to better prepare and respond to these events. The manual, which is particularly focused on needs in low-resource settings, provides technical guidance on good practices and procedures in establishing systems that can: 1) reduce occupational exposures, injury, illness and death among response workers; 2) decrease stress and reduce fears; and 3) promote the health and well-being of health-care and other response workers.

The manual has three main parts. Chapters 1 to 3 cover managerial and technical tools and strategies for managing OSH in emergency situations. These tools include an OSH management systems approach for use in emergencies, an incident command system (ICS), OSH controls and standard precautions and their application during emergencies. Chapters 4 to 8 cover OSH hazards in different types of emergencies, such as outbreak situations covering clinical and community response settings, chemical incidents, radiation incidents and natural disasters, as well as conflict situations. The Appendix includes a collection of tools and resources compiled from various resources that are intended to provide practical support to users on different aspects of OSH in emergencies and outbreaks.

The manual is intended for experts and officials in emergency response organizations who are responsible for workers' OSH. This information is particularly important in countries with high risk of emergencies – such as those with high transmission of highly infectious agents (e.g. cholera, yellow fever, viral haemorrhagic fevers) and/or natural disasters, and chemical and radiological incidents. The key target audience includes personnel from agencies and organizations responsible for implementing the International Health Regulations (IHR) within a country, government agencies in the health and labour sectors, international organizations, nongovernmental organizations (NGOs), humanitarian and charitable bodies, faith-based organizations, hospitals and health-care facilities, public and private companies, security forces, employers and trade unions.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Chapter 1.

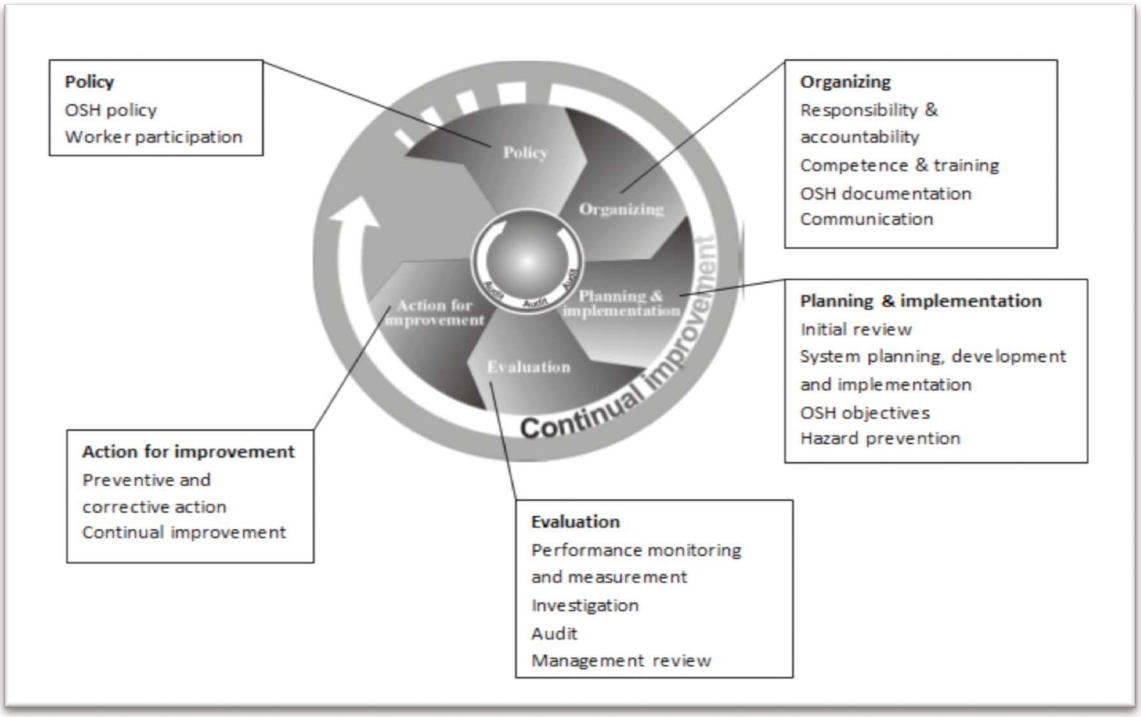
Occupational safety and health during emergencies: management aspects

Managing the OSH of emergency health workers requires a systematic approach that includes various management functions such as planning, organizing, implementing, monitoring and evaluating actions in an orderly manner. This chapter covers various management aspects that are related to the OSH of emergency response workers during outbreaks and emergencies.

1.1 Management systems approach to occupational safety and health hazards and risks

The management of OSH of emergency response workers should be implemented as an OSH management system that is compatible with or integrated into overall emergency response management, including the stages of preparedness, response and recovery *[8]*.

Figure 1. The continual improvement cycle of the OSH management system



Source: OSH Management System: tool for continual improvement, International Labour Organization [9].

Key components of the OSH management system

All managers, team leaders and workers' representatives in emergency operations need to be trained in the development of the OSH management system in outbreaks and emergencies through the ICS. This includes coverage of (Figure 1):

- workplace policy on OSH;
- organizational structure and roles and responsibilities for OSH within the ICS;
- planning, including resource mobilization (e.g. human resources, personal protective equipment (PPE), monitoring equipment, medicines and vaccines, procedures and guidelines on OSH);
- monitoring and evaluation mechanism (e.g. indicators, checklists).

The following are key requirements for the OSH management specific to emergency response workers during outbreaks and emergencies:

- Selection of the right persons with qualifications and skills for the required job.
- Training of selected professionals in health and safety risk assessment, risk management and risk communication management.
- Assessment and management of OSH risks during deployment.
- Health surveillance covering monitoring for adverse impacts of deployment on the physical, mental and social health of responders, and management of these impacts, including through psychological support and counselling.

Selection of the right persons with qualifications and skills for the required job

This is an important step in organizing any response mechanism, whether for disease outbreaks or any other emergency. The process includes matching the requirements of the potential emergency with the qualifications, skills and physical and mental status of the persons to be selected.

Training requirements for OSH management during outbreaks and emergency response

Training is an integral element of the deployment process for response workers in an emergency response to outbreaks, chemical and radiation incidents and natural disasters in order to equip them with knowledge, attitudes and skills to ensure appropriate behaviour for protecting their personal health and safety – both so they can remain healthy and safe and so they can carry out their response activities effectively.

All workers who are expected to be involved in the response to an outbreak or other public health emergency should be trained in the following:

- basic assessment and management of OSH hazards and risks in the field, covering physical, chemical, biological, mechanical and psychosocial hazards;
- hazards and risks associated with specific outbreak or emergency situations such as Infection Prevention and Control (IPC) and the basics of chemical and radiation safety;
- roles and responsibilities of emergency responders under the ICS;
- personal security in the field;
- incident reporting on diseases, injuries and incidents during the emergency operation.

Additionally, during the response, workers should receive daily briefings and instructions on safe working practices relating to specific hazards and risks to their health and safety. Also, such daily briefings would serve as a good opportunity for supervisors to check the health status of the workers Emergency responders (e.g. workers employed in medical treatment units, laboratories and burials, as well as chemical and radiation workers) may need, in addition to the above, training in awareness and specific skills (e.g. use of PPE and chemical and radiation decontamination procedures).

Communication with workers involved in outbreaks and emergencies

Risk communication is a crucial part of the response plan and is required at all stages of deployment. Communication is the responsibility of all supervisors in the field. The key principles for risk communication with health and other emergency workers during outbreaks and emergencies include:

- Risk communication with workers should be personal, face-to-face, and should not rely solely on posters and health education materials;
- Workers' representatives should be involved in risk communication;
- Workers should not learn from the media about risks and dangerous situations; all accidents should be discussed with workers and preventive measures should be taken immediately;
- Risk communication with workers should promote a no-blame culture;
- Risk communication should be fair and should address fears, rights and entitlements and the effectiveness of measures for protection.

Psychological support and counselling

The emergency response process is associated with high levels of stress which affect emergency responders through all stages of deployment. Therefore the aim of psychological support is to prevent and manage stress and its impacts on physical, mental and social health throughout deployment and afterwards.

The effects of stress encountered during an assignment do not magically disappear when emergency response personnel return home. Protection against the impact of stress requires psychological first aid as well as specialized counselling and psychological support from professionals.

1.2 Rights, duties and responsibilities of employers and workers during outbreaks and emergencies

Protecting the health and safety of health-care workers and other emergency responders is crucial to maintaining an adequate and functional workforce and ensuring the continuity of the emergency response and essential health services. In an emergency situation such as an outbreak, chemical spill or radiation release, where workplace risk changes rapidly, employers need to be prepared to adapt their usual practice in consultation with workers, their representatives and technical experts in order to achieve a reasonable balance of safety versus obligation to work. Box 1 describes the risk allowance policy applied in Sierra Leone during the 2015 response to the Ebola outbreak there.

General rights and responsibilities of employers and workers

In dealing with the OSH risks during management of outbreaks and emergencies, the following general rights, duties and responsibilities of employers are specified in the International Labour Organization (ILO) Occupational Safety and Health Convention of 1981 (No. 155) *[10]*:

Employers have overall responsibility to ensure that all practicable preventive and protective measures are taken to minimize occupational risks:

- Employers are responsible for providing adequate information, comprehensive instruction and necessary training on OSH, for consulting workers on OSH issues related to their work, and for notifying the competent authority (e.g. labour, medical inspectorate) of cases of occupational injuries and diseases;
- Employers are required to provide workers with adequate protective clothing and protective equipment and appropriate training on their use, to prevent, so far as is reasonably practicable, the risk of adverse effects on health;
- The following general rights, duties and responsibilities of workers apply:
- Workers are required to report immediately to their supervisor any situation that they have reasonable justification to believe presents an imminent and serious danger to their lives or health. Until the employer has taken remedial action, if necessary, the employer cannot require workers to return to a work situation where there is a continuing imminent and serious danger to life or health;
- Workers have the right to remove themselves from a work situation that they have reasonable justification to believe presents an imminent and serious danger to their lives or health. When a worker exercises this right, he or she shall be protected from any undue consequences;
- Workers are responsible for following established OSH procedures, avoiding the exposure of others to health and safety risks, and participating in training provided by the employer.

The following general principles from the ILO Occupational Safety and Health Convention of 1981 (No. 155) also apply:

- OSH measures shall not require workers to incur a financial cost;
- Cooperation between employers and workers and/or their representatives within the workplace shall be an essential element of workplace-related prevention measures, such as through workers' safety delegates, safety and health committees, and collaboration in providing information and training.

The ILO's List of Occupational Diseases Recommendation, 2002 (No. 194) provides that infections and post-traumatic stress disorder, if acquired through occupational exposure, are considered occupational diseases, and that affected workers have the right to compensation, rehabilitation and curative services.

Rights and responsibilities of employers and workers in emergency response settings

Emergency response workers, including health-care workers, have a contractual obligation and a duty of care to provide services that may put them at risk of infections, toxicities, injuries and diseases. Despite the duty of care, in the face of increased risks inherent to the work in emergencies, emergency response workers may, according to the national context, situation

and practice, have the right to remove themselves from a work situation that they have reasonable justification to believe presents an imminent and serious danger to their lives or health.

Employers of emergency response workers have an obligation to provide safe work conditions and the necessary means to implement appropriate OSH measures. Employers have an obligation to:

- adequately train, equip and protect these workers;
- provide them with the capacity and knowledge to implement OSH techniques;
- provide clear guidelines on the conditions under which these workers should operate, what is expected of them, and the inherent risks of the situation;
- provide appropriate psychological support, as well as implement measures to promote healthy practices;
- provide adequate compensation for the services provided by these workers, in the form of risk premiums and insurance for them and their families and disability benefits for those who contract the infection;
- systematically collect information to support ongoing monitoring and evaluation of the effectiveness of OSH programmes in providing protection.

Box 1. Risk allowance policy, Sierra Leone, for Ebola response workers (ERWs) during the Ebola virus disease (EVD) response *[11]*

- The policy was put into effect on 1 April 2015 until November 2015 when it was later replaced by the EVD-resilient Zero Allowance Policy. The policy included:
- categories of ERWs to be covered;
- risk allowance rates;
- procedures for management and updating of lists;
- verification and audit procedures; and
- complaints management.

Social protection of workers in emergency response settings

Social security, as defined by the ILO, is the protection that a society provides to individuals and households to ensure access to health care and to guarantee income security, particularly in cases of old age, unemployment, sickness, invalidity, work injury, maternity or loss of a breadwinner. It covers all measures that provide benefits, whether in cash or in kind, to secure protection, inter alia, from: lack of work-related income (or insufficient income) caused by sickness, disability, maternity, employment injury, unemployment, old age, or death of a family member; lack of access or unaffordable access to health care; insufficient family support, particularly for children and adult dependants; and general poverty and social exclusion.

The higher-than-normal risks associated with an outbreak and other emergency responses highlight the necessity for the social protection of all workers, including migrants, part-time workers and self-employed workers. The ILO Social Security (Minimum Standards) Convention, 1952 (No. 102) provides general guidance on various benefits that may be applicable during emergencies, namely.

Medical care and sickness benefits

- All workers involved in outbreak and emergency response activities should have coverage for medical care and sickness benefit. Another priority is emergency medical evacuation – the capability to move international aid workers who are potentially exposed to infections, hazardous chemicals or radiation to locations where they can receive appropriate medical care;
- During epidemic control operations, post-exposure treatment should be made available for health-care workers providing care to infected patients;
- Health-care workers – including medical staff, laboratory staff, burial teams and facility cleaners, as well as emergency responders involved in rescue and response and with risk of contact with blood and other body secretions from affected persons during response activities – should have the first call on vaccine;
- Workers should be entitled to sickness benefit during periods of isolation or quarantine. Financial compensation for isolated or quarantined workers should be automatic; this was an essential part of the response strategy during the Ebola virus disease (EVD) response in West Africa. Providing income replacement for workers and self-employed persons is essential to ensure a high rate of compliance with quarantine. If daily wage earners are not compensated during isolation and quarantine, they may continue to come to work, even with a fever, presenting a risk of infecting others;
- Workers also need to be legally protected from dismissal if, while complying with monitoring, travel restrictions, quarantine or isolation orders, they have to be absent from work. In cases where public health authorities impose quarantine, it may be that a worker is requested by an employer to continue to do some work, perhaps remotely from home or the place of quarantine. In such cases, the management and workers' representatives should negotiate an agreement regarding salary to be paid, hours to be worked and general conditions during the quarantine period.

Employment injury benefits

Not all workers have the same level of risk of occupational exposure to highly infectious disease agents, hazardous chemicals or radiation, or are able to claim employment injury benefits. An epidemiological investigation of individual cases will document the occupational or residential source of exposure to highly infectious disease agents, hazardous chemicals or radiation. For those workers with a high intensity of contact with sources of such hazards, the occupational cause of the exposure can be recognized as plausible without an epidemiological investigation.

Other diseases or disorders – whether caused by biological, physical, chemical, psychological or ergonomic hazards – can be recognized as occupational diseases if a direct link between the hazard exposures arising from work carried out at the request of the employer and the disease contracted by the worker is established scientifically or determined by methods appropriate to national conditions and practices.

Health crisis preparedness must include health-worker payment systems and mitigation planning as a core component (Box 2). This requires interagency coordination and country-based needs assessment protocols, development of policies and technical guidance, and the availability and accessibility of quality technical assistance, costing tools and planning frameworks *[12]*.

Box 2. Payment programme for Ebola response workers

The United Nations Development Programme (UNDP), in consultation with a range of partners that included IFRC,[1] UNCDF,[2] UNFPA,[3] UNMEER,[4] WFP[5] and the Payments Programme for Ebola Response Workers (PPERW), provided the governments of the three outbreak countries with the technical assistance and strengthened capacity necessary to ensure timely delivery of incentives to ERWs. Specifically, the PPERW had three main objectives: (1) strengthening health-sector human-resource planning through information management systems; (2) strengthening existing payment platforms and digitizing incentive pay; and (3) establishing a UN-run contingency payment platform in Guinea and Liberia.

In Sierra Leone, the PPERW was responsible for covering 78% of all ERWs, including not only Ministry of Health and Sanitation employees but also volunteer workers. In Guinea and Liberia, where the ministries of health continued to oversee hazard pay to salaried government health workers, the PPERW was limited to oversight of indemnity payments to volunteer ERWs or those not covered by existing partners (roughly 19% of total ERWs in those countries). In Liberia, UNDP facilitated payments to ERWs and strengthened the existing payment mechanism and the information management system *[12]*.

[1] International Federation of Red Cross and Red Crescent Societies; [2] United Nations Capital Development Fund; [3] United Nations Population Fund; [4] United Nations Mission for Ebola Emergency Response; [5] World Food Programme.

Survivors' benefits and funeral expenses

The family members and/or dependants of workers who have died as a result of occupational injuries, diseases or exposure to an occupational hazard should be entitled to survivors' benefits, unless these are already provided to a minimum standard by other social security schemes. The funerals of victims of such cases need to be organized by public health authorities as part of the safe burial scheme.

Maternity benefits and maternity protection

Pregnant women should not be deployed to affected countries and should not participate in activities associated with outbreaks and emergency responses. Pregnant or breastfeeding workers should not be allowed to enter workplaces with a risk of infection transmission.

1.3 Overview of health and safety surveillance and monitoring system implemented during the Ebola virus disease response in West Africa

Managing the OSH of emergency response workers such as health workers is crucial for sustaining both response activities and normal delivery of health-care services for all public health needs of the community. With these objectives, throughout the EVD outbreak response of 2014-2015 in West Africa, WHO put in place a system to ensure the OSH of deployed emergency response personnel *[13]*.

This system included assistance and guidance before, during and after the deployment provided by the WHO Staff Health and Welfare services and other WHO departments involved in the emergency response. The system was established in the affected countries to ensure that the OSH of deployed staff was supported by multidisciplinary teams, including health and safety officers working closely with IPC and other professionals, at national and district levels.

These teams, in coordination with staff from WHO's country offices, ensured that deployed staff received full induction training, briefings about the country situation, instructions about their functions, protective equipment and the contact details of persons to be contacted in case of need or emergency. The health and safety officers were appointed to help deployed staff to follow instructions and procedures in order to keep themselves safe and healthy both during and after working hours and to monitor implementation of these measures.

Pre-deployment stage

The pre-deployment stage consists of the following:

Health checks and medical clearance

Before an emergency response worker leaves on a mission, it is mandatory to ensure that he or she is physically and mentally prepared. Deployment involves an intense working environment with long hours so good physical health and preparedness are important. The deployment is contraindicated in the case of pregnancy.

Once selected for deployment, the emergency response worker needs to obtain medical clearance from the Staff Health and Welfare service at WHO headquarters or from a WHO regional office. The medical clearance is given on review and approval of a complete health examination, including laboratory testing and immunizations, by a certified medical practitioner.

Preventive immunizations

Responders deployed to West Africa during the EVD response were required to be up-to-date with the following vaccines:

- yellow fever (mandatory);
- diphtheria-tetanus (ideally within 5 years) -polio +/- pertussis;
- typhoid vaccine;
- hepatitis A and B;
- meningitis ACYW 135 (mandatory if outbreak is ongoing);
- measles for those born after 1963 who have not had the disease, or 2 doses of MMR
- rabies (recommended);
- cholera vaccine (recommended only in certain situations and based on risk assessment).

Chemoprophylaxis against malaria

As the countries at highest risk during the EVD outbreak, Guinea, Liberia and Sierra Leone were also endemic for malaria. Chemoprophylaxis and personal protection against mosquito bites day and night are important for preventing malaria and other vector-borne diseases. Therefore, it was mandatory that emergency response workers deployed to affected areas should take chemoprophylaxis before, during and after the mission. This holds true for all countries where malaria is endemic.

Induction training

Before deployment to the field or on reaching the country of assignment, the emergency response worker received induction training. This training was delivered at WHO headquarters,

a regional office or a country office, depending on the starting point and travel arrangements. The induction training aimed to provide an introduction to EVD and essential operational guidance to all staff regardless of their functions and affiliations, and to increase awareness about the OSH concerns that the worker should bear in mind. The training package was organized in an electronic format called ePROTECT that has been made available online *[14].*

In addition, for those emergency response workers required to carry out high-risk work such as patient care, safe burials or laboratory work, additional training was offered at headquarters, regional offices or country offices, depending on the path of deployment and reports from staff already deployed.

The emergency response workers were briefed about the country situation before deployment and were provided with reports from staff already deployed. On arrival, they received an additional, more detailed briefing from the health and safety officer. The briefing covered the following:

- immunization status of the responder;
- malarial prophylaxis status on arrival;
- ePROTECT training received and knowledge of hand hygiene;
- key OSH risks and controls to be implemented during deployment;
- provision of medical and hygiene kits and insecticide impregnated bednets.

Once it was assured that the above provisions were in place, the responder was allowed to proceed to the assigned deployment area.

During deployment

During deployment, the code of conduct for health and safety, along with the buddy system, were implemented by the emergency response workers in their respective areas of operation. In addition, worksites and lodging areas are were regularly assessed for IPC and OSH status.

Code of conduct

Particularly in hotspots where the outbreak was not yet under control, and given that early symptoms of infectious diseases such as EVD are non-specific, deployed staff were advised to adopt the following precautionary behaviours in their social and work life:

- to avoid shaking hands and hugging people;
- to keep a distance of at least 1 metre from colleagues during meetings;
- to avoid sexual activity during the mission (anyone choosing not to follow this recommendation should always use condoms);
- to use respiratory etiquette during sneezing or coughing, and to request others to do the same if they do not;
- to perform hand hygiene frequently, especially in the moments mentioned above.

Buddy system

The buddy system is a system where two people – i.e. "buddies" – operate together as a single unit so that they are able to monitor and help each other. In dangerous activities, where buddies are often peers, the main benefit of the system is improved safety. Each buddy can

be there to prevent the other becoming a casualty, or to rescue the other in a crisis. This also allows the less experienced buddy to learn more quickly from close and frequent contact with the experienced buddy than if operating alone.

The responsibility of a buddy is:

- to help create a welcoming environment;
- to give tours of the work area;
- to be a source of clarification of the various policies, procedures and protocols;
- to be patient and positive, helping to develop role confidence;
- to answer frequently asked questions to help lessen the tendency to role confusion and uncertainty;
- to introduce colleagues and staff, thus assisting with building effective and productive networks;
- to assist with training on key processes and procedures, such as using PPE and infection control.

Post-deployment

All deployed emergency response personnel were requested to undergo a post-deployment debriefing session to gather information on the deployment process in order to improve operations. These debriefings focused on what the response personnel had observed, experienced and learned during their deployment, and how the Organization could potentially benefit from this experience.

The experience of feeling listened to about field experience and reviewing organizational practices also serves to reduce stress, if any, in the individual staff member.
After deployment, emergency response personnel were required to contact Staff Health and Welfare services in WHO headquarters or the regional staff physician in the regions, to arrange an end-of-mission debriefing.

The post-deployment debriefing exercises were conducted by the staff counsellor and/or the staff psychologist and focused on how emergency response personnel responded to the stresses they experienced during their deployment. The debriefing explored what their experiences were, what their thoughts and feelings about their experiences were, and how they dealt with those thoughts and feelings. It focused especially on their current emotional state and any needs they might have for further individual or family support or other interventions. It further included education about the possible delayed impact of stressful experiences on an individual. The diagnosis and treatment of post-traumatic stress disorder requires specialized psychological and medical care which should be sought if suspected.

Documentation

The guidance on OSH was compiled into the following key resources:

- WHO Ebola outbreak response handbook for health and safety in the field, providing comprehensive information on elements of the surveillance and monitoring required during deployment *[13].*
- Training slides on ePROTECT training covering OSH instructions, later organized as online training *[14].*

- The GO Training manual covering details of the EVD response, WHO's role, and guidance on safety and health during deployment, also available online *[15].*

1.4 Emergency Responders Health Monitoring and Surveillance

The Emergency Responders Health Monitoring and Surveillance (ERHMS) system under the ICS, as designed by the United States National Institute for Occupational Safety and Health (NIOSH), has served as a useful tool for managing the OSH of emergency responders. The system has been successfully used during the emergency response to the Deepwater Horizon oil spill in the Gulf of Mexico in 2010 (Box 3). An overview of the key components of ERHMS is presented below *[16]*.

Pre-deployment

Rostering and credentialing: These are required in an emergency response to maintain accountability for all emergency responders. The registration and credentialing system is designed to support four interdependent, interoperable functions: (1) registration (recording basic and credential information on each worker); (2) emergency credentialing (assigning a credential level on the basis of responder certifications and education); (3) re-verification (periodically verifies responder information); and (4) emergency badging (assigning an identification badge in accordance with the credential level).

Health screening: Pre-deployment health screening is intended to establish a baseline of physical and emotional health status and should address the responder's physical health status, emotional health status and immunization status. Such information may be obtained from an initial physical examination to determine fitness for duty, or from subsequent medical examinations. This baseline information allows for more informed interpretation of possible post-deployment adverse health effects and is particularly valuable when exposure information is difficult to obtain or interpret, or when it is absent.

Training: The responder is required to be fully certified to perform duty-specific tasks which may have training requirements that are mandated generally, at country level or locally. In addition, the ability of the responder to recognize and avoid possible health and safety risks will influence the responder's performance, survivability and resilience during and after the disaster response.

During deployment

On-site rostering: The process of personnel identification, accountability and tracking can be referred to as the responder roster. The roster should be used to record everyone who reports to the disaster area and is engaged in response or remediation work. The logistics team sis responsible for collecting this information.

Health monitoring and surveillance: Monitoring refers to the ongoing and systematic collection, analysis, interpretation and dissemination of data related to an individual responder's injury, illness and exposure status. This allows for the evaluation of the occurrence of an exposure, determination of the level of exposure an individual responder might experience during duties, and assessment of how that exposure affects the responder. Surveillance refers to the ongoing and systematic collection, analysis, interpretation and dissemination of illness and injury data related to the whole group of emergency workers responding to an event. This allows for the tracking of emergency responder health (illness and injury) trends within a defined population

during response and recovery. A mechanism to allow surveillance should be an integral part of the response to any event.

Response activity documentation and safety controls documentation: Response workers and volunteers may be exposed to many different chemical and environmental hazards during their work. Accurate and useful information on worker exposure is a crucial element in ensuring that exposures are correctly characterized, risk is communicated appropriately, and sufficient information is available to make evidence-based decisions (i.e. PPE and work practice controls) to protect the health and safety of response workers.

Communication of exposure and health monitoring and surveillance data during an emergency response: The collection of environmental exposure data and individual health and safety monitoring data, along with aggregate surveillance data, is relevant to protecting all the responders involved in an event in both the short and long terms. This information must be communicated to workers intra-organizationally, inter-organizationally, and both within and outside the ICS structure.

Post-deployment

Out-processing assessment: Out-processing assessments are conducted to determine the extent, if any, to which individual responders have been adversely affected by their work during deployment and to assess trends within the population of workers in order to identify potential risks to others. All responders should receive an out-processing assessment as part of the demobilization process or as soon as possible after demobilization.

Tracking of emergency responder health and function: Because of potential health and safety risks inherent in emergency response work, post-event tracking of responder health may be appropriate. The goal is to identify adverse health or functional consequences potentially associated with response work (e.g. exposure, illness, injury, or disability – including emotional trauma), to intervene early to maximize the chances of recovery, and to stop further exposure for remaining workers (i.e. through exposure control or medical treatment).

Lessons learned and after-action assessments: As an event concludes, there is a need to assess how the emergency response has been conducted through the pre-deployment, deployment and post-deployment phases and to try to identify ways to improve the response during each phase. This is often accomplished through a document called an after-action report.

Box 3. ERHMS application during the Deepwater Horizon oil spill response

An overview of the use of ERHMS used during the Deepwater Horizon response to manage the oil spill in the Gulf of Mexico, USA, covered the following *[17]*:

Pre-deployment stage

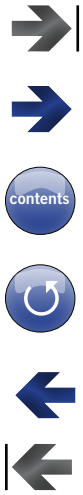
- Rostering and credentialing activities covered 55 388 workers with different past work experiences until October 2010.
- Medical pre-deployment evaluations of emergency responders were conducted to assess their medical status before beginning the response work, to guide medical professionals to identify persons with susceptibilities needing special attention or limitation of their exposures, etc.
- Training was provided to emergency responders, as follows:
- 8 hours operations training for first responders
- 24 hours Occupational Safety and Health Administration (OSHA) Hazpower or HAZMAT technician training, and
- 40 hours Hazpower training.

Deployment stage

- Injury and illness data were collected and compiled weekly. In addition, time trends of heat illness cases were constructed weekly.
- Health hazard evaluations were conducted for both on-shore and off-shore activities for beach clean-up, wildlife rehabilitation, equipment decontamination and waste stream management etc.

Post-deployment stage

- This consisted of out-processing assessments and analysis of exposure data in conjunction with self-reported and health-care provider-generated information.
- The exposure and health components were analysed, including analysis of medical monitoring, medical surveillance and exposure assessment, the pre-deployment baseline and medical examination results. Based on analysis of the above, workers were identified for health tracking and long-term tracking options were explored.


contents

Chapter 2.

Strategies and tools for protecting occupational safety and health in emergencies and outbreaks

The management systems approach provides an overarching framework to manage OSH risks during outbreaks and emergencies. To manage risks within this framework, certain strategies, tools and instruments exist for prevention and control of OSH hazards and risks. These resources can be adapted according to the specific outbreak or emergency situation. This section provides an overview of the "hierarchy of controls", the ICS and infection prevention and control strategies.

2.1 International Health Regulations, 2005

The International Health Regulations (IHR) *[2]* are an international legal instrument that is binding on 196 countries, including all the Member States of WHO. The aim of the IHR is to help the international community prevent and respond to acute public health risks that have the potential to cross borders and threaten people worldwide.

The IHR, which were adopted by the World Health Assembly in 2005, entered into force on 15 June 2007. The regulations require countries to report certain disease outbreaks and public health events to WHO. Building on the unique experience of WHO in global disease surveillance, alert and response, the IHR define the rights and obligations of countries to report public health events, and establish procedures that WHO must follow to uphold global public health security.

Apart from disease agents, the IHR cover the risk of spread of toxic, infectious or otherwise hazardous materials that may occur naturally (or not) that have contaminated, or have the potential to contaminate, a population and/or a large geographical area.

The IHR also include specific measures to be taken at ports, airports and ground crossings to limit the spread of health risks to neighbouring countries, and to prevent unwarranted travel and trade restrictions so that traffic and trade disruption is kept to a minimum.

The following recommendations and provisions specified under the IHR for protection of the health and safety of the general public also protect emergency care providers:

- recommendations with respect to persons, baggage, cargo, containers and conveyances;
- recommendations covering airports, ports and general crossings;
- the role of competent authorities;
- core capacity requirements for surveillance and response;

- the decision instrument for the assessment and notification of events that may constitute a public health emergency of international concern.

The following public health measures related to health and safety of emergency care providers are recommended:

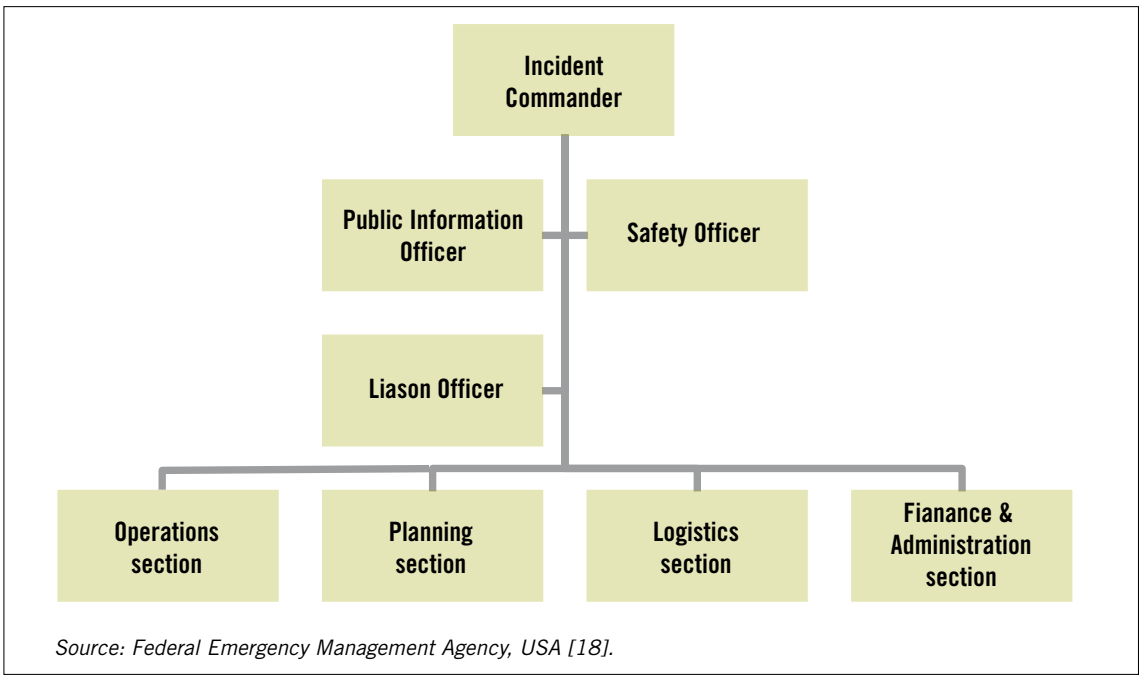
- health measures on arrival and departure;
- special provisions for conveyances and conveyance operators;
- health provisions related to entry of travellers;
- the Maritime Declaration of Health;
- the health section of the Aircraft General Declaration;
- ship sanitation certificates.

2.2 Incident Command System for managing outbreaks and emergencies

The ICS is a standardized on-scene incident management concept designed specifically to allow responders to adopt an integrated organizational structure equal to the complexity and demands of any single incident or multiple incidents without being hindered by jurisdictional boundaries *[18].*

The ICS enables integrated communication and planning by establishing a manageable span of control. An ICS divides an emergency response into five manageable functions essential for emergency response operations: Command, Operations, Planning, Logistics, and Finance and Administration.

Figure 2. Structure of Incident Command System



Source: Federal Emergency Management Agency, USA [18].

Organizational structure

- The minimum ICS should consist of the following and can be expanded according to requirements:
- The command staffs consist of the Public Information Officer, Safety Officer and Liaison Officer. They report directly to the Incident Commander.
- Sections represent the organizational level that has functional responsibility for primary segments of incident management (operations, planning, logistics, finance/administration). The section level is organizationally between the branch and Incident Commander.
- Each section consists of progressively smaller organizational units – i.e. branch, division, group, unit, task force, strike force and, finally, a single resource. A single resource is an individual piece of equipment and its personnel complement, or an established crew or team of persons with an identified work supervisor that can be used to deal with an incident.
- The ICS is designed by identifying the primary activities or functions necessary to respond effectively to incidents. As incidents have become more complex, difficult and expensive, the need for an organizational manager has become more evident. In the ICS, and especially in larger incidents, the Incident Commander manages the organization and not the incident.

In addition to the command function, other desired functions and activities include:

- delegation of authority and provision of a separate organizational level within the ICS with sole responsibility for tactical direction and control of resources;
- provision of logistical support;
- provision of planning services for current and future activities;
- cost assessment, time recording and procurement control necessary to support the response to the incident;
- prompt and effective interaction with the media, and provision of information services for the incident management team, other involved agencies and the public;
- provision of a safe operating environment in all parts of the incident response;
- ensuring that assisting and cooperating agencies' needs are met, and that the agencies are used in an effective manner.

Role and responsibilities

- The Incident Commander is technically not a part of either the general or command staff. The Incident Commander is responsible for overall incident management, including ensuring safety.
- Command staffs are assigned to carry out the staff functions needed to support the Incident Commander. These functions include interagency liaison, incident management safety and public information. Command staff positions are established to assign responsibility for key activities not specifically identified in the general staff functions. These positions may include the Public Information Officer, Safety Officer and Liaison Officer, in addition to others, as required and assigned by the Incident Commander.

- The general staff are responsible for the functional aspects of the ICS. The general staff typically consists of the operations, planning, logistics and finance/administration sections.

Safety Officer: The key responsibilities of the Safety/OSH Officer include:

- identification and mitigation of hazardous situations;
- ensuring that safety messages are communicated and briefings are given;
- exercising emergency authority to stop and prevent unsafe activities;
- review of the Incident Action Plan for safety implications;
- assignment of assistants qualified to evaluate special hazards;
- initiation of preliminary investigation of accidents within the incident area;
- review and approval of the Medical Plan;
- participation in planning meetings.

Organizational measures under the Incident Command System

- The Emergency Management Institute, under the Federal Emergency Management Agency (FEMA) of the USA, lists the following measures as part of health and safety management under the ICS *[18]*:

Risk assessment and management

- The protection of emergency responders must follow a safety management cycle, and those responsible for safeguarding emergency workers must always weigh up whether deploying emergency workers is sufficiently beneficial by taking into account the emergency workers' OSH risks.
- Risk assessments should follow general principles and cover all possible hazards and risks that emergency workers may encounter. Risk assessment at a disaster scene must, for instance, include assessment of whether domino effects are possible (i.e. whether the present event could cause further damage and danger). All past accidents and near-accidents should be taken into consideration when looking for possible risks. Developed on this basis, early planning should anticipate the likely response requirements and should establish all necessary preventive measures.
- A balance between the OSH risks for emergency workers and the possible benefits of emergency actions must be achieved. Duties are also placed on employees to take reasonable care of themselves and others and to cooperate with their employer; employees should act sensibly and responsibly within the command and control of their employer.

To coordinate activities of emergency workers efficiently, authoritarian leadership is the most appropriate style as it functions well in situations requiring unambiguous and rapid instructions.

The available equipment, available technical and personnel resources, tasks, the roles of the emergency organizations/teams/workers and the management tasks must therefore be identified and assigned to organizations/teams/persons before disaster strikes in order to make disaster control as efficient as possible.

Work organization

Limiting exposure to workers: By limiting the numbers of personnel at the scene to the minimum necessary and by releasing personnel no longer needed at the scene as soon as possible, the exposure of emergency workers to hazards at the scene can be reduced. A method for minimizing the exposure of emergency workers and the public to hazards is the creation of "protective-action zones" as a function of the distance from the accident's source and the intensity of the phenomena resulting from the incident.

Job/task rotation: Whenever possible job/task rotation should be considered to reduce exposure to risks and overstrain.

Training:

- Emergency workers must be provided with knowledge of all the types of OSH hazards and their risks they may encounter during their professional activities, the consequences of those risks and possible preventive measures. The training should cover physiological symptoms of being exposed to hazardous substances, appropriate decontamination procedures, proper manual handling, specificity of functioning while under great pressure and stress, and proper selection, use, care and maintenance of PPE.
- Training should be developed and given on standard operating procedures related to different scenarios.
- Training might be essential to help emergency workers better cope with violence at work. Emergency Medical Services (EMS) workers, paramedics and fire-fighters have a higher risk of experiencing violence in the course of their duties than other workers.

Vaccination:

- Vaccination is an effective prevention measure and should be provided where workers may be at risks of hepatitis B, waterborne diseases (cholera, typhoid fever, rotavirus), or exposed to other biological agents that may be used in bioterrorism – such as botulism, tularaemia and smallpox.

Maintenance and storage of personal protective equipment:

- PPE must be selected according to the type of emergency, the hazards at the scene, and the typical duties assigned to a specific group of emergency workers.
- The person responsible for disaster control or for the emergency workers' group in question must take responsibility for selecting additional or alternative PPE. Fit, adjustment, combination with other PPE, specific properties and performance must all be considered.
- For hazard assessment and monitoring at a disaster scene, risks can often be evaluated only by sight, since more complex and detailed monitoring is not possible.
- The correct PPE must be selected, it must be available at the scene and workers must be familiar with it to be able to use it properly.
- In case of terrorist attacks and gun rampages where emergency workers might be soft targets, they might at least be partly protected by bullet-proof and knife-proof vests, safety shoes, helmets and protective clothing. The possible use of protective clothing for rescue workers should therefore also be considered in critical cases and could be routinely available in ambulances.

- Standard safety equipment should include high-visibility reflective material (apparatus, such as cones and signs, and personal protection clothing such as vests and helmets), and additional warning signs and lights. This is particularly important for the safety of emergency and rescue workers in transport accidents, or at disaster and emergency scenes where heavy machines such as cranes and excavators are deployed and visibility is reduced, and when working during nights.
- Chemical detection equipment, gas detectors, radiation alarm systems, fire systems, and the use of safe vehicles may be required in relevant cases.
- Appropriate protective clothing must be provided (skin and body protection from physical risks and dangerous substances). Some examples may be the use of mosquito nets that are treated with insecticides and the use of indoor insect spray, alcohol hand-rub for decontaminating hands to protect against infection. To allow clean and antiseptic working, it is important that PPE such as gloves be used and changed regularly.

Ergonomic equipment

Ergonomic equipment which can reduce workers' strain and their exposure to risks should be considered wherever possible. Examples of use of ergonomically suitable equipment during emergencies include:

- use of mobile equipment to carry bodies or any necessary apparatus;
- use of devices such as elevators when rescuing people from tall buildings;
- transportation of first aid kits in a backpack rather than in bags when walking long distances to the scene of the emergency;
- provision to emergency medical staff of syringes that have safety features that prevent needle-stick injuries and reduce infection risks, complemented with sharps boxes and special training.

Psychological preparedness:

Psychological preparedness at work should help emergency workers to cope with the emotional burdens of their jobs.

Post-interventions psychological help:

Social support during and after deployment in an emergency situation and opportunities to talk and have calm discussions with colleagues or a psychologist have been found to help emergency workers to cope with psychological strain. However, in the case of serious or long-lasting symptoms of mental health problems such as post-traumatic stress disorder, professional help may be necessary.

Long-term care and health surveillance:

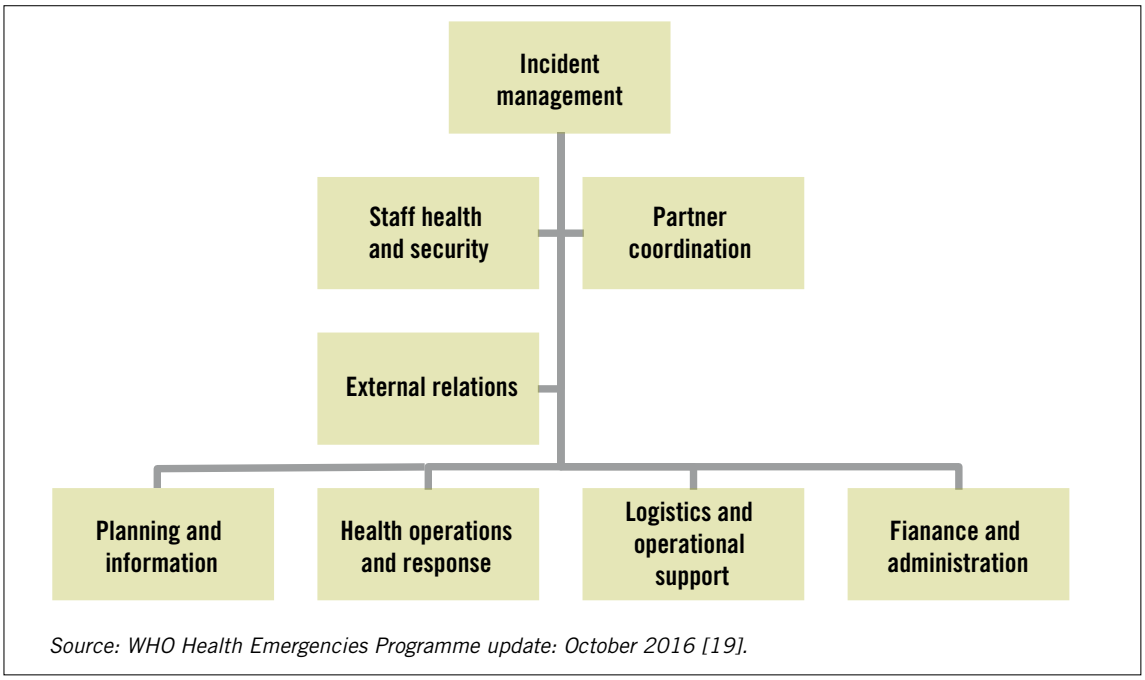
- Health surveillance should be adapted to the tasks required of emergency workers, and should take into consideration potential exposures to different hazards,
- Regular health monitoring through mandatory annual medical examinations, and medical examinations following deployment in major incidents, are helpful in order to:

- assess the physical fitness (including cardiopulmonary testing) of emergency workers;
- detect possible diseases and injuries caused by hazard exposure;
- offer the treatment and rehabilitation necessary at an early stage to protect workers from more severe effects; and
- improve their prospects of recovery.

2.3 The World Health Organization Health Emergencies programme

WHO is currently reforming its emergency programme with the aim of responding rapidly and effectively to health emergencies. The new programme *[19]* refines WHO's role in emergency responses, adding stronger operational capabilities to WHO's traditional technical and standard-setting roles. Under the programme, WHO is helping countries to address the full risk management cycle of prevention, preparedness, response and early recovery.

Figure 3. WHO Health Emergencies Programme incident management structure (simplified)



Source: WHO Health Emergencies Programme update: October 2016 [19].

Organizational structure

The Health Emergencies Programme has a common structure across WHO's country offices, regional offices and headquarters. This means there is one unified emergencies programme with one workforce, one budget, one line of accountability, a single set of processes/systems and a single set of benchmarks. This structure and the results expected are the same in all WHO offices.

The programme is made up of five technical and operational departments, as follows:

Infectious hazards management ensures that strategies and capacities are established for priority high-threat infectious hazards.
Country health emergency preparedness and the International Health Regulations (2005) ensure that country capacities are established for all-hazards emergency risk management.
Health emergency information and risk assessments provide timely and authoritative situation analysis, risk assessment and response monitoring for all major health threats and events.
Emergency operations ensure that emergency-affected populations have access to an essential package of life-saving health services.
Emergency core services ensure that WHO emergency operations are rapidly and sustainably financed and staffed.

Partner coordination

The Health Emergencies Programme works with its partners to protect and save people's lives in all health emergencies. During a crisis, WHO works with the local Ministry of Health and other partners to identify where health needs are greatest and to coordinate the efforts of partner organizations in order to ensure that these areas are covered by both medical supplies and personnel.

WHO regularly collaborates with partner networks to leverage and coordinate the expertise of hundreds of partner agencies. The key partners include the following:

Global Health Cluster: More than 300 partners are responding in 24 crisis-affected countries.
Emergency Medical Teams: More than 60 teams from 25 countries are classified by WHO to provide clinical care in the wake of emergencies.
Global Outbreak Alert and Response Network (GOARN): Since 2000, approximately 2500 health personnel have been deployed in response to over 130 public health emergencies in 80 countries.
Standby Partners: In 2015, WHO's Standby Partners deployed 207 months of personnel support to 18 countries.
Inter-Agency Standing Committee (IASC): WHO is an active member of IASC, the primary mechanism for inter-agency coordination relating to humanitarian assistance in response to complex and major emergencies under the leadership of the Emergency Relief Coordinator.

Country support

WHO's Health Emergencies Programme provides the following services to countries:

- support to the assessment of country health emergency preparedness, and development of national plans to address critical gaps in capacity;
- development of strategies and capacities to prevent and control high-threat infectious hazards; and
- monitoring of new and ongoing public health events to assess, communicate and recommend action for public health risks.

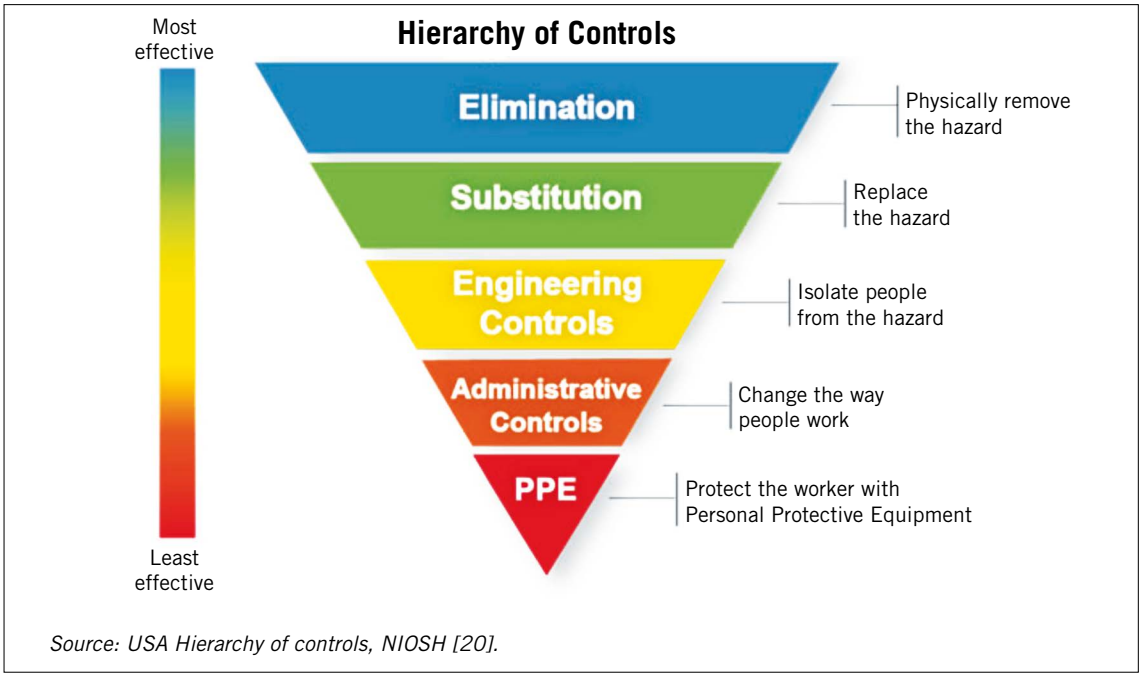
In addition, WHO is working with countries and partners to:

- ensure readiness to diminish public health risks in countries with high vulnerability; and
- provide life-saving health services to affected populations in countries with ongoing emergencies.

2.4 Occupational safety and health controls

To manage the health and safety risks due to various hazards, measures need to be in place for both prevention and mitigation. In OSH, the hierarchy of controls (Figure 4) refers to the preferred order of selecting control measures, from the most effective to the least effective *[20]*. The underlying philosophy is that it is always best to first try to eliminate the hazard. Where that is not possible, the hazard should be firstly contained at the source, secondly along the path, and lastly at the person. Each setting is different, making a workplace assessment necessary to identify hazards and to define control measures.

Figure 4. Hierarchy of occupational safety and health controls



Source: USA Hierarchy of controls, NIOSH [20].

Controlling at the source means eliminating the hazard, or whatever is exposing the workers to risk. This can include implementing a triage process to avoid placing patients with highly infectious diseases, such as viral haemorrhagic fevers, in general health-care facilities outside treatment and care centres for infectious diseases, plus killing/inactivating the virus in specimens for laboratory-testing, containing excreta to allow for natural virus die-off, destroying contaminated waste through incineration or autoclaving, and choosing the least hazardous alternative (e.g. oral instead of intravenous administration of rehydration therapy, and using a prick test instead of phlebotomy for drawing blood samples).

Control along the path refers to engineering and administrative controls that create a barrier between the source of the hazard and the worker. For example, safety-engineered devices are more effective in preventing needle-stick injuries and associated exposure to bloodborne pathogens than training individuals to use needles safely. Engineering controls for highly infectious diseases, such as EVD and other viral haemorrhagic fevers, include laminar flow boxes in laboratories, negative pressure rooms and containment (bubble) beds for clinical care, and needleless intravenous systems to reduce the risk of sharps injuries. In addition, safe water and sanitation services are necessary to ensure sufficient water for hygiene measures and proper disposal of excreta.

Administrative controls aim to prevent risky behaviours and include training workers in safe working methods, defining standard operating policies and procedures for safer work practices, and restricting access to high-risk workplaces. Training on policies and procedures, in donning and doffing (putting on and removing) PPE, and in quarantine and isolation procedures are examples of administrative measures to prevent transmission of highly infectious diseases such as EVD and other viral haemorrhagic fevers. Triage is the process of sorting. In specialized treatment units such as those for cholera and EVD, triage is a crucial administrative control that prevents spread of infection among patients and to health-care workers. Another form is the medical surveillance of workers at risk in order to detect any unfavourable health effects of occupational hazards at an early stage when it is easier to treat the disease (e.g. by monitoring workers for fever or other early symptoms of infectious disease).

Control at the person is the least effective measure in the hierarchy of controls. It involves the use of PPE, including impermeable gown or coverall (if the gown is not impermeable, an impermeable apron should be worn), double gloves, respirator, hood to cover neck and face, eye protection (goggles or face-shield) and boots/closed shoes with overshoes. In addition, training in proper PPE wear, removal, storage and maintenance is needed to ensure that the highest possible level of protection is achieved. In general, the above-recommended PPE should be worn, but risk assessments should be completed for specific tasks in order to select the most appropriate PPE for them. Medical examinations assessing fitness for work aim to identify health conditions that can be exacerbated or made worse by exposure to occupational hazards. In the disease outbreak response in West Africa, access to quality medical care in the field was extremely limited. Therefore, medical clearance to ensure fitness for work was necessary to avoid any complications from pre-existing medical conditions during deployment in outbreak-affected countries.

However, during outbreaks of highly infectious agents, the use of PPE becomes one of the most immediate measures for safeguarding the health and safety of care providers, along with other administrative controls.

2.5 Strategies for infection prevention and control

IPC strategies also involve a hierarchy of controls. Administrative controls are the most important components of infection prevention strategies, and include implementation and facilitation of IPC precautions and safe patient care practices. Environmental and engineering controls can help reduce the spread of some pathogens associated with health care, but safe behaviour is the key. Last in the hierarchy of controls is PPE.

Administrative controls provide policies and standard operating procedures to prevent exposure to, and transmission of, infectious agents to a susceptible person. These include: organizational support for IPC and for management of outbreaks; organization of services; policies on rational use of available supplies and strengthening of IPC infrastructure; education of health-care workers; point-of-care risk assessment; patient triage for early detection; patient placement and reporting; patient flows; zoning; dedicated personnel; regulating entries to isolation facilities; restricting visitors; procedures for environmental cleaning; management of linen and waste; and reduction of intravenous procedures.

Engineering and environmental controls include, for instance, the following: isolation rooms with private toilet facilities for patient triage; physical barriers; ventilation; installation of point-of-use sharps containers; hand-washing facilities and appropriately functioning and accessible hand-rub

dispensers; an appropriate number of commodes; safe needle devices; and safe water and sanitation services, including off-site disposal and treatment of sewage and health-care waste.

2.5.1 Standard precautions

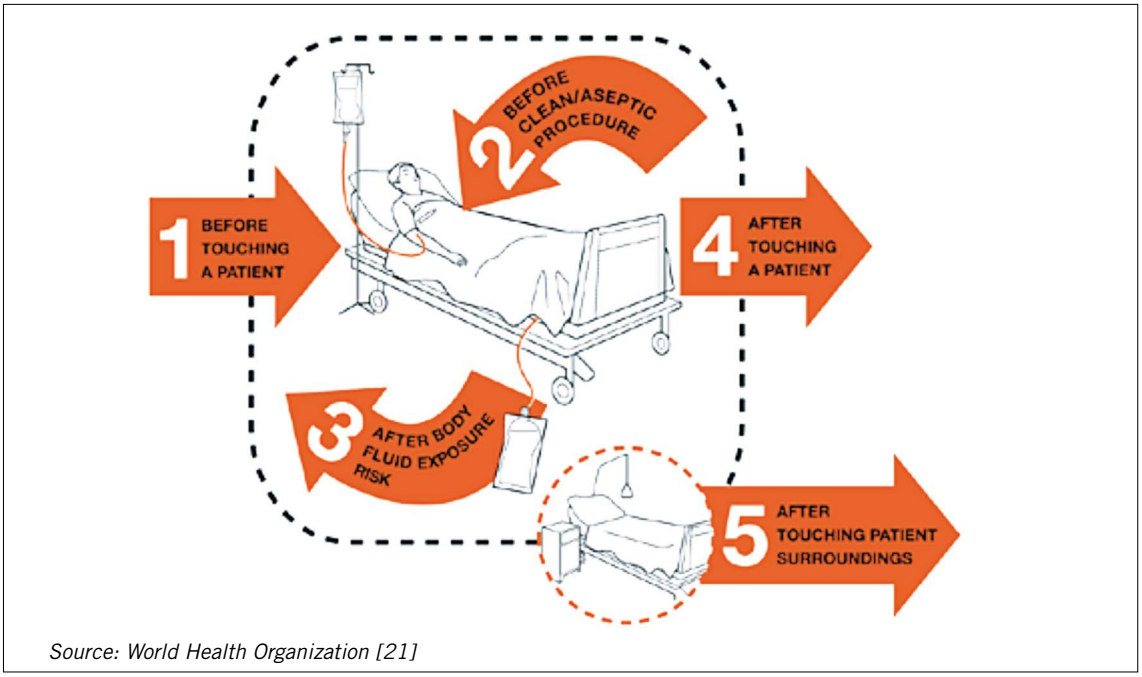
Standard precautions are meant to reduce the risk of transmission of bloodborne and other pathogens from both recognized and unrecognized sources. They are the basic level of infection control precautions which are to be used, as a minimum, in the care of all patients *[21]*.

Hand hygiene is a major component of standard precautions and is one of the most effective methods to prevent transmission of pathogens associated with health care. In addition to hand hygiene, the use of PPE should be guided by risk assessment and the extent of exposure anticipated with blood and body fluids or pathogens.

"My 5 moments for hand hygiene" is an approach developed by WHO that defines the key moments when health-care workers should perform hand hygiene. The situations where hand hygiene is required in clinical care settings include following:

1. Before touching a patient: to protect the patient against colonization and, in some cases, against exogenous infection, by harmful germs carried on care providers' hands
    - Cleaning of hands before touching a patient when approaching him/her.
2. Before clean/aseptic procedure: to protect the patient against infection from harmful germs, including his/her own germs, entering his/her body
    - Hands must be cleaned immediately before accessing a critical site with infectious risk for the patient (e.g. a mucous membrane, non-intact skin, an invasive medical device).
3. After body fluid exposure risk: to protect the care provider from colonization or infection with the patient's harmful germs and to protect the health-care environment from germ spread
    - Cleaning of hands as soon as the task involving an exposure risk to body fluids has ended (and after glove removal).
4. After touching a patient: to protect the care provider from colonization with the patient's germs and to protect the health-care environment from germ spread
    - Cleaning of hands when leaving the patient's side, after having touched the patient.
5. After touching the patient's surroundings: to protect the care provider from colonization with the patient's germs that may be present on surfaces/objects in the patient's surroundings and to protect the health-care environment against germ spread
    - Cleaning of hands after touching any object or furniture when leaving the patient's surroundings, without having touched the patient.

Figure 5. My 5 moments for hand hygiene



Source: World Health Organization [21]

Summary technique

- Hand-washing (40–60 seconds): wet hands and apply soap; rub all surfaces; rinse hands and dry thoroughly with a single-use towel; use towel to turn off faucet.
- Hand-rubbing (20–30 seconds): apply enough product to cover all areas of the hands; rub hands until dry.

Hand hygiene and use of medical gloves

- The use of gloves does not replace the need for cleaning hands.
- Hand hygiene must be performed when appropriate, regardless of the indications for glove use.
- Remove gloves to perform hand hygiene when an indication occurs while wearing gloves.
- Discard gloves after each task and clean hands (gloves may carry germs).
- Wear gloves only when indicated according to Standard and Contact Precautions; otherwise they become a major risk for germ transmission.

Prevention of needle-stick injuries and other blood exposures using a hierarchy of controls

A hierarchy of controls to prevent needle-stick injuries and other blood exposures among health workers, as recommended in *WHO best practices for injections and related procedures [22]* is given below by order of effectiveness (most effective first).

Elimination of hazard: Complete removal of a hazard from the work area is the most effective way to control a hazard. This approach should be used whenever possible. Examples include removing sharps and needles when possible (e.g. by substituting jet injectors for needles and

syringes, or using needleless intravenous systems), eliminating all unnecessary injections, and eliminating unnecessary sharps such as towel clips.

Engineering controls: These are used to isolate or remove a hazard from a workplace. Examples include: sharps disposal containers; when possible, use of sharps protection devices for all procedures (devices with needles that retract, sheathe or blunt immediately after use).

Administrative controls: These are policies, such as standard operating procedures, which aim to limit exposure to the hazard. Examples include: allocation of resources demonstrating a commitment to health-worker safety; a needle-stick injury prevention committee; an exposure control plan; removal of all unsafe devices; and consistent training on the use of safe devices.

Work practice controls: These are controls to change the behaviour of workers in order to reduce exposure to occupational hazards. Examples include: no needle recapping; placing sharps containers at eye level and within arms' reach; sealing and discarding sharps containers when they are three quarters full; and establishing means for the safe handling and disposal of sharps devices before beginning a procedure.

Personal protective equipment

The level of personal protective equipment is the same to elimination of hazards, engineering controls, administrative controls, and work practice controls. It is the 5th element of hierarchy of controls. The use and disposal PPE is essential for reducing exposure. Policies and procedures should specify details on selecting PPE for each job, the location of PPE, and training on how to put on PPE – including the order of donning, decontamination, removal of PPE, and disposal or storage. Additionally, training that includes emphasis on a buddy system, partnering for assistance and review, on donning, use and doffing can increase successful use of PPE.

Selecting PPE: The use of PPE requires selection factors that include supply, size, fit, protection level, comfort, design and experience in use. For example, glove selection is based on the type of exposure. Non-latex gloves are used for protection from infectious diseases, while chemical-resistant gloves are used for protection from chemicals. Other considerations include providing PPE in various sizes and manufactures for fit and comfort which can be key factors in appropriate use.

Gloves

Gloves must be worn according to Standard and Contact Precautions:

- Hand hygiene should be performed when appropriate, regardless of indications for glove use.
- Use of sterile gloves is indicated when an invasive procedure involving mucus membranes or blood is involved (e.g. surgical operations, vaginal delivery, invasive radiological procedures, invasive cardiovascular procedures, total parenteral nutrition and chemotherapeutic agent).
- The use of examination gloves is indicated when there is potential for touching blood, body fluids, secretions, excretions and items visibly soiled by body fluids.
    - Situations with risk of direct human exposure include: contact with blood, contact with mucous membrane and with non-intact skin, and the potential presence of highly infectious and dangerous organisms; epidemic or emergency situations; IV insertion and removal; drawing blood; discontinuation of venous line; pelvic and vaginal examination; and suctioning non-closed systems of endotracheal tubes.

- Situations with risk of indirect patient exposure include: emptying emesis basins, handling cleaning instruments, handling wastes, and cleaning spills of body fluids.

- Use of gloves is not indicated except for Contact Precautions, when there is no potential for exposure to blood, body fluids or a contaminated environment.
- Situations with risk of direct human exposure include: taking blood pressure, temperature and pulse; performing subcutaneous and intramuscular injections; bathing and dressing the patient; transporting patients; caring for eyes and ears (without secretions); and any vascular line manipulation in the absence of blood leakage.
    - Situations with risk of indirect patient exposure include using the telephone; writing in the patient chart; giving oral medications; distributing or collecting patient dietary trays; removing and replacing linen for the patient's bed; placing non-invasive ventilation equipment and oxygen cannula; and moving patient's furniture.

Facial protection (eyes, nose, and mouth)

A surgical or procedure mask and eye protection (eye visor, goggles) or a face-shield should be worn to protect mucous membranes of the eyes, nose and mouth during activities that are likely to generate splashes or sprays of blood, body fluids, secretions and excretions. Shoe/boot covers, hoods and aprons should also be worn.

Gowns and coveralls

Gowns and coveralls should be worn to protect skin and to prevent soiling of clothing during activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions. The soiled gown or coverall should be removed as soon as possible, and hand hygiene should be performed.

Respirators

Respirators protect workers from airborne hazards.

- There are two types of respirator: air-purifying and atmosphere-supplying. Respirators can also be classified as tight-fitting or loose-fitting. N95 respirators or respirators with a higher protection factor should be used when inhalation hazards are present. Tight-fitting respirators include a tight seal between the respirator and the face and/or neck of the user.
- If the respirator's seal leaks, contaminated air will be pulled into the face-piece and can be breathed in. Therefore, anything that interferes with the respirator seal (such as facial hair, earrings, headscarves, wigs and facial piercings) is not permitted. Loose-fitting respirators do not depend on a tight seal with the face to provide protection and therefore they do not need to be fit-tested.
- The employee must be medically cleared and fit-tested with the same make, model, style and size of respirator that will be used. Fit-testing is done to be sure that the respirator's face-piece fits the face. Respirators must be fit-tested before being used for the first time. Retesting should be conducted at least every 12 months to be sure that the respirator continues to fit. Additionally, fit-testing needs to be repeated if there are changes in facial features from surgery or weight gain.
- A user seal check is performed by the wearer each time the respirator is put on. The check determines if the respirator is properly seated to the face or needs to be readjusted.

- Masks or surgical masks are NOT respirators and do not protect the user from exposure to airborne hazards.

Donning and doffing of personal protective equipment

For effective use of PPE to protect health workers, it is essential to follow standard procedures for putting on and take off the equipment.

Donning PPE

Gown:

- Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back.
- Fasten at back of neck and waist. Use duct tape to secure.

Mask or respirator:

- Secure ties or elastic bands at middle of head and neck.
- Fit flexible band to nose bridge.
- Fit snug to face and below chin.
- Fit-check respirator.

Goggles or face-shield:

- Place over face and eyes and adjust to fit.

Gloves:

- Extend to cover wrist of isolation gown.

Doffing PPE

Gloves:

- Outside of gloves is contaminated!
- Grasp outside of glove with opposite gloved hand; peel off.
- Hold removed glove in gloved hand.
- Slide fingers of ungloved hand under remaining glove at wrist.
- Peel off the second glove.
- Discard gloves in waste container.

Goggles or face-shield:

- Outside of goggles or face-shield is contaminated!
- To remove, handle by head band or ear pieces.
- Place in designated receptacle for reprocessing or discard in waste container.

Gown:

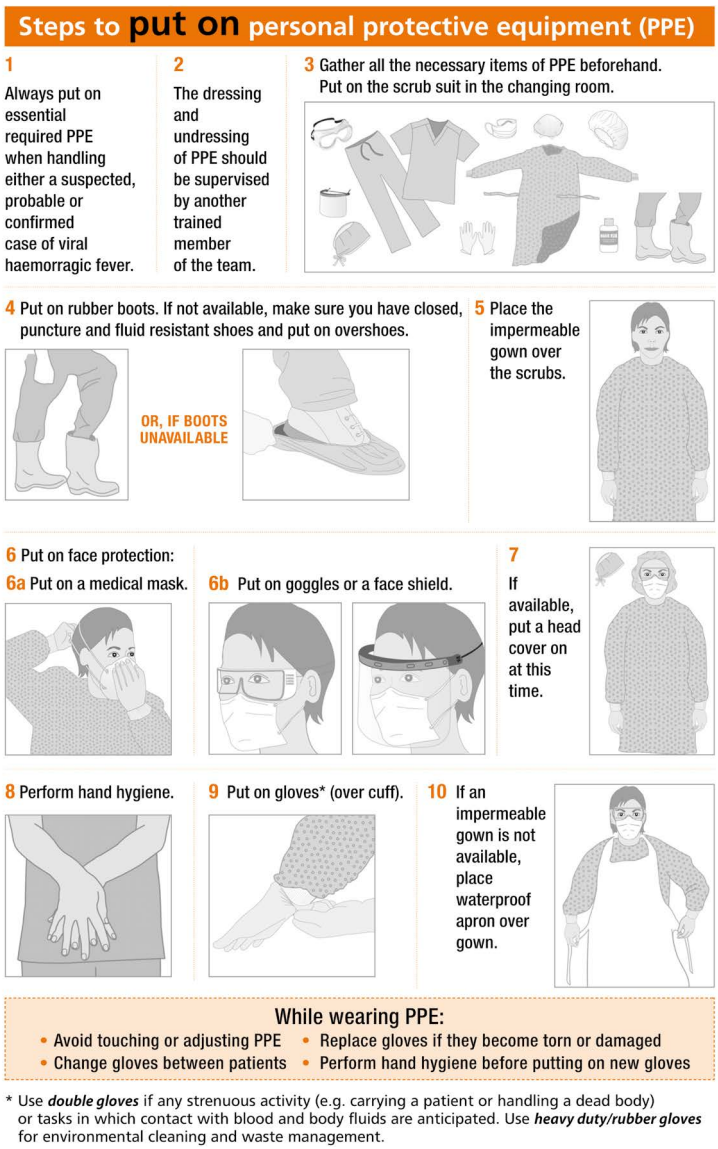
- Gown front and sleeves are contaminated!

- Unfasten ties.
- Pull away from neck and shoulders, touching inside of gown only.
- Turn gown inside out.
- Fold or roll into a bundle and discard.

Mask or respirator:

- Front of mask/respirator is contaminated — DO NOT TOUCH!
- Grasp bottom, then top ties or elastics and remove.
- Discard in waste container.

Figure 6. Putting on personal protective equipment



Source: World Health Organization [13]

Additional (transmission-based) precautions

Additional (transmission-based) precautions are taken while ensuring that standard precautions are maintained. Additional precautions, as described by WHO in *Practical guidelines for infection control in health-care facilities [23]* include airborne precautions, droplet precautions and contact precautions.

Airborne precautions

Airborne precautions are designed to reduce the transmission of diseases spread by the airborne route. Airborne transmission occurs when droplet nuclei (evaporated droplets) less than 5 microns in size are disseminated in air. These droplet nuclei can remain suspended in the air for some time. Droplet nuclei are the residuals of droplets and, when suspended in the air, dry and produce particles in the range of 1-5 microns. These particles can remain suspended in the air for long periods of time, especially when bound to dust particles.

Diseases which spread by this mode include open/active pulmonary tuberculosis (TB), measles, chicken pox, pulmonary plague and haemorrhagic fever with pneumonia.

The following precautions need to be taken:

- Implement standard precautions.
- Place the patient in a separate room that has a monitored negative airflow pressure (often referred to as a "negative pressure room").
- The air should be discharged to the outdoors, or should be specially filtered before it is circulated to other areas of the health-care facility.
- Keep doors closed.
- Anyone who enters the room must wear a special, high filtration, particulate respirator (e.g. N95) mask.
- Limit movement and transport of the patient from the room to essential purposes only.
- If transport is necessary, minimize dispersal of droplet nuclei by masking the patient with a surgical mask.
- Gain the support of engineering services to ensure that the negative airflow pressure is maintained.

Droplet precautions

Diseases which are transmitted by this route include pneumonias, pertussis, diphtheria, influenza type B, mumps and meningitis. Droplet transmission occurs when there is adequate contact between the mucous membranes of the nose and mouth or conjunctivae of a susceptible person and large particle droplets (> 5 microns). Droplets are usually generated from the infected person during coughing, sneezing, talking or when health-care workers undertake procedures such as tracheal suctioning.

The following precautions need to be taken:

- Implement standard precautions.
- Place the patient in a separate room (or in a room with another patient infected by the same pathogen).

- Wear a surgical mask when working within 1-2 metres of the patient.
- Place a surgical mask on the patient if transport is necessary.
- Special air-handling and ventilation are not required to prevent droplet transmission of infection.

Contact precautions

Diseases which are transmitted by this route include colonization or infection with multiple antibiotic-resistant organisms, enteric infections and skin infections.

The following precautions need to be taken:

- Implement standard precautions.
- Place the patient in a separate room (or in a room with another patient infected by the same pathogen).
- Consider the epidemiology of the disease and the patient population when determining patient placement.
- Wear clean, non-sterile gloves when entering the room.
- Wear a clean, non-sterile gown when entering the room if substantial contact with the patient, environmental surfaces or items in the patient's room is anticipated.
- Limit the movement and transport of the patient from the room. Patients should be moved for essential purposes only. If transportation is required, use precautions to minimize the risk of transmission.

Environmental cleaning

- Routine cleaning is important to ensure a clean and dust-free hospital environment. Many microorganisms are usually present in "visible dirt", and routine cleaning helps to eliminate this dirt.
- Administrative and office areas with no patient contact require normal domestic cleaning.
- Most patient care areas should be cleaned by wet mopping.
- Dry sweeping is not recommended. The use of a neutral detergent solution improves the quality of cleaning. Hot water (80°C) is a useful and effective environmental cleaner.
- Bacteriological testing of the environment is not recommended except when seeking a potential source of an outbreak.
- Any areas visibly contaminated with blood or body fluids should be cleaned immediately with detergent and water.
- Isolation rooms and other areas that have patients with known transmissible infectious diseases should be cleaned with a detergent/disinfectant solution at least daily.
- All horizontal surfaces and all toilet areas should be cleaned daily.

Laundry

Linen: The basic principles of linen management are as follows:

- Place used linen in appropriate bags at the point of generation.

- Contain linen soiled with body substances or other fluids within suitable impermeable bags and close the bags securely for transportation to avoid any spills or drips of blood, body fluids, secretions or excretions.
- Do not rinse or sort linen in patient care areas (sort in appropriate areas).
- Handle all linen with minimum agitation to avoid aerosol generation of pathogenic microorganisms.
- Separate clean linen from soiled linen and transport/store separately.
- Wash used linen (sheets, cotton blankets) in hot water (70-80°C) and detergent, rinse and dry preferably in a dryer or in the sun. (Heavy duty washers/dryers are recommended for hospital laundry.)
- Autoclave linen before it is supplied to the operating rooms/theatres.
- Wash woollen blankets in warm water and dry in the sun, in dryers at cool temperatures or dry-clean.

Bedding:

- Mattresses and pillows with plastic covers should be wiped over with a neutral detergent.
- Mattresses without plastic covers should be steam-cleaned if they have been contaminated with body fluids. If this is not possible, contaminations should be removed by manual washing, ensuring adequate personnel and environmental protection.
- Wash pillows either by using the standard laundering procedure described above, or dry-clean if contaminated with body fluids.

Reprocessing of instruments and equipment

Reprocessing of instruments and equipment in an effective way includes following activities:

- cleaning instruments and equipment immediately after use to remove all organic matter, chemicals and
- disinfection (by heat and water or chemical disinfectants) or
- sterilization.

Patient care equipment

- Equipment soiled with blood, body fluids, secretions, excretions etc. should be handled in a manner that prevents skin and mucous membrane exposures, contamination of clothing, and transfer of pathogens to other patients or the environment.
- Reusable equipment should be cleaned, disinfected and reprocessed appropriately before use with another patient.

Used personal protective equipment

WHO's *Practical guidelines for infection control in health-care facilities* recommends certain measures (see Table 1) for management of used PPE *[23].*

Table 1. Management of used personal protective equipment

Equipment	Standard procedure	Comments
N95 or standard surgical mask Use disposable only		Discard in an appropriate waste bag according to the health-care facility guidelines
HEPA (P100) mask Use disposable filters only	Separate the filters from the mask and discard the filters. Clean the mask with detergent and water, dry and disinfect with 70% alcohol before reuse.	Discard the filters in an appropriate bag according to the health-care facility guidelines.
Eye protector, goggles, face-shield Use of disposable items is recommended	If reusable, clean with detergent and water, dry, and disinfect with 70% alcohol or soak in 1% hypochlorite solution for 20 minutes and rinse and dry.	If disposable, discard in appropriate waste bag according to the health-care facility guidelines.
Gown Use of disposable gowns is recommended	If reusable: launder according to the health-care facility guidelines for soiled linen e.g. launder in hot water (70-80°C) if possible OR Soak in clean water with bleaching powder 0.5% for 30 minutes. Wash again with detergent and water to remove the bleach.	If disposable, discard in an appropriate waste bag according to the health-care facility guidelines. If reusable, ideally dry on a clothes drier or in the sun.
Apron Use of disposable aprons is recommended	If reusable Clean with detergent and water, dry, and disinfect with 70% alcohol.	If disposable, discard in an appropriate waste bag according to the health-care facility guidelines.
Cap and shoe covers Use of disposable caps is recommended	If reusable, launder according to the health-care facility guidelines for soiled linen (e.g. launder in hot water (70-80°C) if possible. OR Soak in clean water with bleaching powder 0.5% for 30 minutes. Wash again with detergent and water to remove the bleach.	If disposable, discard in an appropriate waste bag according to the health-care facility guidelines. If reusable: ideally dry in a clothes-drier or in the sun.
Gloves Use disposable only		Discard in the appropriate waste bag according to the health-care facility guidelines
Reusable boots	Clean with detergent and water, dry, disinfect with 70% alcohol	

Health-care waste management

Hospital waste is a potential reservoir of pathogenic microorganisms and requires appropriate, safe and reliable handling. The main risk associated with infection is sharps contaminated with blood. There should be a person or persons responsible for the organization and management

of waste collection, handling, storage and disposal. Waste management should be conducted in coordination with the infection control team.

In its guidance on *Safe management of wastes from health-care facilities* WHO *[24]* lists the following steps for the management of health-care waste:

- generation
- segregation/separation
- collection
- transportation
- treatment and disposal.

Principles of health-care waste management

The safe management of health-care waste involves a systematic approach based on regulatory requirements and available resources for handling and disposal. The key elements include the following actions by facility managers.

- Develop a waste management plan which is based on an assessment of the current situation and which minimizes the amount of waste generated.
- Separate the clinical (infectious) waste from nonclinical waste in dedicated containers.
- Transport waste in a trolley used only for that purpose.
- Store waste in specified areas with restricted access.
- Collect and store sharps in sharps containers. Sharps containers should be made of plastic or metal and have a lid that can be closed. They should be marked with the appropriate label or logo – e.g. a biohazard symbol for clinical (infectious) waste.
- Mark the storage areas with a biohazard symbol.
- Ensure that carts or trolleys used for the transport of segregated waste collection are not used for any other purpose; they should be cleaned regularly.
- Identify a storage area for waste prior to treatment or before it is taken to final disposal area.
- Treatment of hazardous and clinical/infectious waste must be carried out in accordance with national regulations and WHO guidelines. This may involve transportation of infectious waste to a centralized waste treatment facility or on-site treatment of waste.

2.5.2 Prevention of occupational respiratory infections in health-care settings

To prevent the transmission in health-care settings of all respiratory infections (including influenza, meningococcal meningitis) where infection spreads through droplets, the following infection control measures should be implemented at the first point of contact with a potentially infected person. These measures should be incorporated into infection control practices as one component of Standard Precautions.

1. Visual alerts

Visual alerts (in appropriate languages) should be displayed at the entrance to outpatient facilities (e.g. emergency departments, physicians' offices, outpatient clinics) instructing patients

and persons who accompany them (e.g. family, friends) to inform health-care personnel of symptoms of a respiratory infection when they first register for care, and to practice respiratory hygiene/cough etiquette.

The following precautions must be taken to prevent spread of infection from cough:

- Close contact with people who are sick should be avoided.
- Stay at home when sick.
- Cover mouth and nose with a tissue while coughing or sneezing.
- Wash hands often with soap and warm water for 60 seconds. If soap and water are not available, use an alcohol-based hand-rub.
- Avoid touching one's eyes, nose or mouth.
- Practice other good health habits. Clean and disinfect frequently-touched surfaces at home, work or school, especially when someone is ill. Have plenty of sleep, be physically active, manage your stress, drink plenty of fluids and eat nutritious food.

2. Respiratory hygiene/cough etiquette

The following measures to contain respiratory secretions are recommended for all individuals with signs and symptoms of a respiratory infection:

- Cover mouth and nose with a tissue when coughing or sneezing.
- Use the nearest waste receptacle to dispose of the tissue after use.
- If you do not have a tissue, cough or sneeze into your upper sleeve, not your hands.
- Perform hand hygiene (e.g. hand-washing with non-antimicrobial soap and water, alcohol-based hand-rub, or antiseptic hand-wash) after having contact with respiratory secretions and contaminated objects/materials.

Health-care facilities should ensure the availability of materials for respiratory hygiene/cough etiquette in waiting areas for patients and visitors.

- Provide tissues and no-touch receptacles for used tissue disposal.
- Provide conveniently located dispensers of alcohol-based hand-rub; where sinks are available, ensure that supplies for hand-washing (i.e. soap, disposable towels) are consistently available.

3. Masking and separation of persons with respiratory symptoms

During periods of increased respiratory infection activity in the community (e.g. work settings and increased medical office visits by persons complaining of respiratory illness), offer masks to persons who are coughing. Either procedure masks (i.e. with ear loops) or surgical masks (i.e. with ties) may be used to contain respiratory secretions (respirators such as N-95 or above are not necessary for this purpose). Where space and chair availability permit, encourage persons who are coughing to sit at least three feet away from others in common waiting areas. Some facilities may find it logistically easier to institute this recommendation all year round.

4. Droplet precautions

Advise health-care personnel to observe Droplet Precautions (i.e. wearing a surgical or procedure mask for close contact), in addition to Standard Precautions, when examining a patient with symptoms of a respiratory infection, particularly if fever is present. These precautions should be maintained until it is determined that the cause of symptoms is not an infectious agent that requires such precautions.

Chapter 3.

Common risks for safety and health in emergencies

Because of the high degree of infectivity and the case-fatality rate, infection with microbial agents is by far the main occupational health concern for persons involved in outbreak response and preparedness. However, in tropical and subtropical climatic conditions, emergency workers can also be at risk of exposure to common endemic diseases such as malaria, typhoid fever, cholera, hepatitis A and B, HIV/AIDS, tuberculosis, water and foodborne infections and other communicable diseases.

Apart from highly infectious agents, other hazards can further endanger the health of emergency responders and health-care workers. Endemic diseases, psychosocial stress, fatigue and violence in particular can reduce the working capacity of health-care and response workers and hinder the effectiveness of IPC measures. Heat stress due to prevailing climatic conditions as well as from working in heavy PPE can cause illness and can impose serious limitations on working capacity and productivity. Ergonomic concerns, such as manual handling of loads – i.e. patients and heavy materials – with awkward postures, can cause acute musculoskeletal injuries, diminishing work capacity and reduced ability to adhere to strict work practices thus increasing absenteeism.

Short-term expatriate workers and volunteers from all over the world comprise a significant part of the emergency response workforce. Their medical care, security and safety, accommodation, relations with local staff and communities, and adaptation to the climate and sociocultural context of affected countries can also be challenging. This calls for a comprehensive multidisciplinary approach to protecting the health, safety and welfare of the outbreak and emergency response workforce, including measures in OSH, IPC, emergency response, logistics and social welfare. This section presents information on hazards that occur to varying degrees in almost all types of outbreaks and emergencies, plus measures for their prevention and control

3.1 Vector-borne diseases

Countries affected by highly infectious pathogens such as cholera, yellow fever and viral haemorrhagic fevers (e.g. Ebola or Marburg virus disease), are also often endemic for malaria, dengue and other vector-borne diseases. Malaria causes fever and can resemble viral haemorrhagic fevers such as EVD in the early stages, potentially leading to misclassification and isolation in a specialized treatment unit. Chemoprophylaxis for malaria and vigilance in personal protection against mosquitoes and other vectors during day and night are important in preventing vector-borne diseases.

Workers deployed in affected areas with high endemicity of vector-borne diseases such as malaria should take the following precautions:

- Wear long-sleeved clothes.

- Use insect repellent day and night.
- Sleep under an insecticide-impregnated bednet.
- Take malaria chemoprophylaxis before, during and after the deployment, as advised by a medical professional.
- Be aware of the risk, the incubation period, the possibility of delayed onset, and the main symptoms (fever plus influenza-like symptoms, diarrhoea).
- Immediately seek diagnosis and treatment if a fever develops 1 week or more after entering an area where there is a malaria risk and up to 3 months (or, rarely, later) after departure from a risk area.
- Carry standby treatment for malaria, as advised by a medical professional.

3.2 Water and foodborne diseases

Emergency responders have to work in remote areas and difficult conditions where safe food and water may not be available; their stay may involve drinking water from locally available sources as well as cooking locally available foods. In its guidelines for drinking water quality *[25]*, WHO recommends the following measures to travellers to prevent hazards and risks from unsafe water:

- Always avoid consumption or use of unsafe water (even when brushing teeth) if water quality cannot be ensured.
- Avoid unpasteurized juices and ice made from untreated water.
- Avoid salads or other uncooked meals that may have been washed or prepared with unsafe water.
- Drink water that has been boiled, filtered and/or treated with chlorine or iodine and stored in clean containers.
- Consume ice only if it is known to be of drinking-water quality.
- Drink bottled water if it is known to be safe, carbonated bottled beverages (water and sodas) only from sealed, tamper-proof containers and pasteurized/canned juices and pasteurized milk.
- Drink coffee and tea made from boiled water and served and stored in clean containers.

Food safety

In its food safety guidance *[26]*, WHO has specified "five keys to food safety" that cover the following areas of food safety that are required for food preparation and serving in order to maintain the quality and safety of food:

Keeping food preparation areas clean**:** While most microorganisms do not cause disease, dangerous microorganisms are widely found in soil, water, animals and people. These microorganisms are carried on hands, wiping cloths and utensils – especially cutting boards – and the slightest contact can transfer them to food and cause foodborne diseases. Therefore, hand hygiene, environmental sanitation and pest control must be applied in kitchen and storage areas.

Separation of raw and cooked food: Raw food – especially meat, poultry and seafood, and their juices – can contain dangerous microorganisms which may be transferred onto other foods during food preparation and storage. To prevent this, raw meat, poultry and seafood should be kept separate from other foods, and separate equipment and utensils such as knives and cutting boards should be used. Food should be stored in containers to avoid contact between raw and prepared foods.

Thorough cooking of food**:** Proper cooking kills almost all dangerous microorganisms. Studies have shown that cooking food to a temperature of 70°C can help ensure that it is safe for consumption. Foods that require special attention include minced meats, rolled roasts, large joints of meat and whole poultry. Consequently it is essential that food is cooked thoroughly – especially meat, poultry, eggs and seafood – and if cooked food needs to be reheated this should be done thoroughly. Foods like soups and stews need to be brought to boiling to make sure that they have reached 70°C and, for meat and poultry, to ensure that the juices are clear, not pink.

Keeping food at safe temperatures**:** Microorganisms can multiply very quickly if food is stored at room temperature. By holding food at temperatures below 5°C or above 60°C, the growth of microorganisms is slowed or stopped. It is essential that cooked food should not be kept at room temperature for more than 2 hours. All cooked and perishable food should be refrigerated preferably below 5°C. Even food in the refrigerator should not be stored for long and frozen food should be thawed at room temperature before cooking. The cooked food should be kept piping hot, preferably at more than 60°C prior to serving.

Use of safe water and raw materials**:** Raw materials, including water and ice, may be contaminated with dangerous microorganisms and chemicals. Toxic chemicals may be formed in damaged and mouldy foods. Care in selecting raw materials and simple measures such as washing and peeling may reduce the risk. It is essential that safe water is used, or water should be made safe by boiling or by use of chlorine tablets or solutions. Fresh and wholesome foods should be selected, pasteurized milk should be used, and fruits and vegetables, especially if eaten raw, must have been washed thoroughly. Packaged food should not be used beyond its expiry date *[26]*.

3.3 Vaccine-preventable diseases

Immunization against vaccine-preventable endemic diseases is one of the most valuable protective measures to protect health-care workers and emergency responders from highly communicable diseases. Workers deployed to areas with high prevalence of endemic diseases should be up to date with the vaccinations required for the area of deployment.
WHO has summarized guidance for immunization of health-care workers against various vaccine-preventable diseases on its website *[27]*.

For example, for the responders deployed in the Ebola response in West Africa, WHO recommended that vaccines be given against the following diseases prior to deployment *[28]*:

- yellow fever (mandatory);
- diphtheria-tetanus (ideally within 5 years), polio, pertussis;
- typhoid fever;
- hepatitis A and B;
- meningitis ACYW 135 (mandatory if outbreak is ongoing);

- measles for persons born after 1963 who did not have the disease, or 2 doses of measles-mumps-rubella vaccine (MMR);
- rabies;
- cholera (vaccine recommended in limited situations, based on risk assessment).

3.4 Heat stress

Emergency workers who are exposed to extreme heat or who work in hot environments may be at risk of heat stress. Exposure to extreme heat can result in occupational illnesses and injuries. Heat stress can result in heat stroke, heat exhaustion, heat cramps or heat rashes. Heat can also increase the risk of injuries in workers as it may result in sweaty palms, fogged-up safety glasses, and dizziness. Burns may also occur as a result of accidental contact with hot surfaces or steam.

Emergency response work during natural disasters, chemical and radiological incidents and outbreaks often involves prolonged exposure to heat due to working outdoors under the sun. In addition, emergency responders working to fight fires during disasters, wildfires and other fire-related emergencies may suffer from direct impacts such as burns.

Use of recommended PPE which covers the entire body, or a large part of the body/skin surface, in semi-permeable and impermeable materials – as required by fire-fighters and health-care workers in specialized treatment units – traps heat and sweat. This limits the body's protective mechanism of evaporative cooling and instead promotes heat storage and increased body temperature. This is compounded in settings where care is provided outdoors in hot and humid conditions, and where electrical power and air-conditioning are lacking.

The following administrative and work practice measures to prevent and manage heat stress and its impacts are advised by the United States Centers for Disease Control and Prevention (USCDC) *[29]*:

- Time for acclimatization: For workers who are new to the hot region, work exposure time in hot environmental conditions should be increased gradually over 7-14 days to reduce the risk of heat-related illnesses and increase the ability to work safely. If this is not possible, workers new to the climate should work shorter shifts until their bodies adjust to the heat. Workers new to the climate should be scheduled to carry out no more than 20% of the usual work shift on their first day, with no more than a 20% increase on each additional day. Workers with previous experience with the job in this climate should be scheduled for no more than 50% of the usual work shift on Day 1, 60% on Day 2, 80% on Day 3 and 100% on Day 4.
- Increasing awareness of all workers: Workers need to be able to recognize the symptoms of heat-related illnesses. These illnesses include a continuum of health effects ranging, with increasing severity, from heat rash, heat cramps, heat syncope (fainting), heat exhaustion and breakdown of skeletal muscle to heat stroke requiring emergent medical attention to prevent organ damage (i.e. brain, heart, kidney, liver or muscle) and death. The serious risks associated with heat-related illnesses, coupled with the increased risk of becoming incapacitated or compromised while working in a hot environment, make it important for all workers, co-workers and supervisors to recognize the signs and symptoms of heat-related illnesses.

- Buddy system: Workers need to use a buddy system to inform supervisors immediately when they recognize signs or symptoms of heat-related illness in themselves or others. Buddies should be instructed to ask their buddy co-worker periodically how he/she feels and leave the work area with the co-worker if needed.
- Limiting the exposure time: For workers working in specialized treatment units and wearing full PPE, the working time should be limited to a maximum of one hour before taking rest. Work in an outdoor hot environment must be performed during morning and evening hours if possible to avoid exposure to heat.
- Duration of rest: Adequate periods of rest and rehabilitation/cooling areas should be provided for staff.
- Access to potable water: Workers should have easy access to adequate amounts of cool (i.e. 10-15°C or 50-59°F) potable water and electrolyte replacement fluids or oral rehydration salts during rest/rehabilitation periods.
- Monitoring of hydration status: Workers should monitor the colour and volume of their urine output and drink fluid often to maintain hydration.
- Emergency procedures: Emergency procedures should be established for workers who exhibit heat-related symptoms, including consideration of cool water baths for symptomatic persons who are severely affected.
- Overall well-being: The overall well-being of workers should be promoted and the impacts of heat stress should be prevented by encouraging adequate sleep, diet and hydration on work and non-work days, and limiting the use of alcohol, caffeinated products and sleep aids.

3.5 Slips, trips and falls

Accidents and incidents due to slips, trips and falls can contribute to human suffering and the loss of precious manpower during an outbreak or emergency. In addition, weather and other conditions, as well as urgent requirements for work to be done, can contribute to such incidents. These are one of the major causes of serious injuries to workers in health-care facilities.

The main causes of slips, trips and falls, as enumerated by USCDC in *Slip, trips and fall prevention for health-care workers*, include the following *[30]*:

- Contaminants on the floor (water, grease, oil, fluid, food): Contaminants on the floor are the leading cause of slips, trips and fall incidents in health-care facilities. Water, grease and other fluids can make walking surfaces slippery.
- Poor drainage: pipes and drains: Water pipes and drains that are improperly aligned can cause liquid to spill onto walking surfaces, while clogged drains can cause water to back up onto the floor.
- Walking surface irregularities: Poorly-maintained uneven ground, protruding structures, holes, rocks, leaves and other debris can cause employees to stumble, trip, slip or fall.
- Weather conditions (rain, ice and snow): Rainwater, ice and snow can cause employees to slip and fall.
- Inadequate lighting: Common areas where inadequate lighting poses a hazard include parking structures, storage rooms, hallways, stairwells and walkways both inside and outside the facility.

- Improper use of ladders and step-stools: Ladder and step-stools used to work from heights can create a hazardous situation if not used properly.
- Tripping hazards (clutter, including loose cords, hoses, wires, medical tubing): Clutter can build up in storage areas, work areas, hallways and walkways potentially leading to a slip, trip or fall incident. Exposed cords on the floor, stretched across walkways and tangled near work spaces, can catch an employee's foot and lead to a trip and fall incident.

Human factors associated with slips, trips and falls

Human factors represent the ways in which people relate to their environment. Human factors that can affect the risk of a slip or trip include:

- communication: whether safety instructions, signs and labels are understood correctly;
- fatigue: how tiredness can affect the ability to carry out a task;
- personality: how people react differently to instructions (e.g. some ignore them, some take risks);
- capability: asking someone to do something beyond their capability (e.g. lack of training);
- behaviour: how people act (e.g. rushing around, taking short-cuts);
- perception: ability to take in information about one's environment (e.g. being distracted).

Certain activities can affect slips and trips. For instance:

- Carrying/lifting: One may not see a hazard on the floor and if a person loses balance, he/she is more likely to fall.
- Pushing/pulling: One needs more grip and may not see a hazard on the floor.
- Rushing: When one is moving faster, one needs more grip and one has less time to react to a hazard.
- Distraction: If a person's attention is drawn to something or to someone nearby, that person may be less likely to see a hazard on the floor.

The European Agency for Safety and Health at Work (EU-OSHA) *[31]* recommends the following preventive actions:

- Good housekeeping: Poor housekeeping and general untidiness are major causes of slips and trips. Keep the working environment clean and tidy, with floors and access routes kept clear of obstacles. Remove rubbish regularly so it does not build up.
- Cleaning and maintenance: Regular cleaning and maintenance will minimize risks. Rubbish should be removed regularly and work areas kept clear. Cleaning methods and equipment must be suitable for the surface being treated. During cleaning and maintenance work, take care not to create new slip and trip hazards.
- Lighting: Ensure good lighting levels, functioning and position of lights to ensure that all floor areas are evenly lit and all potential hazards (e.g. obstructions and spills) can be clearly seen. Lighting levels need to allow safe passage through the premises. Exterior lights may be required as outdoor workplaces must be adequately lit.

- Walking surfaces: Surfaces such as floors should be checked for damage regularly and maintenance carried out when necessary. Potential slip and trip hazards include holes and cracks and, indoors, loose carpets and mats. In any location, the floor surface should be suitable for the work carried out (e.g. it may need to be resistant to oil and chemicals used in production processes). Coating or chemically treating existing floors can improve their slip-resistant properties. The floor should be kept clean
- Spillages: Spills should be cleaned up immediately using an appropriate cleaning method (chemical treatment may be required). Warning signs should indicate where the floor is wet and alternative routes should be arranged.
- Obstructions: Where possible, obstructions should be removed to prevent trips occurring. If it is not possible to remove an obstruction, then suitable barriers and/or warning notices should be used.
- Trailing cables: Equipment should be positioned so that cables do not cross pedestrian routes. Cable covers should be used to fix cables securely to surfaces.
- Footwear: Workers need to have footwear that is suitable for their working environment, taking account of the type of job, floor surface, typical floor conditions and the slip-resistant properties of the soles.
- Outdoor workplaces: Outdoor workplaces must be arranged so that risks of slipping and tripping are minimized (e.g. through anti-slip measures in icy conditions and suitable footwear).

3.6 Road traffic injuries

Outbreaks and emergency responses require intensive use of vehicles for road transport – ranging from bicycles and motorcycles to heavy trucks – both for rapid movement of responders as well as of materials and supplies. Social mobilization and contact-tracing activities may require the frequent use of bicycles and motorcycles. During an outbreak emergency response, it is very difficult to obtain adequate health care and even minor road traffic injuries can have major consequences. In addition, the climatic conditions in many tropical countries cause continuous heavy rain for months together that wash away the roads and make transportation extremely difficult and hazardous.

Some 90% of road traffic deaths and injuries occur in low-income and middle-income countries, yet those countries account for only 54% of the world's registered vehicles *[32]*. Practical steps that governments, policy-makers, planners, employers, communities and individuals can take to improve the occupational health and safety of drivers and ensure a safe workplace transportation system include: managing speeding, controlling drinking and driving, using seatbelts and helmets, avoiding long driving or working hours, avoiding using a mobile telephone while driving, ensuring a safe road design, guaranteeing safer vehicles, ensuring quality post-crash care and enforcing road safety regulations.

A safe and efficient transportation system is even more important during outbreaks or other emergencies. The key elements required for a safe transportation system include:

Roads and transport infrastructure

- Roads and paths are defined and there should preferably be a one-way system with a divider in the middle of the road to separate traffic travelling in opposite directions.

- Roads are such that the need for reversing is eliminated or minimized.
- Road surfaces are in good condition through proper maintenance.
- Speed breakers are in place at specified locations, especially near schools, hospitals, markets and other busy places.
- Pedestrian crossings are in place.

Vehicles

- Vehicle selection criteria such as good driver access/visibility are considered when purchasing or deploying vehicles.
- Vehicles are maintained in good condition with special attention to tyres, brakes, horns and lights.
- Reversing aids such as a reverse horn and rear-view mirrors are provided.

Procedures

- Speed limits are set for vehicles in accordance with regulatory requirements.
- Reversing is controlled through proper parking.
- Drivers have proper authorization to drive.
- The driver is in a safe position during loading of heavy materials.
- Mobile telephone use while driving is prohibited;
- The use of seat belts by drivers and travellers is compulsory.
- There is an incident reporting system for recording and investigating incidents in order to prevent accidents.

People

- Competent drivers are employed and monitored through regular driving competency and medical fitness tests.
- Drivers are required to keep to the speed limit.
- Pedestrians are aware and use designated walkways.

In addition, regular maintenance of vehicles and ensuring fitness of drivers are essential for preventing road traffic accidents.

3.7 Ergonomic hazards

Many ergonomic hazards are created or exacerbated by activities conducted during outbreak and emergency responses. These hazards can cause pain and disability, hindering an effective response. Some ergonomic hazards are addressed here, along with measures to reduce risk.

Manual handling of loads: During disasters such as earthquakes, fires, hurricanes and tsunamis, rescue and response operations involve the search for injured and dead among destroyed structures. Heavy materials and obstructions have to be moved and bodies have to be handled and transported to medical facilities. Such activities put workers at risk of back injuries. Manual moving of heavy loads should be minimized.

Awkward postures: In nearly all emergencies, and especially in earthquakes and structural collapses, bending and twisting are significant risk factors for back and other musculoskeletal injuries among first responders. Similarly, during outbreak responses, handling dead bodies and patients in communities and health-care facilities, and frequent bending and kneeling to give medication, feed and clean patients on mattresses on the floor puts health workers under unusual physical strain. Awkward positions can cause acute back injuries and can significantly reduce work capacity and productivity.

Measures for prevention and control of ergonomic hazards during outbreaks and emergencies may include the following:

- Use of backpacks instead of bags: For transportation of first aid and other emergency materials over long distances and difficult terrain, the use of backpacks may help to reduce ergonomic strain.
- Placing patients on beds whenever possible: A "cholera bed", also known as a "cholera cot", is a wooden pallet with a hole cut in the centre. It is designed to stand at an appropriate height so that health-care workers do not have to bend to provide care. Waterproof sheeting is placed over the pallet, while the hole allows stool to be channelled into a receptacle placed directly underneath the bed. Faecal excretions and vomiting are collected into buckets. Cots such as these are preferable to health-care workers bending to treat patients placed on mattresses on the floor.
- Provision of large enough work spaces: The staff changing room between the high-risk and low-risk zones should be large enough and adequately equipped to allow more than one person to disinfect and undress at the same time (with large staff numbers, allow space for 4-6 persons).
- Bed spacing: It is important to allocate adequate space between beds. In undivided wards, there should be sufficient space (2 metres or 6.5 feet) between beds to allow staff to work unhindered.
- Use of mechanical aids (e.g. stretchers or wheelchairs for lifting and transport): Lifting devices or devices for moving materials have generally not been available during the outbreak and emergency response, especially during the initial stages. However, efforts should be made to avoid lifting and moving patients or exposed persons by hand. All patients or exposed persons unable to walk, including children, should be moved on stretchers, or on sheets if stretchers are not available. At least two response persons should be available when a person is moved.
- Safe manual handling: To move bodies in the absence of stretchers, at least four, and if possible six, people should be available. It is important to keep at least one stretcher clean and available at all times in vehicles for transporting patients, as well as one available for triage/moving individuals.
- Use of steps and/or ramps: Steps or ramps can be installed at the rear of the ambulance or transport vehicle for patients who can move without assistance and for easy transportation of materials.
- Advanced task planning: Tasks should be planned carefully to avoid strains. Pre-intervention planning of tasks and resources required to reduce ergonomic stress and strains is particularly important. For example, performing tasks in full PPE can be difficult due to altered sensory input, diminished dexterity and a greater susceptibility to fatigue.

3.8 Violence

Violence can occur in emergency situations. The high fatality rate caused by highly infectious diseases, chemicals and radiation leakages, together with their unpredictable onset and the nature of symptoms, can provoke fear which can lead to violent incidents. In the case of infectious diseases, there may be doubts about the existence of the disease agent, prompting some people to question the intentions of health-care workers. Mistrust can turn to hostility and violence, which can be directed at health-care workers and others dealing directly with patients and their families. Workers conducting safe burials are also at risk. Similarly, during natural disasters, community emotions due to deaths and injuries, loss of livelihood and the sufferings of children and older persons can be directed against emergency workers in the form of violent actions.

Violence against emergency workers can take the form of physical or verbal abuse, and can happen inside or outside the workplace. Physical violence, including rape and death, may result in psychological and/or physical harm. Psychological violence includes stigma and discrimination, and can take the form of verbal abuse, bullying and threats. Sexual harassment is also possible in both physical and psychological forms.

Community hostility leading to violence can be encountered when:

- traditional practices (caring for a sick family member, burials, etc.) are interrupted by infection control specialists for safety and infection control reasons;
- communities misunderstand the disease or doubt its existence, and health-care workers are perceived as infecting people instead of helping them.

For instance, during the EVD outbreak response, in a rural village in Guinea, a team of eight health-care workers, journalists and politicians were killed while on an outreach visit that aimed to educate the community about Ebola.

Strategies to prevent violence in the context of outbreaks and emergency response

The following strategies are useful in mobilizing and sensitizing families and communities to outbreaks and emergency response interventions, and reducing hostility and potential violence:

- Good communication with families and communities can be sustained by delivering a culturally appropriate educational campaign. Such a campaign can begin by assessing the social and cultural issues affecting the disease response, and can be delivered by local people. However, stigmatization and the safety of the messenger must be taken into account. It is important to involve community leaders, as they can reassure communities by reducing harmful rumours and encouraging families to adopt safe practices.
- Giving communities the opportunity to voice their concern and give feedback can be useful in ensuring that emergency response measures are accepted. The method used to receive community input should be decided according to the resources available.
- Establishing a good rapport with patients' or victims' families depends on communication. Families appreciate clear and comprehensible explanations of what has happened to the person, or to the dead body, and why. This helps prevent misinterpretation and hostility.

- To show respect for tradition without compromising safety, response teams must develop a good understanding of cultural traditions affecting the outbreak or epidemic. Traditional customs and practices should be encouraged so long as they can be carried out safely by, or with, trained staff. For instance, the burial team must treat dead bodies in a dignified and respectful manner.
- Families traditionally care for the sick, and need to remain in continuous communication with the patient. Family members should wear PPE if they have contact with a patient.

Protecting emergency workers from violence

- Monitoring and assessing the level of acceptance or hostility in the community is crucial to ensure that community workers are not put in unsafe situations.
- Workers should always work in teams, and should never enter a house without consent.
- A driver should always remain nearby and monitor the activity of workers to ensure that transportation is readily accessible if there is a need to evacuate quickly.
- Protocols can help workers feel confident and safe about performing their work. Levels of community acceptance should be assessed at regular intervals as beliefs and behaviours regarding disease transmission evolve.
- Reliable communication (via radio or other means) must be maintained with the health-care team deployed to rural areas.
- can stay in the car, monitor the team's activities, and report any incidents to the radio operator.
- The team should avoid entering a village in full PPE. Arriving in normal clothes helps to humanize the process and the villagers' response. Full protective gear can be put on after procedures have been clearly and transparently explained to the community.

Personal safety and security measures

Workers involved in outbreak and emergency responses need to be aware of the higher likelihood of encountering crime and violence. Pre-deployment training in security is highly recommended.

3.9 Fatigue

Emergency response workers often work longer and more consecutive shifts than the typical 40-hour work week. Working longer hours may increase the risk of work injuries and accidents and can contribute to poor health. Evidence suggests that working more than 12 hours per day is associated with a 37% increased risk of injury *[33]*. Fatigue and stress from strenuous work schedules can be compounded by heavy workloads, unfavourable environmental conditions (e.g. inadequate or damaged infrastructure, hazardous materials and debris, sparse living conditions), long commutes and personal demands on workers.

To confront these challenges, emergency response organizations need to develop their own fatigue management programmes that can be tailored to specific incidents. Organizations need to assess the types of activities they expect to conduct during a response, estimate the

conditions in which these activities may be performed, identify the factors typically present at response sites that can result in fatigue risk factors, define controls that target these risk factors, and establish evaluation schedules to assess the effectiveness of the controls.

Fatigue risk factors

- Many factors can lead to increased risk of fatigue, reduced alertness and productivity, and increased risk of errors, hazardous exposures and injuries in the workplace. The risk factors that should be considered when developing policies and procedures to manage worker fatigue include the following:
- long working hours;
- insufficient or fragmented sleep (less than 7-8 hours of uninterrupted sleep);
- shift work/rotating shifts/night shift work;
- sleeping during the day;
- sleep debt with no possibility to make up lost sleep;
- lack of, or limited, rest breaks;
- physically and mentally demanding work;
- exposure to temperature and other environmental extremes;
- exposure to biological, chemical and physical hazards, particularly if not well characterized;
- work requiring the use of PPE;
- limited access to recreational/fitness equipment;
- exposure to psychological stressors (e.g. close contact with sick or dead victims);
- unfamiliar work environment and/or work task/operations;
- temporary or communal living conditions (which may contribute to psychological stress and result in insufficient or fragmented sleep);
- limited access to nutritious meals;
- travel time to work site.

Fatigue risk assessment should consider the following:

work hours, work rotations, shifts and rest periods in the different operations of the organization;

- the range of conditions that can be encountered by responders, (e.g. the extent of disruption of normal activities, infrastructure status, population displacement, tensions, worksite security);
- the nature of the accommodation provided for workers during operations (e.g. hotel/motel, trailer, tent; food service or ready-to-eat meals; sanitary facilities; recreational opportunities);
- the various types of work performed in the operation and, considering any mission changes, likely to be performed in future operations;
- the management and administrative support functions and services (e.g. contracting, financial services, clerical support);

- the types of stressful situations experienced by workers and likely to be experienced at future events (e.g. exposure to bodies or seriously ill persons, severe devastation, homeless victims, orphans).

Strategies to prevent fatigue

NIOSH, in the USA, recommends the following strategic measures to prevent fatigue during response situations *[34]*;

- Regular rest: Establish at least 10 consecutive hours per day of protected time-off duty to obtain 7-8 hours of sleep. Rest and a full complement of daily recovery sleep are the best protections against excessive fatigue in sustained operations. Allowing only shorter off-duty periods (e.g. 4-5 hours) can compound the fatigue of long work hours.
- Rest breaks: Frequent brief rest breaks (e.g. every 1-2 hours) during demanding work are more effective against fatigue than a few longer breaks. Allow longer breaks for meals.
- Shift lengths: Five eight-hour shifts or four 10-hour shifts per week are usually tolerable. Depending on the workload, 12-hour days may be tolerable with more frequent interspersed rest days. Shorter shifts (e.g. eight hours) during the evening and night are better tolerated than longer shifts. Fatigue is intensified by night work because of night-time drowsiness and inadequate day-time sleep.
- Workload: Examine work demands with respect to shift length. Twelve-hour shifts are more tolerable for "lighter" tasks (e.g. desk work). Shorter work shifts help counteract fatigue from highly cognitive or emotionally intense work, physical exertion, extreme environments or exposure to other health or safety hazards.
- Rest days: Plan one or two full days of rest to follow five consecutive eight-hour shifts or four 10-hour shifts. Consider two rest days after three consecutive 12-hour shifts.

Measures for control of fatigue

Specific measures to prevent and reduce worker fatigue during an emergency response include:

- Education: Provide information on signs, symptoms and health effects of fatigue, as well as deployment preparedness training. The programme should address the process used to educate/inform workers.
- Advance planning: The following elements should be in place under the plan:
  - contingency planning for incident mobilization and identifying who does what and when (e.g. the roles of advance incident management teams);
  - support services that are critical for managing fatigue;
  - policies for assignment of personnel to positions for which they are specifically trained and medically cleared, and for the provision of PPE when needed;
  - consideration of additional medical requirements (e.g. unique vaccinations), and the typical procedures in place for checking workers in and out so that worker locations are tracked throughout the incident;
  - base camp/site security and ensuring that workers practise advance planning (e.g. have "go kits" ready, have alternatives in place for child care, pet care and bill-paying).

- Work hours and rest periods: Establish policies regarding duration of deployments, work hours, work shift rotation and rest breaks during each phase of an operation. Include time off after a predetermined number of consecutive days of work (e.g. minimum of 10 hours of rest in a 24-hour period, with as much of that as possible in consecutive hours; and 48 hours off after 14 consecutive days of work). Move as quickly as possible to regular work schedules so that workers can manage their own rest. Describe how this policy will be managed and enforced (e.g. provisions in place to ensure that sufficient personnel who are properly trained and medically qualified will be available for deployment).
- Transportation: Know the range of transportation method(s) to be used. Include a variety of options to reflect the various situations workers will face. Recognize the potential for worker impairment and driver impairment from long work hours.
- Living conditions: Describe the range of lodging options (e.g. commercial hotels/motels, trailers, tent cities), as well as options for providing meals, privacy, quiet sleep areas, sanitation facilities, security, laundry facilities, vector control and malaria prevention.
- Recuperation provisions: Establish opportunities for exercise and recreation, recognizing that these opportunities help to maintain worker functionality.
- Health-care services: Describe the available medical, mental health and stress management services that can be provided.

3.10 Psychosocial stress during outbreaks and emergencies

Workers responding to outbreaks and emergencies can encounter many sources of stress. Stress refers to a psychological response, which often includes worry, anxiety, feeling overwhelmed or run-down, or a sense of depression or of not doing well enough. Often these feelings come with somatic complaints such as body pain. Not all stress is problematic; some level of stress helps a person to keep safe and to work well in challenging situations. However, often this stress response becomes too much – especially in situations of chronic adversity such as an emergency – and can lead to a state of chronic stress in which the person feels overwhelmed or unable to cope.

High stress and the problems associated with it are normal in a difficult situation and do not mean that persons are weak, incompetent or unable to do their jobs. It may be the case that persons are so committed to work that they do not take enough time to care for themselves. Other problems in life – such as problems at home, lack of social supports, health problems or other uncertainties – can make the work stress harder to deal with.

Stress at work can be kept to a manageable level if the individual and the team or organization implements a number of strategies, some of which are easy and quick to implement. This is helpful for individuals and also for those they are trying to help, as self-care is likely to mean that persons are more effective in their roles and less likely to experience a level of stress so great they need to take time off work. These strategies are explained in this section.

During the deployment, there may be many sources of stress related to the type of emergency, resources available or the uncertainty or limited impact possible. Sources of stress may include:

- fear for one's own well-being or that of family members and co-workers who might contract a deadly disease or suffer health effects from chemicals or radiation (this may be particularly relevant in areas where fatality rates are high, or where there is rapid deterioration or obvious symptoms, as with viral haemorrhagic fevers);
- work-related pressures such as limited time, long hours, performing tasks following strict OSH procedures, or communicating with large teams, often from different cultures and disciplines;
- physical exertion compounded by cumbersome equipment (e.g. PPE), often accompanied by heat stress, dehydration and exhaustion;
- lack of basic safety equipment for personal protection;
- stigmatization of people working in high-risk areas which may lead to being shunned by family or community or even exposed to violence;
- lack of social support or social networks;
- tension between established safety protocols and the desire to care for or support individuals (e.g. ensuring safe burial practices, isolation, and implementing no-touch policies);
- limited understanding of cultural belief systems that may have relevance (such as not understanding or accepting why some persons may follow burial practises that may increase the risk of infection);
- difficulty in maintaining self-care activities such as exercise, good eating habits and getting enough rest;
- a desire to fulfil one's duties and to help, despite not having been paid for months.

Following deployment, factors that cause stress may include;

- memories related to the adverse events and human tragedy observed during the response;
- fear of long-term effects of exposure to chemicals, infectious diseases or radiation;
- difficulties in readjusting to life after deployment.

People may react to stress in different ways in emergency situations. There may be changes in behaviour, such as a change in activity level or job performance, increased use of substances as a way of coping, or changes in the person's ability to relax or level or irritability. A range of physical reactions (which may have other causes) can also occur, such as stomach problems, changes to weight, fatigue, headaches or other unexplained aches and pains. Psychological changes may include increased anxiety, low mood, low motivation, anxious or depressive thoughts, and related behavioural changes such as frequent crying, isolation or difficulty in accepting help.

In most cases, stress related to work will be manageable with good organizational and managerial support. However, in some cases people may present with symptoms of a mental health condition which may be related to the high-stress environment. Assessment of such a problem by a health worker should be considered if the person asks for an assessment or his/her functioning and the ability to undertake a number of tasks is impaired.

Post-traumatic stress disorder: It is common for people to develop a wide range of psychological reactions or symptoms after experiencing extreme stress during humanitarian emergencies. For most people, these symptoms are transient.

When a specific, characteristic set of symptoms (re-experiencing, avoidance and heightened sense of current threat) persists for more than a month after a potentially traumatic event, the person may have developed post-traumatic stress disorder (PTSD).

Persons presenting with PTSD often report very similar symptoms to those of persons with moderate depressive disorder (e.g. poor sleep, low mood). Assessment by a qualified health worker may be required to identify the PTSD symptoms of re-experiencing events, avoidance and difficulty in falling asleep or staying asleep.

Burnout: Burnout is a term commonly used to refer to long-term exhaustion and diminished interest in work as a result of long-term stress and work overload. It can occur particularly among individuals who are highly motivated, dedicated and involved in the work in which they participate. The desire to achieve high goals and expectations may contrast with physical, emotional and mental exhaustion, resulting in an inability to achieve.

Some persons – such as those with a history of mental health problems, ongoing critical personal stressors (e.g. personal illness, illness of a family member, history of family violence, risk of poverty or loss of work) or with reduced social support networks, or persons exposed to extreme stressors or potentially traumatic events – may be at increased risk of impairing levels of stress or mental health problems post-deployment.

Preventing and managing response work-related stress

Organizations deploying aid workers should develop policies for the following areas:

- pre-deployment and post-deployment screening and assessment of the capacities of staff to respond to anticipated stressors;
- appropriate pre-assignment preparation and training in managing stress;
- regular monitoring of staff response in the field;
- ongoing training and support to help staff deal with their daily stressors;
- specific and culturally-appropriate support to staff and teams in the wake of critical or traumatic incidences or unusual/unexpected sources of severe stress;
- practical, emotional and culturally-appropriate support for staff at the end of the assignment or contract;
- ongoing support for staff adversely affected by exposure to stress, trauma or disease during their deployment.

Measures to prevent workplace stress

Team-based practices

- Good communication: One of the best ways to reduce stress is to provide as much good-quality information as possible, to enable workers to feel informed and to give them a sense of control.
- Sharing up-to-date information with the workforce: Information-sharing is very important in reducing stress. There should be a mechanism for the clear flow of information about the hazard, modes of transmission and symptoms, as well as protective measures for workers. Information should also be shared with the community and should be regularly updated. It is especially important to inform

health-care workers promptly if one of their co-workers has become ill. The unit supervisor should gather staff together as soon as possible and give workers an opportunity to ask questions, express concerns and make suggestions. Health-care workers should not have to hear that a colleague has fallen ill through rumour, and should not have to wonder how this happened.

- A venue to express concerns and ask questions: It is especially important that workers have a place where they can ask questions and express concerns about the health risks to themselves and colleagues. Care should be taken to ensure confidentiality of people's health status. For instance, a manager may convey to a team that a colleague is unwell but is not in a critical condition without divulging the details of the health problems.
- Multidisciplinary team sessions: At least weekly, the multidisciplinary team of direct care-givers, supply managers, cleaners and others involved in the response should meet to exchange concerns. This could be a meeting of the supervisors of each of these groups. The purpose of these meetings is to identify concerns, including about the well-being of staff, and to work together on strategies to solve problems.
- Checklist and buddy system: It is important that health-care workers assess and understand their own strengths, weaknesses and limitations, including recognizing signs of stress and burnout in them and in others. General measures to assist individual coping mechanisms should be explained. It is also important for health-care workers to have an opportunity to register their concerns and complaints confidentially, yet in a manner that will maximize the likelihood that these concerns are indeed addressed. The buddy system is a useful way in which psychological support can be provided, and is a good way to monitor stress and burnout.
- Psychological first aid: In the guide for field workers on psychological first aid (PFA) *[35]*, WHO has described the key characteristics of this approach that facilitate its application in field situations. PFA:
  - provides practical care and support which does not intrude;
  - assesses needs and concerns;
  - helps people to address basic needs (e.g. food and water, information);
  - involves listening to people, but does not pressure them to talk;
  - comforts people and helps them to feel calm;
  - helps people to connect to information, services and social supports;
  - protects people from further harm.
- Campaigns to reduce stigma: Because the public is aware that health-care workers are at higher risk of contracting disease such as EVD through occupational exposure, health-care workers are often stigmatized and socially isolated. Even families of health-care workers have been known to be stigmatized and socially avoided by friends and acquaintances. As such, comprehensive public education campaigns should address the social stigma and exclusion of health-care workers resulting from the public's potentially excessive fear of contagion or contamination, as well as other commonly-held beliefs. Importantly, campaigns should encourage the public to value the role of the men and women on the frontline fighting the epidemic, so that workers feel proud of what they are doing. Such campaigns can be organized as part of the social mobilization packages in outbreaks.

- Use of humour and participatory techniques: These can promote dialogue, innovative solutions and positive changes in attitude. Methods such as participatory theatre have been used with health-care workers to address the problem of workplace bullying, by creating a feeling of bonding among participants. Creative techniques may also dissipate fear by promoting humour.

Organizational culture:

- Team-building techniques should be practised, including facilitating communication and conflict management. The organizational culture should be sensitive to others, as families of local staff may be affected by the outbreak.
- A mental health professional should contact all national and international staff members (including translators, drivers, volunteers etc.) who have survived a critical incident 1-3 months following the event. The professional should assess how the survivor is functioning and feeling, assess for mental health conditions (e.g. depression, PTSD, substance use) and refer for clinical treatment those persons with substantial problems that have not healed over time.

Individual practices

- Regulated rest periods: Managers need to be familiar with, and convey to staff, health and safety practices and procedures, including the need for sufficient rest and breaks during the work day.
- Basic needs: Managers need to ensure that there are opportunities to promote physical health, including exercise, and the workers can maintain healthy eating habits.
- Psychological support: A venue should be provided where health-care workers can share fears and worries confidentially. A psychologist should be available to go to the worksite at particularly stressful times, such as when a member of the team dies.
- Role-modelling by organization and field managers: Managers should be role models for staff under their supervision and should conduct themselves in ways that show how to mitigate stress (e.g. taking appropriate work breaks, practising stress-reduction and relaxation exercises). Most importantly, the field manager must ensure that the basic needs of staff are met and protective equipment provided, that the workforce is valued, and that its efforts are appreciated.

Measures for managing stress during different stages of the emergency response

In its guide to managing stress in crisis response situations, the United States Department of Health and Human Services recommends the following measures to be implemented by emergency managers during different stages of the emergency response *[36]*:

Minimizing stress before the crisis

- Ensure that workers become familiar with the overall emergency response system and the roles and responsibilities of key teams, including their own, in it.
- Establish clear lines of authority and responsibility to minimize stress by eliminating confusion about who reports to whom.
- Provide regular training on stress management techniques.
- Create a facility evacuation plan and practise drills regularly.

- Provide ongoing training to ensure that workers are thoroughly familiar with safety procedures and policies.
- Develop guidelines to help workers prepare for deployment.
- Maintain an updated list of family members' contact information for each employee.

Minimizing stress during the crisis

- Clearly define individual roles and re-evaluate them if the situation changes.
- At each shift change provide briefings on the current status of the work environment, safety procedures and required safety equipment.
- Partner inexperienced workers with experienced veterans. The buddy system is an effective method to provide support, monitor stress and reinforce safety procedures. Ensure that outreach personnel enter the community in pairs.
- The system can also help in provision of PFA to the person who experiences stress at an initial stage.
- Rotate workers from high-stress to lower-stress functions.
- Initiate, encourage and monitor work breaks, especially when casualties are involved. During lengthy events, implement longer breaks and days off, and curtail weekend work as soon as possible.
- Establish respite areas that visually separate workers from the scene and the public. At longer operations, establish an area where responders can shower, eat, change clothes and sleep.
- Implement flexible schedules for workers who are directly impacted by an event. This can help workers balance home and job responsibilities.
- Monitor and manage the work environment, transport and living conditions as follows:
  - Provide personal protective equipment for protection against high noise, dust and fumes wherever required.
  - Mitigate the effects of extreme temperatures through the use of protective clothing, proper hydration and frequent breaks.
  - Ensure that lighting is sufficient, adjustable and in good working order.
  - Provide security for workers at facilities or sites in dangerous areas.
  - Provide mobile telephones for workers in dangerous environments. Ensure that staff know who to call when problems arise.

Minimizing stress after the crisis

- Allow time off for workers who have experienced personal trauma or loss. Arrange to bring these persons back into the organization by initially assigning them to less demanding jobs.
- Develop protocols to provide workers with stigma-free counselling so that they can address the emotional aspects of their experience.
- Organize exit interviews to help workers put their experiences in perspective and validate what they have seen, done, thought and felt.

Chapter 4.

Occupational safety and health in outbreaks of communicable diseases: clinical and community settings

The climate of many tropical countries is favourable to the development and spread of outbreaks of various diseases - especially those with vectors that do not survive cold winters and that multiply in rainy seasons. The interaction of hosts, microbes and the environment determines the development and spread of infectious diseases, which has become greater and faster with the increase in travel, globalization and population growth, particularly in countries that lack capacities for public health preparedness and response. These infections may spread and lead to an event that might become a public health emergency of international concern.
According to the IHR, the following categories of events may constitute a public health emergency of international concern:

- A case of the following diseases is unusual or unexpected and may have serious public health impact, and thus shall be notified: smallpox, poliomyelitis due to wild-type poliovirus, human influenza caused by a new subtype, SARS.
- An event involving the following diseases shall always lead to utilization of the algorithm, because they have demonstrated the ability to cause serious public health impact and to spread rapidly internationally: cholera, pneumonic plague, yellow fever, viral haemorrhagic fevers (Ebola, Lassa, Marburg), West Nile fever, other diseases that are of special national or regional concern (e.g. dengue fever, Rift Valley fever, meningococcal disease).
- Any event of potential international public health concern, including those of unknown causes or sources and those involving events or diseases other than those listed above. Examples under this category include events with risk of spread of toxic, infectious or otherwise hazardous materials that may occur naturally or otherwise and that have contaminated or have the potential to contaminate a population and/or a large geographical area.

Large numbers of health workers are actively involved in management of such outbreaks (Box 4). They include first responders from emergency medical teams, health-care workers in emergency units and specialized treatment units, and laboratories that are directly involved in rescue, transportation, first aid, emergency care and treatment of affected communities.

The prevention and control of occupational infections among care providers in infectious outbreak response require close collaboration between OSH and infection control specialists, representatives of the organization's management and frontline health-care and others to evaluate the hazards, compile the data on potential exposures that have occurred, and make recommendations for prevention. When several employers or organizations use the same facility, workplace, or process they need to collaborate closely to ensure that all workers, both expatriate and domestic, regular and subcontractors, are equally and effectively protected from infection and occupational illness and injuries.

Box 4. OSH risks and impacts on health-care and other workers during the Ebola virus disease outbreak in West Africa

The unprecedented EVD outbreak posed serious health risks for workers in health care and other occupations. According to a WHO preliminary report *[6]* of the period from 1 January 2014 to 31 March 2015, 815 confirmed and probable cases among health workers were recorded in the VHF database, with 328 in Sierra Leone, 288 in Liberia and 199 in Guinea. During the same period, health workers accounted for 3.9% (815 of 20 955) of all confirmed and probable cases reported (all ages). Except for the first few months, during which there were only a few reported cases, health-worker infections as a proportion of all monthly numbers of cases peaked in July 2014 and decreased thereafter. The decrease from 12% in July 2014 to a low of 1% in February 2015 reflects the effective implementation of preventive interventions.

In countries with widespread and intense transmission of EVD, it was difficult to distinguish between occupational and community or residential exposure, particularly among local workers who maintained daily contact with their family members and the community. In addition to health-care staff, other workers at risk included cleaners, laboratory workers, traditional healers, traditional midwives, funeral and burial workers, home-care workers and religious leaders. Workers at risk of contact with undiagnosed patients included those conducting contact-tracing (including public health and community workers), point-of-entry and exit screening personnel, and travel industry staff (i.e. on aircraft, ground transport and ships). Taxi drivers, security forces (guards, police and soldiers), sex workers and workers handling waste in Ebola-affected communities were also at risk.

4.1 Occupational safety and health in Ebola treatment and care units

In order to ensure the safety of both patients and health-care workers, the following OSH provisions must be in place in facilities for treatment of cases:

- The facilities need to be designed with optimal separation between the green zone (the least contaminated area) and the red zone (the most contaminated area) and with unidirectional flow (always green to red and never the reverse). In some contexts (e.g. remote rural areas or larger Ebola treatment units) there may also be one or more "lowest risk" areas – e.g. offices or staff living quarters where street clothes and shoes may be worn. These areas must be completely fenced off and kept separate from the green and red zones.
- There should be separate entrances for patients, staff and visitors. This area should allow direct access to patients who arrive on foot or by ambulance, eliminating any interaction with staff or other patient areas. There must be adequate space near the ambulance arrival area for ambulance decontamination.
- The staff entrance must permit screening upon arrival and should provide direct access to a changing room. Staff must change into scrubs and boots before entering the rest of the Ebola treatment unit compound. This area should have secure storage for staff clothes and belongings.
- The triage area should be large enough to allow one metre of distance between patients, have at least one hand-washing station, offer protection from sun and rain, and have a dedicated latrine. Moreover, an outdoor waiting area should be provided for persons accompanying patients and should incorporate the elements listed above.

- The use of PPE is the most visible in the hierarchy of controls. However, such controls are the weakest and should not be relied upon as a stand-alone primary prevention strategy. PPE provides physical barriers between an uninfected person and an infectious agent or source of infection. This protection includes, but is not limited to, gloves, gowns, masks, facial and eye protection and respirators.
- The effective and appropriate use of PPE relies on the user's adherence to protocols and is therefore the most easily compromised control. Focusing only on the availability and use of PPE, to the exclusion of engineering and administrative controls, results in suboptimal protection of all persons in health-care settings, including workers.

Infection prevention and control

The prevention and control of highly infectious diseases such as EVD and other viral haemorrhagic fevers in all health-care settings requires the strengthening and careful application of standard precautions when providing care to all patients, regardless of the signs and symptoms they present with. These IPC measures include *[37]*:

- hand hygiene;
- risk assessment for the appropriate use of PPE;
- injection safety and prevention of injuries from needles and other sharp instruments;
- cleaning and disinfection of the patient environment and patient-care equipment;
- laundry and waste management;
- respiratory hygiene.

4.2 Occupational safety and health in the cholera treatment unit

A cholera treatment unit (CTU) is a specialized treatment unit for clinical management of cases of cholera and waterborne diseases. The strategies for protection of health-care workers in CTUs are similar to those used in Ebola treatment units and include the following:

- triage;
- isolation of patients;
- disinfection;
- hand-washing;
- personal protective equipment.

The CTU consists of the following four sections that prevent infections among patients and health-care workers *[38]*:

- selection and observation;
- hospitalization;
- convalescent room for treatment with oral rehydration solutions;
- neutral area (for kitchen, stocks of material etc.).

The key health and hygiene rules for infection prevention and control in CTUs are provided in Table 2.

Table 2. Health and hygiene rules in the cholera treatment unit

Mode of transmission	Essential rules	Additional recommended rules
People	Access limited to patient + one family member + staff One-way flow of people (i.e. from clean to unclean areas only)	No more than one caregiver per patient
Water	Safe water (chlorination concentration according to specific use) Large quantity needed (minimum 10 litres per person per day)	Ideally 50 litres per patient per day
Hands	Hand-washing stations with safe water Wash hands with water and soap - before and after taking care of patients - after using latrines - before cooking or eating - after leaving the admission ward	Cut and clean nails
Food	Cooked food Health-care workers should not handle food or water	Food provided by CTU (rather than by families)
Clothes and bedding	Wash clothes and bedding with the appropriate chlorine solution based on guidelines	If chlorine is unavailable, wash clothes with soap and dry them in the sun
Environmental contamination (faeces and waste)	Ensure exclusive latrines for the facility Disinfect buckets, soiled surfaces and latrines regularly with the appropriate chlorine solution Use incinerator for medical waste	Latrines should be sited at least 100 metres from wells or surface sources Special cholera beds (cholera cots)
Corpse	Separate morgue Disinfect corpses	Identify safe funeral practices Dispose of corpses as soon as possible

4.3 Managing occupational safety and health in laboratories handling infectious agents

WHO's *Laboratory biosafety manual [39]* covers various levels of biosafety requirements for different types of laboratories. In addition, in its guidance on handling highly infectious specimens (e.g. of avian influenza), WHO recommends that the following measures should be in place to protect the health and safety of laboratory workers *[40]*:

- Responsibility for developing a comprehensive safety policy, including a safety manual, and supporting programmes for its implementation normally rests with the director or head of an institute or laboratory. Laboratory safety is also the responsibility of all supervisors and laboratory employees, and individual workers are responsible for their own safety and that of their colleagues.

- Good microbiological technique is fundamental to laboratory safety. The use of safety equipment, combined with good procedures and practices, will help to reduce the risks involved in dealing with biosafety hazards.
- Standard precautions should always be followed; barrier protection (gowns, gloves) should be used whenever samples are obtained from patients. In addition to these standard precautions, eyes should be protected.
- Basic containment – Biosafety Level 2 (BSL2) – practices and procedures should be the minimum requirement for handling specimens.
- Good laboratory practices should be followed. Eating, drinking, smoking, applying cosmetics and handling contact lenses are prohibited in the laboratory working areas.
- PPE (gown, gloves, eye protection) should be worn in the laboratory when handling and processing specimens and performing diagnostic testing.
- All technical procedures should be performed in a way that minimizes the formation of aerosols and droplets.
- Biological safety cabinets or other physical containment devices should be used for all manipulations that may cause splashes, droplets or aerosols of infectious materials (e.g. centrifugation, grinding, blending, vigorous shaking or mixing, sonic disruption, opening of containers of infectious materials whose internal pressure may be different from the ambient pressure).
- The use of hypodermic needles and syringes should be limited. They must not be used as substitutes for pipetting devices or for any purpose other than parenteral injection or aspiration of fluids from laboratory animals. Mouth pipetting must be strictly forbidden.
- Adequate and conveniently located biohazard containers should be available for the disposal of contaminated materials.
- Work surfaces must be decontaminated after any spill of potentially dangerous material and at the end of the working day. In general, freshly prepared bleach solutions are appropriate for dealing with biohazardous spillage.
- Personnel must wash their hands often – especially after handling infectious materials and animals, before leaving the laboratory working areas, and before eating.
- PPE must be removed before leaving the laboratory.

4.4 Management of exposure to blood, body fluids and other contaminants in health-care settings

Unprotected exposure of mucous membranes and skin to body fluids of suspected or confirmed patients, contaminated objects and bodies of the deceased should be considered as high-risk exposure incidents. In most cases, such incidents include touching unprotected skin while removing PPE, sharps injuries while providing care to patients, and touching an infectious person or contaminated objects. Exposure incidents related to infectious materials such as blood, vomit and other body secretions should be reported and investigated *[41]*.

In case of such incidents involving cases of highly infectious diseases such as VHFs like Ebola, Marburg and other viral haemorrhagic fevers, health-care and other workers should follow these actions:

- Immediately and safely stop any current tasks, and leave the patient care and workplace areas.
- Remove PPE carefully, following appropriate procedures. Exposure during PPE removal can be dangerous and may result in occupational transmission of viral haemorrhagic fevers such as EVD.
- Immediately after removal of PPE, wash the affected skin surfaces or the site of the injury with soap and running water or saline for at least 15 minutes. Accordingly, irrigate mucous membranes (e.g. conjunctiva) with copious amounts of water or an eyewash solution. Do not use chlorine solutions or other disinfectants.
- Immediately report the incident to the local coordinator. This is a time-sensitive task and should be performed as soon as the health-care worker leaves the patient care unit.
- Exposed persons should be medically evaluated, taking into account other potential bloodborne exposures (e.g. HIV, hepatitis B and C), and should receive follow-up care, including fever monitoring twice daily for 21 days (i.e. maximum duration for of incubation period for EVD) after the incident. Immediate consultation with an expert in infectious diseases is recommended for any person who develops fever within 21 days of exposure.
- Workers suspected of being infected should be isolated and should receive care until a negative diagnosis is confirmed.
- It is essential to conduct contact-tracing and follow-up of family, friends, co-workers and other patients who may have been exposed to viral haemorrhagic fevers such as EVD through close contact with the infected health-care worker.
- Infection with viral haemorrhagic fevers such as Ebola and Marburg viruses in persons who have had occupational contact with sources of the virus should be considered an occupational disease in the context of the ILO list of occupational diseases.

Post exposure prophylaxis

WHO's current recommendations on post-exposure prophylaxis (PEP) *[42]* are based on scientific evidence and include:

- PEP should be offered, and initiated as early as possible (and ideally within 72 hours), to all persons with exposure that has the potential for HIV transmission.
- Assessment for eligibility should be based on the HIV status of the source whenever possible and may include consideration of background prevalence and local epidemiological patterns.
- Exposures that may warrant PEP include parenteral or mucous membrane exposure (sexual exposure and splashes to the eye, nose or oral cavity). Exposure to the following body fluids may pose a risk of HIV infection: blood, bloodstained saliva, breast-milk, genital secretions, and cerebrospinal, amniotic, rectal, peritoneal, synovial, pericardial or pleural fluids.
- Exposures that do not require PEP include those when the exposed person is already HIV-positive, when the source is established to be HIV-negative, and when exposure is to body fluids that do not pose a significant risk (e.g. tears, non-bloodstained saliva, urine, sweat).

- Although PEP is ideally provided within 72 hours of exposure, people may not be able to access services within this time. Providers should consider the range of other essential interventions and referrals that should be offered to clients presenting more than 72 hours after exposure.
- In some settings with high background HIV prevalence or where the source is known to be at high risk for HIV infection, all exposure may be considered for PEP without risk assessment.
- The fluids, as mentioned above, carry a high risk of HIV infection, but this list is not exhaustive and all cases should be assessed clinically and decisions made by the health-care workers as to whether exposure constitutes significant risk.

Assessment

The assessment of the person exposed, conditions during exposure and the status of the source person need to be assessed as follows:

- clinical assessment of exposure;
- eligibility assessment for HIV PEP;
- HIV-testing of exposed persons and source if possible;
- provision of first aid in case of broken skin or wound.

Counselling and support

These are required to prepare the person for investigations, treatment and follow-up, including potential adverse effects of treatment with medicines. The following elements need to be covered:

- risk of HIV;
- risks and benefits of HIV PEP;
- side-effects;
- enhanced adherence counselling if PEP is to be prescribed;
- specific support in cases of sexual assault.

Prescription

This includes selection and initiation of treatment with appropriate medicines and must cover:

- PEP initiated as early as possible following exposure;
- 28-day prescription of recommended age-appropriate antiretroviral medicines;
- information on medicines;
- assessment of underlying comorbidities and possible drug-drug interactions.

Follow-up

The follow-up is an essential part of PEP and covers:

- an HIV test at 3 months after exposure;
- a link to HIV treatment if possible;
- provision of prevention intervention as appropriate.

The steps to achieve these include:

- Provide first aid immediately.
- Assess exposure for potential HIV or other bloodborne infections.
- Test the exposure source for HIV and hepatitis B and C infection.
- Test the health worker who was exposed and provide counselling and care referral.
- Maintain confidentiality of both health worker and patient.
- Ensure follow-up testing and clinical evaluation.
- Provide PEP if needed, with counselling.
- Analyse cases of exposure to improve practice.
- Have an established compensation procedure in the event of claims.

Management of possible exposure to other conditions (e.g. hepatitis B and C):

- The risk of transmitting hepatitis B virus (HBV) and hepatitis C virus (HCV) is higher than the risk of transmitting HIV in most cases of exposure, especially in the health-care setting.
- Previous HBV vaccination should be assessed and vaccination offered if required according to age-appropriate national immunization schedules.
- Hepatitis B immunoglobulin protects by passive immunization if given shortly after exposure and should be considered if available for unvaccinated or partly vaccinated persons in addition to vaccination.
- Screening for HCV should be offered in accordance with WHO guidelines. Individuals should be counselled on the risk of acquiring HCV and should be referred to specialist care if seroconversion occurs.

4.5 Occupational safety and health protection of health workers from acute respiratory diseases during respiratory disease outbreaks

WHO's interim guidelines on IPC of epidemic- and pandemic-prone acute respiratory diseases in health care *[43]* recommend the following measures for protection of health workers against acute respiratory diseases (ARDs):

ARDs that may constitute a public health emergency of international concern due to their outbreak and epidemic potential may include:

- severe acute respiratory syndrome (SARS);
- new influenza virus causing human infection;
- novel ARD with potential to have a high public health impact.

Severe acute respiratory syndrome: SARS is caused by a SARS-associated coronavirus (SARS-CoV) which can infect animals and humans. Human-to-human transmission of SARS occurs mainly through droplets or contact, although transmission through infectious respiratory aerosols of various sizes may occur at short range.

New influenza virus causing human infection: Avian influenza A viruses typically infect birds, but sometimes can infect other animals and humans, and have been associated with clusters of human cases. The strain associated with the largest number of human episodes is H5N1.

Novel ARD with potential to have a high public health impact: Infectious diseases have spread across populations and regions throughout history and it is likely that newly-emerging infectious diseases will continue to be identified. Many infectious diseases have animal reservoirs and can infect humans under certain circumstances.

The rationale for protection of health workers from ARDs include:

- During seasonal or pandemic influenza outbreaks, health workers can become infected with influenza through exposure either in the community or in the health-care facility (not necessarily as a result of patient exposure). Once infected, they can serve as sources of virus transmission to other staff and to their patients, who are at increased risk of complications associated with ARD.
- While seasonal influenza vaccine does not provide protection against new influenza viruses, such as avian influenza, it will help to prevent concurrent infection with seasonal human influenza and thus reduce confusion in diagnosis and unnecessary absence from work.
- Prevention of seasonal influenza would also theoretically minimize the possibility of assortment of human and novel influenza viruses within the immunized health-care worker.
- Health-care workers who provide care for any patient with an ARD of potential concern may potentially be exposed to these pathogens and should be monitored and supported as needed.

Recommendations for health facility administrators

- Whenever possible, immunize health-care workers against seasonal influenza and monitor vaccine uptake.
- Health-care workers who are at high risk for complications of ARDs of potential concern (e.g. pregnant women, immunocompromised persons, and persons with cardiopulmonary or respiratory diseases) should be informed about the medical risks and offered work assignments that do not involve providing care to ARD patients.

Special recommendations for health-care facilities managing patients with ARDs of potential concern include the following:

- A register should be kept of health-care workers who have provided care to patients with ARDs of potential concern for contact-tracing.
- A surveillance system for health-care worker influenza-like illness should be developed. Health-care workers with influenza-like illness should be excluded from high-risk units (e.g. neonatal intensive care units).
- A system should be developed to monitor health-care workers' health – especially health-care workers providing care to patients with ARDs of potential concern – with self-reporting by symptomatic health-care workers.
- If antiviral prophylaxis is recommended by local policy, health facility administrators should develop a system to provide antiviral prophylaxis to health-care workers exposed to patients with ARDs of potential concern. If necessary, the administration

should contact public health officials for assistance in obtaining adequate supplies for prophylaxis of health-care workers providing care for patients with ARDs of potential concern, in line with local guidance.

- It should be ensured that health-care workers (especially those taking care of patients with ARDs of potential concern) have timely access to newly-developed vaccines to prevent acquisition of ARDs of concern.
- Methods should be developed to provide additional support to health-care workers (e.g. emotional and family support), as necessary.

Recommendations for health-care workers who have provided care for patients known or suspected to be infected with an ARD of potential concern:

- Organize health-care workers into groups designated for caring for patients and check health-care workers' temperature regularly (e.g. before each work shift); monitor for symptoms of influenza-like illness (cough, sore throat, difficulty in breathing) for 7–10 days after the last possible exposure to a patient with ARD of potential concern.
- In the event of fever > 38°C, or the development of influenza-like illness, health-care workers should immediately limit their interactions with others, be kept out of work, exclude themselves from public areas, and notify the infection control/occupational health team (and/or their health-care provider) that they are symptomatic and have had contact with patients with an ARD of potential concern.

4.6 Occupational safety and health in outbreak response in community settings

The emergency response to the outbreak includes actions carried out by different organizations, both local and international. The response includes government and local authorities in affected at-risk countries, civil society, the private sector, NGOs, multilateral organizations, international financial institutions and agencies of different countries. The strategic objectives of the response strategy are to stop the outbreak, treat the infected, ensure essential services, preserve stability and prevent outbreaks in other countries. Apart from specialized treatment units such as those for EVD and cholera, these activities are carried out in different care settings, including homes, health centres, during transport by air, sea and road, and at entry points to countries or districts. In addition to health-care workers in health facilities, other categories of workers are also at high risk of infection.

This section describes the requirements for preventing occupational infections in the most typical community settings of the outbreak response, where response activities pose OSH risks and hazards to emergency responders.

4.6.1 Community work (e.g. social mobilization, contact-tracing, case-finding)

Work in the community – such as case-detection, contact-tracing and social mobilization – involves a high risk of contact with undetected cases and poses a high occupational health risk

of infection for health workers. Consequently, such work must always be carried out with the following safeguards in place:

- Shaking hands and any other social contacts during social mobilization activities and interviews should be avoided.
- PPE such as an impermeable gown, face mask, eye protection and examination gloves, boots and hand hygiene products (preferably an alcohol-based hand-rub solution) should be available for use.
- Distance of more than one metre (about 3 feet) should be maintained between the responder and the interviewee even if the person does not appear to be sick.
- Any physical contact with the interviewee and with the environment is to be avoided.
- When these precautions are adopted and when interviewing asymptomatic individuals (e.g. no fever, diarrhoea, bleeding or vomiting), PPE is not required.
- Hand hygiene is to be carried out after any contact with a suspected case and a potentially contaminated environment, and when leaving the place where interviews were conducted for contact-tracing and case-finding in the community.

4.6.2 Ambulances and vehicles for patients or dead bodies

Persons transporting a patient with highly infectious disease are at risk of exposure through contact with the patient's body fluids. Those transporting the bodies of persons who have died from highly infectious diseases are also at risk. Cleaning and disinfecting the vehicle also poses a risk of infection.

The following control measures should be applied:

- Response personnel who have direct physical contact with a suspected or confirmed case (e.g. helping the patient to enter the ambulance, providing care to patients during transport) should use appropriate PPE.
- If a patient is not vomiting or bleeding and does not have diarrhoea, PPE should include at least gloves, mask and gown.
- If a patient is vomiting, bleeding or has diarrhoea, or when handling dead bodies, PPE should always include either coverall or full protection with double gloves, respirator such as N95, impermeable gown (or a waterproof apron over a non-impermeable gown), eye protection (goggles or face-shield) and boots/closed shoes with overshoes.
- A patient who is coughing should be asked to wear a mask.
- Before a dead body is loaded into a vehicle, the body should be put in a double plastic body bag. The outer surface of each body bag should be wiped with a suitable disinfectant (e.g. 0.5% chlorine solution), and the bag should then be sealed and labelled as highly infectious material.
- PPE should always be changed and safely disposed of after assisting a patient who has been vomiting or bleeding or has had diarrhoea, or after loading dead bodies.
- PPE should be put on and carefully removed according to WHO instructions and pictograms. When removing PPE, care should be taken to avoid any contact between the soiled items (e.g. gloves, gowns) and any area of the face (i.e. eyes, nose or mouth) or non-intact skin.

- PPE should be disposed of in waste containers or plastic bags for highly infectious material.
- Responders should perform hand hygiene with an alcohol-based hand-rub solution or with soap and water after exposure to a patient's blood and body fluids, after touching contaminated surfaces/items/equipment, and after removal of PPE.
- PPE is not required for persons driving or riding in the vehicle, provided that drivers or riders will not touch any patient or any person accompanying a patient, and will not help to load or handle a dead body.
- Ambulances and other vehicles used for patient transport should be regularly (at least once a day) cleaned and decontaminated with standard detergents/disinfectants (e.g. a 0.5% chlorine solution). If the surfaces have been soiled with blood or body fluids, they should be cleaned and decontaminated immediately.
- Ambulances and other vehicles used for patient transport should always be equipped with gloves, masks and full PPE sets, alcohol-based hand-rub solutions, waste bags, body bags, a water tank, wipes, detergent and disinfectant. Ambulance operators should be trained to ensure this, as well as to undergo the fit-test required for use of respirators.

4.6.3 Post-mortem examinations

Post-mortem examination of the remains of patients who died due to a suspected infectious disease such as cholera, Ebola or Marburg disease should be limited to essential evaluations only and should be performed by trained personnel *[37]*. The following precautions need to be taken while conducting post-mortem examinations:

- The IPC staff should be consulted for any decision-making on post-mortem examinations.
- Post-mortem examination of such patients' remains should be limited to essential evaluations only and should be performed by trained personnel.
- Personnel examining remains should wear a full set of PPE.
- In addition, personnel performing autopsies of cases of known or suspected haemorrhagic fever or other acute respiratory diseases should wear a particulate respirator (e.g. FFP2, or EN-certified equivalent, or US NIOSH-certified N95) or a Powered Air Purifying Respirator (PAPR).
- When removing PPE, avoid any contact between soiled gloves or equipment and the face (i.e. eyes, nose or mouth).
- Hand hygiene should be performed immediately following the removal of PPE.
- Place specimens in clearly-labelled, non-glass, leak-proof containers and deliver directly to designated specimen-handling areas.
- All external surfaces of specimen containers should be thoroughly disinfected (using an effective disinfectant) prior to transport.
- Tissue or body fluids for disposal should be carefully placed in clearly marked, sealed containers for incineration.

4.6.4 Safe and dignified burials

Hazards posed by the corpse

Dead body management workers, sprayers, technical supervisors, and family and community liaison workers are at risk of exposure through direct contact with body fluids on a corpse, clothing, bedding or other surfaces/objects. Other risk factors include heat stress from working outside in full PPE, violence from family and community members, ergonomic problems from manual handling of loads (bodies and coffins), and psychological distress from dealing with human remains and witnessing human suffering.

The bodies of people who have died from highly infectious diseases such as cholera, Ebola or Marburg virus are highly infectious and require burial by special teams who are properly trained and equipped. Safe burials, as recommended by WHO *[44]*, include the following 12 steps:

Step 1: Prior to departure: team composition and preparation of disinfectants

Step 2: Assemble all necessary equipment

Step 3: Arrival at deceased patient home: prepare burial with family and evaluate risks

Step 4: Put on all PPE

Step 5: Place the body in the body bag

Step 6: Place the body bag in a coffin, where culturally appropriate

Step 7: Sanitize family's environment

Step 8: Remove PPE, manage waste and perform hand hygiene

Step 9: Transport the coffin or body bag to the cemetery

Step 10: Burial at the cemetery: place the coffin or body bag into the grave

Step 11: Burial at the cemetery: engage community for prayers as this dissipates tensions and provides a peaceful time

Step 12: Return to the hospital or team headquarters.

Burial teams should include seven members: four for dead body management (with full PPE gear), one sprayer (with full PPE gear), one technical supervisor (not wearing PPE) and one person to interact with family and community (not wearing PPE). The team should also use body bags, disinfectant and transportation.

The essential materials that need to be assembled include:

- For hand hygiene: alcohol-based hand-rub solution (recommended) OR clean running water, soap and towels (recommended) OR chlorine solution 0.05% (when options above are not available).
- PPE: one pair of disposable gloves (non-sterile, ambidextrous), one pair of heavy-duty gloves, disposable coverall suit (e.g. Tyvec suit), impermeable plastic apron, face protection (goggles and mask), footwear (rubber boots recommended OR, if not available, shoes with puncture-resistant soles and disposable overshoes).
- For waste management: disinfectant, one hand sprayer (0.05% chlorine solution), one back sprayer (0.5% chlorine solution), leak-proof and puncture-resistant sharps container.

IPC recommendations for the handling of the remains of persons who have died from highly infectious diseases such as Ebola include *[44]*:

- Only trained personnel should handle remains during the outbreak.
- Health-care workers, family members and burial teams must observe standard precautions in health care when handling a body that has died from Ebola or Marburg virus. This includes: the use of full PPE when handling the dead body of a suspected or confirmed case of haemorrhagic fever, compliance with hand hygiene guidelines, and standard precautions for contact with infected blood, body fluids and materials – especially splashes on surfaces.

The handling of human remains should be kept to a minimum. The following recommendations should be adhered to in principle, but may need some adaptation to take account of cultural and religious concerns:

- Hand hygiene should be performed immediately before putting on gloves and immediately after the removal of PPE.
- Plug natural orifices. Place the body in a double bag, wipe over the surface of each body bag with a suitable disinfectant (e.g. 0.5% chlorine solution) and seal and label with an indication of highly infectious material. Immediately move the body to the mortuary.
- PPE should be put on at the site of collection of human remains and worn during the process of collection, placement of the body in a body bag, and placement of body bag into a coffin. The PPE should be removed only once the body is secure in the coffin, and should be removed immediately afterwards.
- Remains should not be sprayed, washed or embalmed. Any practice of washing the remains in preparation of "clean burials" should be discouraged.
- PPE is not required for persons driving or riding in a vehicle to collect human remains, provided that drivers or riders will not be handling a dead body of a suspected or confirmed case of haemorrhagic fever.
- The bearers of the coffin must wear thick (heavy duty) gloves.
- After being wrapped in sealed, leak-proof material, remains should be placed inside a coffin if possible, and buried promptly.
- It is strongly recommended that the graves of such victims be identified in accordance with local customs.

The burial process is a very sensitive matter for the family and the community and can be the source of trouble or even open conflict. Consequently, before starting any procedure, the family must be fully informed about the dignified burial process and their religious and personal rights to show respect for the deceased. Ensure that the formal agreement of the family has been given before starting the burial. No burial should begin until family agreement has been obtained.

Stretchers should be used to move human remains. There should be a sufficient number of persons in the team so that at least four people can carry the body. The work should be organized to allow for breaks without PPE, and proper hydration.

4.6.5 Points of entry and exit, land crossings, airports and sea ports

Workers at points of entry and exit at airports, seaports and land crossings provide services that include: control of documentation, scanning of body temperature and health assessments of international travellers, and handling of baggage, cargo, containers, conveyances, goods and postal parcels. Risk factors for workers at points of entry and exit include contact with the body fluids of international travellers, and contaminated surfaces and clothes *[45]*.

- Workers carrying out screening of passengers should be supplied with PPE commensurate with the risk assessment for their tasks. PPE should include, at the minimum, disposable gloves. Workers should avoid touching travellers and should maintain a safe distance of 1 metre or 3.2 feet wherever possible.
- Workers should perform hand hygiene with soap and water or alcohol-based hand-rub.
- Medical or public health staff conducting health assessments of sick or suspect travellers should be supplied with PPE – including disposable gloves, long-sleeved impermeable gown, face mask, eye protection (i.e. face-shield or goggles) and closed-toed shoes with shoe coverings or gum boots. Face mask, eye protection and a water-resistant apron are important in case the gown is not impermeable, particularly if there is any risk of blood or body fluid splashes (e.g. if the patient is vomiting, bleeding or has diarrhoea).
- Workers conducting exit screening should be trained in the correct use of PPE and infection control when handling suspected cases, and must perform hand hygiene with soap and running water or an alcohol-based hand-rub solution and a single-use towel.
- Personnel at points of entry and exit, including cargo handlers, should not handle packages that are visibly soiled with blood or body fluids.

4.6.6 Aircraft

Travelling in an aircraft to distant areas or countries by a suspect or known case of highly infectious disease poses huge challenges for controlling the spread of disease agents to regions or countries not affected by the disease. In such cases, it is essential that airport ground personnel and cabin crew should be appropriately trained, and medical and universal precaution kits for managing cases/contacts should be available on board in accordance with International Civil Aviation Organization (ICAO) guidelines. At points of entry and exit, crew should follow International Air Transport Association (IATA) standard operating procedures on the management of communicable disease on board that provide the following guidance *[46]*:

Handling an inbound case of suspected communicable disease on an aircraft

- The case definition of a "suspect case", based on IATA guidelines, includes fever (temperature 38°C/100°F or greater) associated with one or more of the following signs or symptoms: appearing obviously unwell, persistent coughing, impaired breathing, persistent diarrhoea, persistent vomiting, skin rash, bruising or bleeding without previous injury and confusion of recent onset.

- If an on-board suspect case of communicable disease is identified by the cabin crew, the flight crew should notify the en route air traffic controller who will in turn notify air traffic control at the destination airport. The information transmitted will include details such as flight number, origin, destination, expected time of arrival, number of persons on board and number of suspect cases. The public health authority should be notified of the case by the destination air traffic controller in accordance with local arrangements. The time before the arrival of the aircraft may allow the public health authority to carry out "remote risk assessment", usually indirectly via the airline operations control centre or ground-to-air medical adviser. Proactive risk assessment may determine whether any public health response is required and will allow measures in the local response plan to be initiated prior to the aircraft's arrival, thus minimizing delay. The benchmark for the maximum delay to passengers and/or aircraft attributable to the public health authority management of a case of suspected communicable disease should be one hour.

On board an aircraft, the following measures should be immediately considered, in accordance with operational procedures recommended by IATA:

- Distance other passengers if possible and reseat them away from the symptomatic passenger, preferably placing the sick traveller near a toilet for his/her exclusive use.
- Cover the nose and mouth of the patient with a medical face mask (if tolerated) if there are respiratory symptoms (e.g. coughing or sneezing). If the mask cannot be tolerated, the sick passenger should be provided with tissues and asked to cover his/her mouth and nose when coughing or sneezing and to perform hand hygiene afterwards.
- Provide the sick passenger with a plastic bag for disposing of used tissues, and an air sickness bag if experiencing nausea or vomiting.
- Store soiled items (used tissues, face masks, linen, pillows, blankets, seat pocket items, etc.) in a biohazard bag if one is available; if not, use a sealed plastic bag and label it "biohazard".
- Limit contacts of the passenger to the minimum necessary. Only one (or two if a sick passenger requires more assistance) cabin crew should care for the sick passenger and preferably only cabin crew members who have already had contact with that passenger. This cabin crew member or anyone in direct contact with the sick passenger should use universal precautions. They should wear gloves and perform hand hygiene after removing them.
- Instruct cabin crew members to perform hand hygiene by hand-rubbing with an alcohol-based hand-rub solution for 20-30 seconds or hand-washing with soap and water for 40-60 seconds if hands are visibly dirty, after any direct contact with the sick passenger or with his/her personal belongings or any objects/surface potentially contaminated with blood or body fluids from the sick passenger, and after removing gloves. If gloved hands are visibly dirty with body fluids (e.g. vomit) gloves should be removed at the site of the sick passenger and hand hygiene performed immediately. Dedicated crew members assisting the sick traveller should use suitable PPE for dealing with the traveller and for cleaning procedures on board as necessary.
- The possibility of transmission to other passengers and crew on board the aircraft should be assessed by health-care providers on arrival. In the vast majority of cases, the condition will be due to illness such as malaria or minor illness such as common influenza *[47]*.

- If the investigation concludes that the passenger has symptoms compatible with communicable disease and had a risk of exposure in affected countries in the past, passengers and crew members may be at risk if they have been in direct contact with body fluids or heavily contaminated objects. The following epidemiological measures based upon proximity to the index patient should be considered:

Passengers and crew with reported direct contact

To gather this information, any records of significant events on the flight should be obtained from the airline. Co-travellers and crew members who report direct body contact with the index case and passengers who were seated adjacent to the index case – on the side, in front or behind, including across the aisle – should undergo contact-tracing.

Cleaning of contaminated aircraft

If the case is suspected or diagnosed after leaving the aircraft, staff who cleaned the section and seat where the index case was seated should also undergo contact-tracing. Passengers, crew members and cleaning staff who are identified through contact-tracing should be assessed for their specific level of exposure. Passive self-monitoring of temperature (e.g. monitoring temperature only if feeling feverish) and symptoms or active self-monitoring (e.g. by regular temperature measurement twice a day) for those at a higher risk level should be continued for the longest incubation period (e.g. 21 days for viral haemorrhagic fevers such as EVD).

4.6.7 Ships

The IHR model of a maritime declaration of health *[48]* contains questions that include the following symptoms as grounds for suspecting the existence of a disease of an infectious nature:

(a) fever, persisting for several days or accompanied by (i) prostration; (ii) decreased consciousness; (iii) glandular swelling; (iv) jaundice; (v) cough or shortness of breath; (vi) unusual bleeding; or (vii) paralysis.

(b) with or without fever: (i) any acute skin rash or eruption; (ii) severe vomiting (other than sea sickness); (iii) severe diarrhoea; or (iv) recurrent convulsions.

The major risks for ship workers are contact with body fluids from passengers or crew members or surfaces and clothes contaminated with their body fluids. The key control measures are as follows:

- Maintain a safe distance (1 metre or 3.2 feet) from passengers or crew members; use gloves to handle documents.
- Avoid touching belongings and contact with surfaces and clothing that have had possible contact with body fluids. Frequently perform hand hygiene.
- Ensure that the ship's master, doctor or crew member appointed to deal with health problems on board is fully informed and is educated about the risks of viral haemorrhagic fevers such as EVD, and the precautions and protective measures to be taken by crew members to prevent them from contracting the virus.
- Crew members should follow the recommendations in WHO's *Travel and transport risk assessment: interim guidance for public health authorities and the transport sector [45].*

Guidance for ship operators

In case a passenger presenting with symptoms compatible with viral haemorrhagic fevers – such as EVD (fever, weakness, muscle pain, headache, sore throat, vomiting, diarrhoea, bleeding) – is on board a ship, the following precautions must be applied:

- Keep the affected person's cabin doors closed; if not, place in an isolation room on board.
- Provide information about the risk of viral haemorrhagic fevers such as EVD to persons who will take care of the patient or will enter the patient's cabin or isolation room.
- Maintain a log of all persons entering the cabin or isolation room; all should be considered contacts unless a diagnostic test is reported as negative.
- Ensure that a health worker who enters the cabin or isolation room to provide care to the affected person or to clean the cabin uses PPE as follows:
  - non-sterile examination gloves or surgical gloves; gloves (cleaners should preferably use heavy duty/rubber gloves);
  - a disposable impermeable long-sleeved gown to cover clothing and exposed skin, a medical mask and eye protection (eye visor, goggles or face-shield) when coming in close contact with the affected person and/or if any exposure to blood or body fluids is expected; if unavailable, a waterproof apron should be worn over a non-impermeable gown;
  - rubber boots or closed, puncture- and fluid-resistant shoes with overshoes;
  - before exiting the cabin or isolation room, PPE should be removed in such a way as to avoid contact with the soiled items and any area of the face.
- anyone providing care to the person in isolation should perform hand hygiene by hand-rubbing with an alcohol-based hand-rub solution for 20-30 seconds or hand-washing with soap and water for 40-60 seconds if hands are visibly dirty, before putting on gloves, after any direct contact with the affected passenger or with his/her personal belongings or any objects/surface potentially contaminated with his/her blood or body fluids and after removing PPE *[49]*.

WHO guidance for prevention and control of acute respiratory disease, such as H1NI1 influenza, on ships includes the following *[50]*:

- Where there has been, or there continues to be, a number of travellers with influenza-like symptoms on board, efforts should be made by the ship operator to separate sick and suspect passengers leaving the ship from those who are about to board. It may be necessary to use separate halls to prevent human-to-human transmission. If both sets of passengers are obliged to use the same area, it should be cleaned effectively after disembarking passengers have left and before embarking passengers arrive.
- The ship's operator may, if so required by the Member States and available on board, appoint a medical officer or trained crew member to take responsibility for the basic health preventive and control measures and emergency medical treatment, such as:
  - initiate active surveillance (case-finding) among the crew members to detect new cases once a person with influenza-like symptoms has been identified and to oversee surveillance activities;

- improve awareness of passengers and crew members about the symptoms and signs of pandemic influenza (H1N1) 2009, complications from infection, and infection control measures such as hand hygiene and social cough etiquette;
- promote the practice of hand hygiene and cough etiquette;
- collect the surveillance case data in a timely and appropriate manner and report to the ship operator daily, if so required and possible;
- review medical log data daily for both passengers and crew members to evaluate illness trends and to alert the ship's master of the need to investigate and contain outbreaks.

4.6.8 Taxis and public transport

In countries with intensive transmission of highly infectious communicable diseases (e.g. influenza, EVD, Marburg virus etc.), taxi drivers (vans, cars, motorcycles) are at risk of exposure through contact with the coughs and/or sneezing of passengers, or contact with the body fluids, especially if the driver assists passengers to enter the vehicle. Transmission may also come from clothes or belongings contaminated with body fluids that are placed on seats or other surfaces of the vehicle.

Control measures include identifying possible or confirmed Ebola cases by asking passengers questions about recent illnesses or visits to a medical facility, and observing passengers for signs or symptoms (e.g. bleeding, inability to stand or move without assistance). Do not touch possible and confirmed Ebola cases or their belongings. Decontaminate the vehicle as soon as possible using bleach. Workers decontaminating the vehicle should wear full PPE.

Social mobilization should be used to educate the community that taxis or public transport should not be used to move patients with signs and symptoms of viral haemorrhagic fevers such as EVD. Instead, health-care workers should be contacted and private vehicles used to transport patients to health-care facilities.

In areas with widespread and intense transmission of viral haemorrhagic fevers, taxi drivers should be advised to:

- set up a partition between the front and the back seats of the car;
- avoid shaking hands with customers;
- perform hand hygiene frequently with either water and soap or alcohol-based hand-rub, particularly after touching surfaces or objects soiled with blood and body fluids, even if gloves were used;
- cover the back seats with plastic sheets, which should be immediately changed and disposed of in a sealed waste bag if soiled with blood and body fluids (do this while wearing gloves);
- carry alcohol-based hand-rub, gloves, waste bags, wipes and a disinfectant;
- drivers should refer immediately to a health-care facility/authority if they have been exposed to a sick person likely to have a viral haemorrhagic fever such as EVD (physical contact with the patient or with his/her blood or body fluids).

4.6.9 Waste-water workers

Pathogenic microbes such as Ebola virus, V. cholerae and leptospirosis may be found in the faeces and urine (excreta) of infected persons. Waste-water workers who come into direct contact with excreta should take precautions, including hand hygiene and wearing PPE. This includes waste-water workers in health-care facilities, those transporting waste, sewage workers and workers at waste-water treatment plants receiving sewage from specialized treatment units and affected communities.

Basic hygiene practices for workers handling waste

- Avoid smoking, chewing tobacco or gum while handling human waste or sewage.
- Cover sores, cuts and wounds with clean, dry bandages.
- In case of accidental spillage of human waste or sewage in the eyes, gently flush the eyes with safe water.
- Use waterproof gloves to prevent cuts and contact with human waste or sewage.
- Wear rubber boots at the worksite and during the transport of human waste or sewage, remove rubber boots and work clothes before leaving the worksite.
- Clean contaminated work clothing daily with 0.05% chlorine solution (1 part household bleach to 100 parts water).
- Follow hand hygiene procedures.
- Before eating, remove soiled work clothes and eat in designated areas away from human waste and sewage-handling activities.

Personal protective equipment for workers handling sewage and waste water

When dealing with sewage and waste water, PPE should include:

- protective face mask or splash-proof face-shield to protect nose and mouth from splashes of human waste or sewage;
- goggles to protect eyes from splashes of human waste or sewage;
- liquid-repellent coveralls to keep human waste or sewage off clothing;
- waterproof gloves to prevent exposure to human waste or sewage;
- rubber boots to prevent exposure to human waste or sewage.

4.6.10 Insecticidal spraying for vector control activities

Vector control activities may be a crucial component of emergency response in the case of vector-borne disease outbreaks such as those of dengue, yellow fever and malaria. Vector control may also be required after floods, tsunami and cyclones as well as part of routine activities in camp sites providing temporary lodging for the community affected by disaster. Methods for mosquito control include space spraying of insecticides, applying larvicides and, in some cases, indoor residual spraying of insecticides (applied to selected indoor surfaces such as walls or under furniture).

Vector control workers are exposed to insecticides when opening containers, mixing and loading spray solutions, spraying insecticide products with hand-carried or vehicle-mounted equipment,

washing and maintaining spray equipment, and disposing of empty containers. Spills, splashes and leaks of insecticide in concentrated form can lead to exposure by accident.

In its interim guidance on protection of spray workers during the handling of insecticides for control of Zika virus outbreaks, WHO recommended the following measures *[51]*:

- planning for protective measures, such as identifying relevant national regulations on pesticide purchase, use and application techniques, information on ingredients and their potential health effects, and making information available through a globally harmonized system of hazard communication *[52]*;
- protecting the health and safety of operators, such as by providing protective equipment (cotton overall covering arms and legs, rubber chemical-resistant protective gloves, hat with broad rim, chemical googles or face-shield, rubber boots and ear muffs);
- spraying of insecticides in a way that minimizes exposure of operators and residents;
- compulsory training of workers in the safe use of insecticides;
- strict personal hygiene such as regular washing, changing clothes and cleaning of equipment;
- storage and disposal of insecticides in a safe, secure place and in line with the manufacturer's label recommendations;
- provision of medical supervision of spray operators;
- managing acute poisoning with insecticides, such as first aid and decontamination (washing) of the skin and eyes as soon as possible after exposure and treatment (there is no specific treatment; symptoms are treated and further absorption should be prevented).

Measures during application of insecticides should include:

- daily briefings on measures to protect workers' health and for safe work practices;
- prohibition of smoking, eating and drinking during the application of insecticides and larvicides;
- use of appropriate PPE;
- use of correct maintenance procedures for equipment to ensure that no leakages occur during spraying operations;
- recalibration of spray equipment after 25 hours of operation, major maintenance or a change of product;
- use of semi-closed automatic dilution machine for water-diluted sprays.

The selection of PPE depends on the OSH risks associated with the different tasks. PPE must comply with national regulations on pesticide use and manufacturers' recommendations must be taken into account.

Personal protective equipment to be used during handling and spraying insecticides

When handling concentrated insecticide products, pouring out, mixing or preparing a spray liquid, and filling equipment:

- cotton coverall covering the arms and legs (two sets should be provided per worker per day to allow for change in case of wetting);
- rubber chemical-resistant protective gloves;
- hat with broad rim;
- chemical goggles or face-shield;
- rubber boots.

In addition to the above, when spraying with hand-held devices and operating vehicle mounted-foggers by hand, wear air-purifying half-mask respirator with organic vapour cartridge(s) in combination with filters for aerosols and particles, such as N95, R95 or P95 filter (respirator filters must be changed periodically in accordance with the manufacturer's instructions), and ear muffs when working with noisy foggers.

When applying microbial larvicides and growth regulators:

- working clothes;
- rubber gloves;
- dust masks when handling formulations in granular form.

Storage and disposal of insecticides

All insecticides used in space treatment or larviciding should be stored in a safe, secure place and in accordance with the manufacturer's label recommendations. Unused, diluted insecticide must not be left in the spray equipment after fogging or larviciding, and should not be stored. Unused diluted insecticide and empty containers and sachets should be disposed of in accordance with national guidelines and regulations and the recommendations of the manufacturer. Empty containers should be triple-rinsed with the solvent being used (e.g. kerosene oil, diesel, water) and rendered useless before disposal. The rinsate should be used in preparing the subsequent spray liquid as applicable, or disposed of in accordance with national guidelines.

Decontamination

- All contaminated clothing should be removed to prevent further absorption. Affected skin should then be washed with soap and flushed with large quantities of water. If the eyes are contaminated, the lids should be gently opened with the fingers and the insides (conjunctivae) washed with clean running water for several minutes. Care should be taken that runoff from one eye does not enter the other eye.
- Decontamination of the skin and eyes should take place as soon as possible after exposure. Special medical treatment should be sought promptly after decontamination. Specific measures are needed for different groups of insecticides that are found in the globally harmonized system information for that product.

Pre-placement examination

- All operators should go through a preliminary health assessment to determine if there are any contraindications to working with the specific insecticides being used.
- The preliminary health assessment should consist of a physical examination, medical history, occupational history, comprehensive metabolic panel (blood sugar, electro-

lyte and fluid balance, kidney and liver functions), baseline cholinesterase RBC/plasma tests (for those using organophosphates and carbamates) and pulmonary function test (for those required to wear a respirator).

- Working with organophosphates and carbamates may cause complications of pre-existing peptic ulcer, bronchial asthma, anaemia, degenerative diseases of the central nervous system, chronic colitis, a history or evidence of psychosis, and diseases such as myasthenia gravis and glaucoma, which are treated with cholinesterase-inhibiting drugs.

Medical surveillance

- Arrangements must be made to ensure that any exposed person can easily report any symptoms to a supervisor, who will then notify a medical officer. In particular, any unusual illness not associated with well recognized signs and symptoms of poisoning by a specific insecticide should be noted and reported to the appropriate health authorities.
- Monitoring should be implemented to detect any subtle neurological effects in exposed persons, such as loss of ability to understand written material and to concentrate. In addition to clinical surveillance, quantitative biochemical tests can be carried out to assess the degree of exposure, both during pre-placement and during employment on a periodic basis.
- All cases of acute or chronic poisoning of operators and other personnel resulting from occupational exposure to insecticides should be reported to the competent authority dealing with registration and compensation of occupational diseases and injuries according to established national practice and regulations.

Chapter 5.

Occupational safety and health in chemical incidents

5.1 Emergencies caused by chemical incidents

Chemical incidents of varying scales and consequences are a common occurrence in most parts of the world. They may arise from a technological incident, a natural disaster or a deliberate act. A chemical incident can involve a release of chemicals into the environment (e.g. from an explosion, containment failure or illegal dumping) and also from the adulteration or contamination of products such as food, drink or medicines. This chapter applies to chemical releases into the environment. Some examples are provided in Table 3.

Between 2000 and 2009, almost 3200 technological disasters were reported worldwide, with approximately 100 000 people killed and more than 1.5 million affected. These chemical incidents involved chemicals released from chemical plants due to explosions and emissions, natural disasters, dumping of toxic waste, conflicts and terrorism. Some examples of major chemical incidents between 2000 and 2010 are listed in Table 3.

5.2 Occupational safety and health hazards and risks of chemicals

A chemical incident has been defined by WHO's *Manual for public health management of chemical incidents* as "an unexpected uncontrolled release of a chemical from its containment". A public-health chemical incident has been defined as "where two or more members of the public are exposed (or threatened to be exposed) to a chemical" *[56]*. Chemical incidents may be sudden events with a rapid release of chemicals over a limited period of time or more chronic events that can continue for days or even years.

Major industrial incidents can be caused by explosions of large vapours or flammable gases, fires or toxic releases. Common toxic releases from plants include chlorine, ammonia, sulfuric acid, hydrogen chloride, phosgene and hydrogen sulphide. For instance, in December 1984 a toxic gas plume of methyl-isocyanate was released into the air from a chemical plant in Bhopal, India, following failure of safety valves and other safety controls. Chemical release may also happen during transportation of gases through pipelines, or by rail, road and waterways.

Chemical incidents affect people in a number of ways, including:

- the toxic effects of the chemicals;
- the effects of fire;
- the effects of explosion.

Table 3. Examples of major chemical incidents, 2000-2010

Year	Location	Description of incidence	Consequence
2003	Gao Qiao, China	Gas well blowout releasing large quantities of hydrogen sulphide	243 deaths, 9000 people poisoned, 64 000 people evacuated
2006	Côte d'Ivoire	Dumping of toxic wastes in the city of Abidjan	10 deaths, thousands made ill
2006	China	Plant explosion and fire, with release of 100 tonnes of pollutants in the Songhua river which crosses international borders	Five deaths, millions of population without water for several days
2008	China	Milk and infant formula adulterated with melamine	Some 300 000 infants and 50 000 children hospitalized, with 600 children dying with kidney stones and other kidney defects
2010	Nigeria	Lead poisoning from informal gold mining in an area where lead is prevalent, using crude dust-generating technology	More than 400 children showing toxicity died and many communities affected
2010	Hungary	Burst of sludge reservoir at aluminium plant, with pollutants released to nearby villages and the Danube river which crosses international borders	At least 9 deaths and 150 injuries due to corrosive effects of reservoir sludge
2010	USA	Explosion of the Deepwater Horizon oil rig in Gulf of Mexico	11 deaths from explosion, minor injuries and effects on health of health workers, other workers and volunteers living near shoreline, with possible long-term effects [53]
2012	Republic of Korea	Release of 8 tonnes of hydrogen fluoride from a chemical plant in Gumi	5 deaths, at least 18 injured, evacuation of local residents, crops destroyed, declaration of a special disaster zone [54]

Source: International Health Regulations 2005, WHO, 2008 *[55]*

Toxic effects of chemicals

Chemicals enter the body through the skin, eyes, lungs or digestive tract. Absorption is affected by factors such as the properties of the chemical, the route and duration of exposure and the person's age (young children absorb proportionately more than adults). Ambient conditions such as temperature may also affect absorption by changing the physical state of a chemical. In the context of emergency response, the most likely routes of exposure will be inhalation, and dermal and eye exposure. Absorption via the lungs is usually rapid whereas dermal absorption is slower.

The effects of exposure are determined by the toxicity of the chemical, the amount absorbed that reaches target tissues, and factors that influence susceptibility – e.g. age, general health, genetic factors (such as slow or fast metabolizers) and concomitant exposure to other chemicals. A short exposure to a high concentration may be enough to cause toxic effects. When the exposure is prolonged and the dose rate low, it may be the total cumulative dose that causes toxicity.

Toxic effects can be local (e.g. burning or blistering of the skin, eyes or respiratory tract) as caused by corrosive agents, irritant gases and some organic solvents, or the effects may be systemic (e.g. toxicity due to lead, mercury, organophosphorus insecticides or cyanide). Some

effects (e.g. eye and respiratory irritation or central nervous system depression) can occur within minutes or hours of the exposure, as in the case of nerve agent poisoning. Other effects (e.g. congenital malformations or cancers) may take months or years to appear.

Toxic effects of gas release

Based on their health effects, gases can be classified as irritant or asphyxiating. Irritant gases have corrosive properties – i.e. they cause injuries to surface tissues such as skin and mucus membranes and cause inflammation of air passages. Examples include ammonia, chlorine and sulfur oxides. Asphyxiating gases are those that interfere with the supply and utilization of oxygen in the body. Chemical asphyxiation causes death by preventing the transportation of oxygen by blood (e.g. carbon monoxide) or by inhibiting cellular respiration (e.g. hydrogen cyanide).

Exposure to chemicals in fire

The key threats to life during a fire include thermal injury, heat stress, toxic gases and oxygen deficiency. Depending on the substances that are burning, the smoke can be a complex mixture of many hazardous chemicals. Typical constituents include soot, carbon monoxide, carbon dioxide, sulfur dioxide, nitrogen oxides, hydrogen chloride, phenol, formaldehyde, isocyanates, benzene and others. Carbon monoxide is a key factor in most fires. Hydrogen cyanide is formed in fires involving polyurethane, nylon, silk and wool. In cases of explosion, there is sudden release of chemicals and pressure effects that cause physical injuries along with chemical and other effects associated with fire.

Chemical burns

Chemical burns can be caused by many substances – such as strong acids, alkalis, drain cleaning agents, organic solvents and gasoline. In some cases, pain and redness may develop hours after the exposure. The damage may be worse than one would expect from the burn on the skin. As in case of hydrogen fluoride acid, the burn may initially appear mild but may progress to a full thickness burn if not treated *[57]*.

The International Chemical Safety Cards (ICSC) database *[58]*, a joint undertaking between WHO and ILO with the cooperation of the European Commission (EC), is available online and provides essential health and safety information on chemicals.

5.3 Occupational safety and health management of emergency responders during chemical incidents

This section describes some basic principles of chemical incident response. It highlights the roles of emergency responders that can result in chemical exposure, as well as the protective measures that should be put in place.

5.3.1 Incident Command System for managing chemical emergencies

Where there is an organized response to a chemical incident, this is usually managed through an Incident Command and Control centre. The functions of incident command in a chemical emergency include ensuring that the following tasks are implemented:

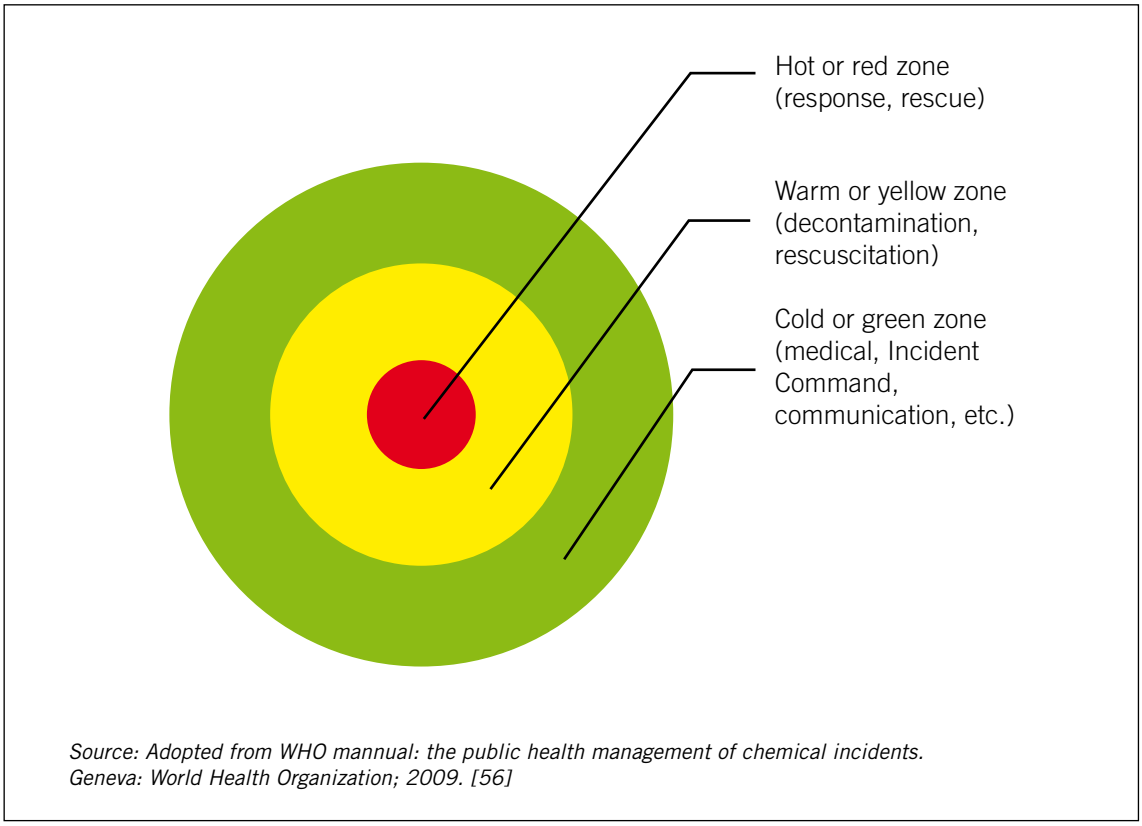
- assessment of the situation;
- rescue of people;
- evacuation of people from hazardous areas;
- establishment of safety and security parameters;
- entry to hazardous areas is limited to essential and authorized staff only, through the establishment of exclusion and access zones;
- personal protection guidelines are followed;
- conventional hazards such as fire are dealt with;
- deployment of other teams, such as for monitoring and decontamination.

Zoning of the incident scene

To manage a chemical incident such as a chemical spill, a series of zones may be established around the incident site to control access and establish a corridor for controlling contamination. Typically, there will be three zones:

- Red, hot or exclusion zone: This is the area where there is active or suspected release of chemicals. This zone should extend far enough to prevent contamination of people and materials outside this area. Very limited activities can be performed here (e.g. operations to control the release and to rescue victims). No decontamination or patient care is provided in this zone. Personnel should wear full chemical PPE.

Figure 7. Zoning of the chemical incident scene



Source: Adopted from WHO mannual: the public health management of chemical incidents. Geneva: World Health Organization; 2009. [56]

- Yellow, warm or contamination-reduction zone: There may or may not be active release but the concentration of chemicals will be lower than in the hot zone. Emergency response personnel will still need chemical protection. Victims, emergency responders and equipment are normally decontaminated at the boundary between this and the cold zone. There is a risk of secondary contamination.
- Green or cold zone: There is no contamination. The contaminated victims, emergency response personnel and equipment must be decontaminated before entering this zone. This zone contains all administrative functions for managing the chemical incident (e.g. the command unit and ambulances).

Access control – i.e. limiting entry to different zones only to authorized persons – is an important measure to control the spread of contamination to emergency responders.

Safe work practices to be followed by emergency responders in red and yellow zones

Emergency responders in red and yellow zones should:

- minimize exposure time to that essential for lifesaving or initial monitoring;
- avoid unnecessary contact with surfaces or potentially contaminated material;
- use natural ventilation flows to reduce exposure (e.g. position upwind of the chemical release, as in the case of gas leaks);
- ensure mandatory decontamination;
- carry out post-exit evaluation for signs and symptoms of exposure.

The United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) suggests guidance for emergency responders undertaking hazardous materials operations *[59]*.

Prior to committing resources to a contaminated site, the following should be considered:

- A risk analysis should be conducted on the basis of a hazard/risk assessment and the site survey.
- Teams should evaluate the risk in relation to the rescue of viable victims versus recovery of the dead.
- Teams should also consider other search and rescue priorities within the immediate vicinity.

In general, the following tactics should be adopted while assessing a site that is suspected to be contaminated:

- Ensure a safe approach – usually downwind or, in the event of a liquid spill, up a slope.
- Ensure that clear command and control arrangements are in place and are well understood by all present.
- Secure the site as best as possible to ensure the safety of others.
- Attempt to identify the contaminant (using UN numbers, Dangerous Goods or Hazchem codes).
- Assess the potential harm and minimize environmental contamination where possible.

- Call in assistance (e.g. expert advice, additional resources) if possible.
- If within the team's capability, render the site safe.
- Always assume the worst until proven otherwise.

Decontamination can be both equipment- and labour-intensive. Therefore consideration should be given to avoiding overextending the teams' capability in this area. Whenever protective clothing or equipment is used, decontamination strategies need to be considered.

While undertaking search and rescue operations at any worksite, teams should consider the following issues and implement a monitoring regime for the duration of the operations:

- oxygen levels;
- flammability of substance or surrounding atmosphere;
- toxicity levels;
- explosive limits;
- radiological monitoring.

The following considerations may affect the decision of whether to conduct search and rescue operations:

- Condition of voids: if the hazard can be easily isolated or mitigated and this is carried out, the situation is considered handled and operations are to continue.
- Time required to access victims: this will be an estimate of the time required to reach the first victim. It should include the time it would take to mitigate hazards, cut through floors, walls, roofs etc., and to shore up and brace the access route as well as relevant adjacent structures, if required.
- Special occupancy information: increased attention and monitoring will be given to certain types of target hazards, especially those involving nuclear energy, radiological elements, specialized military facilities, chemical manufacture, and biological production or storage.
- Decontamination: careful planning is needed to ensure that the team has procedures in place to provide adequate decontamination of members, including search dogs.

The following should be considered when undertaking detection and monitoring:

- Operational worksite detection and monitoring should be performed by the assigned Hazmat specialist in the team and should include the following:
- establishment of safe perimeters for each assigned structure;
- establishment of clean entry points to each assigned structure;
- planning for the need to monitor additional voids or potential spaces encountered during operations;
- establishment of decontamination sites, including appropriate disposal of contaminated runoff;
- ensuring decontamination of assigned tools and equipment, including protective clothing;
- ensuring decontamination of assigned transportation vehicles.

5.3.2 Personal protective equipment

Emergency response personnel and staff in health-care facilities who are managing contaminated victims/patients may become exposed to toxic chemicals through direct contact with the chemical on the patient's skin or clothing or by inhalation or mucosal contact with a vapour hazard. These personnel should therefore be provided with appropriate PPE and be trained in its use. The level of PPE depends on the likely degree of exposure and the toxic properties of the chemical concerned. The greater the likely exposure or the more severe the toxicity of the chemical concerned, the higher the degree of chemical protection needed. As an example, personnel involved in controlling a chemical release or rescuing exposed victims (e.g. those operating in the red zone) may need the highest level of chemical protection. Health-care personnel managing patients exposed to a chemical that has limited dermal and inhalational absorption may need little more than aprons and gloves. When deciding on the appropriate level of PPE, the need for adequate protection against toxicity must be balanced against the potential difficulties and discomfort associated with working in high-level equipment.
Depending on the type, PPE should be decontaminated prior to removal or else carefully removed and disposed of safely.

Levels of PPE protection

Use of PPE by first responders during a chemical emergency is grouped by the Occupational Safety and Health Agency of the USA into four categories *[60]* on the basis of the degree of protection afforded.

Level A protection should be worn when the highest level of respiratory, skin, eye and mucous membrane protection is needed. A typical Level A ensemble includes:

- positive-pressure (pressure demand), self-contained breathing apparatus (SCBA), or positive-pressure supplied air respirator with escape SCBA;
- fully encapsulating chemical protective suit;
- gloves, inner, chemical-resistant;
- gloves, outer, chemical-resistant;
- boots, chemical-resistant, steel toe and shank (depending on suit boot construction, worn over or under suit boot).

Level B protection should be selected when the highest level of respiratory protection is needed but a lesser level of skin and eye protection is needed. Level B protection is the minimum level recommended on initial site entries until the hazards have been further identified and defined by monitoring, sampling and other reliable methods of analysis, and until equipment corresponding to those findings is utilized. A typical Level B ensemble includes:

- positive-pressure (pressure demand), self-contained breathing apparatus (SCBA), or positive-pressure supplied air respirator with escape SCBA;
- chemical-resistant clothing (overalls and long-sleeved jacket, coveralls, hooded two-piece chemical splash suit, disposable chemical resistant coveralls);
- gloves, outer, chemical-resistant;
- gloves, inner, chemical-resistant;
- boots, outer, chemical-resistant, steel toe and shank.

Level C protection should be selected when the type of airborne substance is known, concentration is measured, criteria for using air-purifying respirators are met, and skin and eye exposure is unlikely. Periodic monitoring of the air must be performed. A typical Level C ensemble includes:

- full-face or half-mask, air-purifying respirator;
- chemical-resistant clothing (one-piece coverall, hooded two-piece chemical splash suit, chemical-resistant hood and apron, disposable chemical-resistant coveralls);
- gloves, outer, chemical-resistant;
- gloves, inner, chemical-resistant;
- boots, steel toe and shank, chemical-resistant.

Level D protection is primarily a work uniform and is used for nuisance contamination only. It requires only coveralls and safety shoes/boots. Other PPE is based on the situation (types of gloves, etc.). It should not be worn on any site where respiratory or skin hazards exist.
For contact hazards, nitrile or butyl rubber gloves, not latex, are suitable. In addition, chemically-resistant clothing is suitable. In its absence, fluid-resistant clothing or gown can also be used and regularly changed.

Standard medical and surgical masks provide no protection to mucus membranes from toxic vapours. An air-purifying respirator such as one fitted with an activated charcoal filter or SCBA is required. SCBAs require proper training, safety and fit-testing and can be worn by the user for a limited period only.

5.3.3 Decontamination of emergency response personnel

Emergency response personnel who become contaminated with chemicals in the course of their work should undergo decontamination at the first opportunity and certainly before leaving the yellow zone, receiving medical treatment or leaving work. Prompt and effective decontamination is important to protect against both acute and long-term toxic effects of the chemical concerned. Basic equipment for decontamination is listed in Box 5. It is also important for protecting others (e.g. colleagues and family members) from secondary contamination.

Decontamination is usually achieved through the physical removal of the chemical or, in certain limited circumstances, by chemical inactivation. Taking off contaminated clothing will usually remove a significant amount of the chemical. Decontamination methods are divided broadly into wet (using soap and water to wash off the chemical) and dry (using absorbent materials to soak up and brush off the chemical). Chemicals of a viscous or oily nature can be difficult to remove using one method alone.

Organizing a decontamination unit in a health-care facility

WHO's *Interim clinical management of patients exposed to chemical weapons: interim guidance document [61]* covers the following aspects related to decontamination in a health-care facility:

- Decontamination should be carried out in a designated area and cleansing materials such as water, soap and sponges should be provided. The decontamination area should have clearly indicated zones for receiving contaminated personnel (the pre-decontamination zone) and for carrying out decontamination. Additionally, the

"clean zone" is where personnel can dress and be given treatment if necessary. Movement should be in one direction only, from the pre-decontamination zone to the decontamination zone to the clean zone.

- The decontamination zone includes any areas where the type and quantity of hazardous substance is unknown and where contaminated victims, contaminated equipment or contaminated waste may be present. It is reasonably anticipated that employees in this zone might have exposure to contaminated victims, their belongings, equipment or waste. This zone includes, but is not limited to, places where initial triage and/or medical stabilization of possibly contaminated victims occurs, the pre-decontamination waiting (staging) areas for victims, the actual decontamination area, and the post-decontamination victim inspection area. This area will typically end at the emergency department door. In other documents this zone is sometimes called the "warm zone".
- The post-decontamination zone is an area considered uncontaminated. Equipment and personnel are not expected to become contaminated in this area. At a hospital receiving contaminated victims, the hospital post-decontamination zone includes the emergency department (unless contaminated). This zone is also sometimes called the "cold zone".
- Pregnant health-care providers should not be permitted to work in the pre-decontamination and decontamination areas.

Decontamination at the end of a work cycle by able-bodied personnel

If wearing chemical protection suits, responders must wash their PPE before removing it, using a soap and water solution and a soft brush, starting from the head and working down to the feet until contamination is removed. The PPE should be removed by rolling it downward (from head to toe) rather than pulling it over the head. SCBA should be removed after the other PPE has been removed. After removal, all PPE should be placed in labelled and durable polyethylene bags. The person should then shower, taking care to cleanse all areas, including skin folds, with soapy water, and then put on clean clothing.

Other types of PPE should be carefully removed, again avoiding pulling items over the head. Clothes should be placed in a labeled and durable polyethylene bag for later cleansing or disposal as hazardous waste, depending on the chemical concerned. The person should then shower, taking care to cleanse all areas including skin folds with soapy water, and then put on clean clothing.

Decontamination of contaminated/disabled personnel

If an emergency responder has become disabled as a result of contamination or as a consequence of trauma, he/she must be decontaminated by others using the following procedure:

- Decontamination should take place before entry into a health-care facility.
- Clothing should be carefully removed in such a way as to avoid exposing unexposed areas. Clothing should be cut off if necessary.
- Decontamination should be carried out and supervised by an appropriately trained responder wearing adequate PPE.
- The use of a dry or wet method should be adapted to local resources and the situation. Information on the rinse-wipe-rinse technique is given below.

- Decontamination may need to be accompanied by other activities such as triage and medical resuscitation.
- Contaminated materials and clothing should be disposed of safely as hazardous chemical waste.

Emergency decontamination using rinse-wipe-rinse technique

The key steps of the procedure are as follows:

1. Any liquid on the skin should be blotted off with clean absorbent material (e.g. wound dressing). Gently rub off any solids (e.g. powder).
2. Affected areas should be gently rinsed or washed with soapy water (use 0.9% saline for open wounds) to dilute the contaminants and remove particulates. Start with the face and work down to the toes, paying special attention to skin folds, skin creases, nails, ears and hair. Eyes should be flushed copiously with 0.9% saline, as using only small amounts may facilitate the spread and absorption of some chemicals.
3. Affected areas should be wiped gently but thoroughly with a sponge or soft brush or washcloth to remove organic chemicals and petrochemicals (hot-water soluble). Sponges and washcloths must be replaced regularly.
4. Affected areas should be rinsed and, once clean, dried gently with disposable towels.
    - The following information about the exposed individual should be recorded:
    - details of the person (e.g. name, age, sex, address, medical history);
    - the way in which the person was exposed to the chemical;
    - exposure time (time of day and duration);
    - exposure pathway (i.e. air, soil, or water);
    - symptoms, including their time course;
    - samples collected (e.g. biomarkers);
    - treatment indicated and provided.

Box 5. Basic equipment for emergency decontamination for chemicals

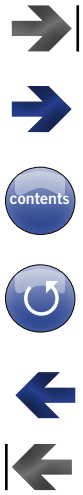
- Scissors
- Buckets (5-10 litres capacity)
- Sponges, soft brushes (for washing clothes)
- Clean water source (ideally lukewarm water), hosepipe for moist rinsing, saline solution (for wound irrigation, eyes and other mucous membranes), distilled water, if possible
- Liquid soap, washing-up liquid, shampoo without conditioner
- Disposable towels, drying cloths
- Large plastic bags (for clothing and double-bagging)
- Small clear plastic bags
- Identification/triage labels/tags, pen
- Sturdy containers (for used decontamination equipment)
- Replacement clothing or sheets, blankets
- Stretchers

Source: *Interim clinical management of patients exposed to chemical weapons: interim guidance document [61].*

5.3.4 Medical surveillance of emergency responders

As chemicals have both acute and long-term toxic effects on health, it is essential that all emergency responders are subject to medical surveillance throughout their deployment. This requires the following elements to be in place:

- A detailed medical check-up for determining fitness for deployment should take place in the pre-deployment phase, including a check of the respiratory system to assess fitness for using respirators.
- During deployment, as much information as possible should be collected on the nature of the work and type of hazards, duration of work, exposure concentration of chemicals in the working environment, incidents of contamination and adverse health effects, if any.
- Immediately after the response, a post-deployment medical examination should focus on exposures during deployment, including a psychological assessment. Thereafter, based on the type of exposures during deployment, the responders may be examined periodically.
- Medical treatment of all exposed persons is to be carried out whenever required during the deployment cycle. For complex systemic involvement of body systems, the treatment may involve consultation with a clinical toxicologist and, in some cases, the use of antidotes at tertiary-care health facilities.


contents

Chapter 6.

Occupational safety and health in radiation incidents

Nuclear and radiological incidents are infrequent when compared with events involving other hazardous materials such as chemicals. Despite their low frequency, however, nuclear and radiological events generate high levels of public concern and political engagement at local, national and international levels. In addition, concerns regarding potential malicious uses of radioactive and nuclear materials have increased with the heightened awareness of international terrorism and a variety of radiation and nuclear scenarios can be postulated.

Significant incidents at nuclear installations include those at Windscale, United Kingdom (1957), Three Mile Island, USA (1979), Chernobyl, Ukraine (1986), Tokaimura, Japan (1999) and Fukushima, Japan (2011). Incidents involving significant radiation exposures to radioactive sources include exposure of people to abandoned sources (New Delhi, India, 2010), occupational accidents (Chile, 2005), and medical overexposures (Epinal, France, 2004) *[62]*.

Consequently, the scale and types of radiological and nuclear emergencies may range from an isolated occupational or medical over-exposure of one person to a major catastrophe with global dimensions. Regardless of the scale or cause of an accident, there is a common denominator - i.e. impacts on human health. The IHR include radionuclear hazards in their scope.

6.1 Sources and scenarios of radiation incidents

A radiological emergency is an emergency in which there is, or is perceived to be, a hazard due to radiation exposure from a source may include the following[1]:

- medical symptoms of radiation exposure;
- loss or theft of a dangerous radioactive source;
- public radioactive contamination/exposure;
- a transport emergency involving radioactive materials;
- detection of elevated radiation levels;
- presence of a radiological dispersal device (RDD).

The sources of radiation are used in various fields, including industry, medicine and research; therefore radiological emergencies may occur anywhere.

[1] See: www-ns.iaea.org/tech-areas/emergency/iec/frg/what-is-a-rad-emergency.asp, accessed 12 October 2017.

Any source of radiation has the potential to give a radiation dose through external or internal routes as follows:

External routes: Individuals can be exposed to radiation from radioactive material in the environment:

- directly from a radioactive source or from radioactive material deposited on the ground or other surfaces;
- dispersion of a radioactive material in gaseous or vapour form in the atmosphere.

Internal routes: Individuals can be exposed to radiation from radioactive material within the body by:

- inhaling radioactive material in the atmosphere from the incident or re-suspended from the ground;
- ingesting food/water that has been contaminated with radioactive material;
- absorbing radioactive contamination through the skin or open wounds into the body.

Health effects from exposure to radiation include one or more of the following:

- short-term effects such as skin burns or acute radiation syndrome at high doses of radiation;
- long-term effects such as an increased risk of certain types of cancer reported at doses above 100 mSv;
- psychological effects even where little or no radiation exposure has occurred.

6.2 Occupational safety and health management of emergency responders during radiation emergencies

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS) *[63]* define an emergency exposure situation as a situation of exposure that arises as a result of an accident, a malicious act or any other unexpected event, and that requires prompt action in order to avoid or to reduce adverse consequences. Preventive measures and mitigation actions have to be considered before an emergency exposure situation arises. However, once an emergency exposure situation does arise, exposures can be reduced only by implementing protective actions.

During an emergency, each particular protective action (elaborated in emergency preparedness and response planning) might be implemented separately, and optimization of the entire strategy needs to consider all pathways of exposure, in order to ensure that the residual dose[2] is reduced to as low as reasonably achievable. The optimized protection strategy is to be implemented when generic criteria, for use in protection strategies that are compatible with reference levels, are exceeded, to provide for rapid action. Such actions are often needed in the absence of detailed radiological information that is usually associated with planned exposure situations in which the source is under control. In emergency situations, reference levels

[2] Residual dose refers to the dose expected to be incurred after protective actions have been terminated (or after a decision has been taken not to take protective actions).

should be selected to be within, or if possible below, the 20–100 mSv band[3] 18 recommended in the ICRP Recommendations of 2007 (Publication 103).

Occupational exposures in emergency and existing exposure situations are to be subject to the available operational and procedural arrangements, including assessment, monitoring, engagement and training. Individual exposure should be optimized, with appropriate boundaries of reference levels. Depending upon the prevailing circumstances, these reference levels may be greater than the recommended values of dose limits that are applicable to planned exposure situations. In emergency or existing exposure situations, the reference levels represent the level of dose or risk, above which it is judged to be inappropriate to plan to allow exposures to occur, and for which therefore protective actions should be planned and optimized. The initial intention would be to not exceed, or to remain at, these levels.

The higher levels of exposure in an emergency may be necessary and appropriate over a short period of time, given the prevailing circumstances, and subject to optimization of protection. Such levels would not be expected to continue for extended periods because reductions in exposures can be realized as additional information becomes available, and some measure of control over the source and the exposure situation is achieved. The relevant recommendations of the ICRP are set to prevent tissue reactions and the ambition is to reduce all doses to levels that are as low as reasonably achievable, economic and social factors being taken into account.

In exceptional situations such as in nuclear and radiological emergency operations, informed emergency workers may volunteer to take actions where there is a probability of receiving doses that might exceed 50 mSv (the occupational dose limit for workers in a single year). The only situations in which this is applicable are listed as follows (paragraph 4.17 of the BSS):

- No emergency worker is subject to an exposure in an emergency in excess of 50 mSv other than:

  (a) for the purpose of saving life or preventing serious injury;

  (b) if undertaking actions intended to avert a large collective dose; or

  (c) if undertaking actions to prevent the development of catastrophic conditions.

- When undertaking intervention under these circumstances, all reasonable efforts shall be made to keep doses to workers below twice the maximum single-year dose limit, except for life-saving actions, in which every effort shall be made to keep doses below 10 times the maximum single-year dose limit in order to avoid deterministic effects on health. In addition, workers undertaking actions in which their doses may approach or exceed 10 times the maximum single-year dose limit shall do so only when the benefits to others clearly outweigh their own risk.

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[3] The ICRP Recommendations of 2007 (Publication 103) gives three bands for use in selecting reference levels:
(1) The dose constraint or reference level of up to about 1 mSv, in the case when individuals are exposed to radiation from a source that yields little or no benefit for them, but which may benefit society in general.
(2) Reference levels of 20–100 mSv would be used where individuals are exposed to radiation from sources that are not under control or where actions to reduce doses would be disproportionately disruptive.
(3) Dose of greater than 100 mSv being incurred within a short period of time or in one year would be considered unacceptable, except under the circumstances relating to exposure of emergency workers that are addressed specifically.

- Response organizations and employers should ensure that emergency workers received might exceed 50 mSv do so voluntarily; that they have been clearly and comprehensively informed in advance of the associated health risks, as well as of available measures for protection and safety; and that they are, to the extent possible, trained in the actions that they may be required to take.
- Workers undertaking an emergency intervention may include, in addition to those employed by registrants and licensees, such assisting personnel as police, fire-fighters, medical personnel and drivers and crews of evacuation vehicles.
- The person legally responsible for ensuring compliance with the foregoing requirements shall be specified in emergency plans.

According to the BSS, it is essential that emergency preparedness and response planning be undertaken in advance based on the optimization of a protection strategy, which may be composed of several specific actions based on the circumstances.

In line with the requirements embodied in the ILO Radiation Protection Convention, 1960 (No. 115) which applies to all activities involving exposure of workers to ionizing radiations, including emergency workers, exceptional exposure of workers is neither justified for the purpose of rescuing items of high material value, nor, more generally, because alternative techniques of intervention, which do not involve such exposure of workers, would involve an excessive expense. It is therefore essential that activities that have associated significant potential exposures be examined and addressed in the authorization process, and that the appropriate resources are identified and emergency plans put in place to minimize or eliminate the exposure of workers.

The ILO Radiation Protection Recommendation 1960 (No. 114) provides that, so far as is practicable, a complete record of all doses received in the course of work by every worker should be kept so that the cumulative dose may be taken into account for employment purposes. Paragraph 3.83(d) of the BSS 2014 outlines that workers should provide to the employer, registrant or licensee such information on their past and present work that is relevant for ensuring effective and comprehensive protection and safety for themselves and others.

Once emergency operations have ended, other activities (source recovery, clean-up, waste disposal, etc.) should follow occupational radiation protection guidance as directed by a radiological assessor.

- All reasonable steps shall be taken to assess and record the doses received by workers involved in emergency intervention. The doses received and the consequent health risk shall be communicated to the workers involved.
- Workers shall not normally be precluded from incurring further occupational exposure because of doses received in an emergency exposure situation. However, qualified medical advice shall be obtained before any such further exposure if a worker who has undergone an emergency exposure receives a dose exceeding 10 times the maximum single-year dose limit or at the worker's request.

The ICRP Recommendations of 2007 (Publication 103) states that workers undertaking recovery and restoration operations in a later phase of emergency exposure situations should be considered as occupationally exposed workers and should be protected according to normal occupational radiological protection standards, and their exposures should not exceed the occupational dose limits recommended by the ICRP. Workers undertaking work

such as repairs to plant and buildings or activities for radioactive waste management, or undertaking remedial actions for the decontamination of the site and surrounding areas, should be subject to the relevant requirements for occupational exposure in planned exposure situations as outlined in section 3 of the BSS.

6.2.1 Guidance for protection of emergency responders during radiation emergencies

Based on the basic principles of radiation protection, the general guidelines that should always be followed by emergency responders during radiation emergencies include the following[4]:

- Female workers who become aware that they are pregnant or are breastfeeding should be encouraged to immediately notify their employers and should be excluded from emergency duties.
- Avoid touching suspected radioactive items.
- Ensure you are visually identifiable and that you are in the accountability system when within the inner cordoned area.
- Perform only life-saving and other critical tasks near a potentially dangerous radioactive source.
- Minimize time spent within 10 metres of suspected dangerous radioactive materials/source.
- Avoid the smoke, or use available respiratory protection equipment (for response personnel), within 100 metres of a fire or explosion involving a potentially dangerous radioactive source.
- Keep hands away from the mouth and do not smoke, eat or drink until hands and face are washed (to avoid inadvertent ingestion).
- Change clothes and shower as soon as possible.
- When treating or transporting contaminated persons, use normal barrier methods (standard precautions) such as surgical gloves and masks.
- Workers who may have been significantly contaminated or exposed (e.g. those within the inner cordoned area) should be monitored for radioactive contamination. If monitoring cannot be performed immediately, shower and change clothing as soon as possible.
- Medical evaluation of those potentially exposed and/or contaminated may be necessary in order to determine their subsequent medical management. Therefore, persons who are involved in a radiological emergency should be registered.
- Instruments of the type normally used by emergency services that measure gamma dose rate, including radiation pagers, cannot detect hazardous levels of all forms of radioactive materials. Only a trained and properly equipped radiological assessor can perform a complete assessment of the radiological hazards. Therefore, personnel protection guidelines should always be followed until a radiological assessor evaluates the hazard and provides specific recommendations.

[4] See: http://www-pub.iaea.org/MTCD/Publications/PDF/EPR_FirstResponder_web.pdf, accessed 12 October 2017.

Guidelines that should be followed if gamma dose rate is known

- Follow guidelines listed above that should always be followed.
- If ambient dose rate in a particular area is greater than 100 mSv/h:
  – perform only lifesaving actions.
  – limit total time of staying there to under 30 minutes.
- Do not proceed into an area with an ambient dose rate of greater than 1000 mSv/h unless directed by the radiological assessor.

Guidelines that should be followed if self-reading dosimeters are being used

- Follow guidelines listed above that should always be followed.
- Follow the "Emergency worker turn back guidance" as provided in *Manual for first responders to a radiological emergency* (Vienna: International Atomic Energy Agency; 2006).

Instructions for health and safety of the first responder monitor during monitoring of responders and the public

- Establish a monitoring location in an area with ambient dose rates below 0.3 Sv/h that is close to the decontamination area.
- Wear gloves and protective clothing as available. Change gloves regularly.
- Follow personnel protection guidelines that should always be followed, as described above.
- Monitor a person's hair, hands, pockets, dirty parts of clothes, feet and face, holding the monitor about 10 cm from the monitored surface.

Instructions for health and safety during decontamination of externally-contaminated casualty in hospitals by the hospital emergency team

- Wear PPE, including respiratory protection as required.
- Change gloves and survey the hands frequently to prevent the spread of contamination to other sites.
- Remove patient's clothing and place in labelled plastic bags.

6.2.2 Incident Command System for managing radiation emergencies

Radiation emergencies, like chemical incidents, are also managed through an Incident Command and Control system. Table 4 shows the response teams involved in a radiation emergency at the scene and at the hospital. In radiation emergencies, it has been observed that local emergency services (e.g. local medical, law enforcement, fire services) have the most important role in the early response.

The teams for environmental monitoring, radiological triage, decontamination, people monitoring, dose assessment and records that operate at the scene, as well as the radiation protection officer and health/medical physicist roles, are specific to a radiological emergency.

Environmental monitoring team: The function of the environmental monitoring team is to carry out environmental monitoring at the site of incident to assess radiation and contamination levels.

Radiological triage team: The function of the radiological triage team is to prioritize people for medical assessment, radiation measurements and decontamination procedures.

People monitoring team: The function of the people monitoring team is to monitor people for external contamination and possibly also for internal contamination. Other functionaries and teams in the Incident Command System include support functions from records, logistics and administrative teams.

Role of helpers in emergency: The helpers are the members of the public who willingly and voluntarily help in response to a nuclear or radiological emergency. Helpers are provided with information about the potential exposures and impact risks and are aware that they may be exposed to radiation while helping in response to a nuclear or radiological emergency.

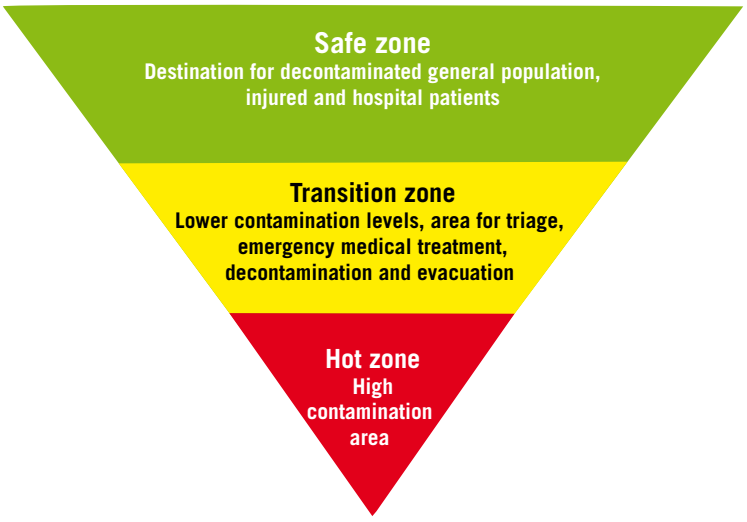
The scene is organized into different zones based on radiation exposure levels, and accordingly various activities are performed in different zones as shown in Figure 8. The red zone is a high-contamination zone where activities should be conducted only by first responders.

Table 4. Response teams involved in a radiological emergency

At the scene	At the hospital
Tactical Incident Command	Security personnel
First responders	Ambulance team
Security personnel	Emergency medical manager
Medical team	Hospital emergency team
Environmental monitoring team	Pathology department
Radiological triage team	Radiation protection officer
Decontamination team	Health/medical physicist
People monitoring team	
Dose assessment team	
Records team	
Ambulance team	

Source: TMT Handbook, Norwegian Radiation Protection Agency *[64]*.

Figure 8. Risk zones in radiation emergencies



Source: Nuclear and Radiological Emergency Guidelines, International Federation of Red Cross and Red Crescent Societies *[65]*.

6.2.3 Personal protective equipment

PPE should be selected on the basis of known or anticipated contamination levels in the work area, anticipated work activity, worker health considerations, and regard for non-radiological hazards that may be present. Personnel are required to wear PPE when entering areas containing contamination levels above specified limits in order to prevent contamination of skin and clothing. The degree of protective clothing required depends on radiological conditions in the work area and the nature of the job (Box 6). Basic factors that determine the type and extent of protective clothing required are:

- type and form of contamination;
- levels of contamination;
- type of work being performed.

Box 6. Personal protective equipment appropriate to the responder's role

(In all cases PPE giving a similar level of protection must be used)

a. First responders and emergency workers entering the red zone must wear:
   full-face respirator when non-radiological hazards are not present and the assigned protection factor (APF) is appropriate;
   waterproof gloves (must be abrasion-resistant);
   waterproof clothing (all skin and hair must be covered);
   waterproof shoes or boots;
   safety helmet;
   personal dosimeter (measuring instantaneous dose rate as well as cumulative dose) with alarm;
   personal dosimeter (film badge or thermos-luminescent dosimeter);
   high-visibility clothing (recommended).

b. First responders and emergency workers entering the yellow zone and medical staff handling contaminated casualties must wear:
   surgical gloves (must be changed frequently);
   waterproof coveralls that cover arms, legs, neck and head;
   respirators;
   plastic shoe covers;
   hair cover (e.g. surgical cap);
   personal dosimeter (film badge or thermos-luminescent dosimeter) (recommended).

c. Personnel carrying out decontamination must wear:
   PPE as in b, above, plus
   waterproof clothing (recommended).

Source: TMT Handbook, Norwegian Radiation Protection Agency *[64]*.

6.2.4 Decontamination

Decontamination of injured persons can be carried out either in hospital or adjacent to the incident, depending on the severity of injuries. Decontamination as described in this section refers to the removal of radioactive contamination and not removal of chemical or biological materials.

- Decontamination procedures consist of removing clothing and washing the body with soap and water to eliminate most external contamination. Removal of outer clothing without washing may reduce contamination by 80-90%.
- Persons carrying out decontamination should not eat, drink or smoke and should keep hands their away from their mouth until their outer clothing has been removed and they have showered.
- At the decontamination facility, a one-way system should be established so that people in need of decontamination do not come into contact with those people who have been decontaminated. Areas for decontamination must have separate entrance and exit points.
- Contamination with radioactive materials is not immediately life-threatening. Decontamination should be carried out as soon as possible, but generally does not require the same immediacy as in the case of chemical or biological contamination, except in extreme circumstances where the radioactive contamination is sufficient to cause severe effects.
- If contamination is present on clothing, the contaminated clothing must be changed. If contamination is found on skin, the person must go through decontamination procedures.
- Contaminated or potentially contaminated items such as casualties' clothes, dressings, equipment, staff clothing etc. should be bagged, labelled and stored in a secure area.

6.2.5 Occupational health surveillance of persons occupationally exposed to radiation in emergencies

Article 12 of the ILO Convention No 115 states that: "All workers directly engaged in radiation work shall undergo an appropriate medical examination prior to or shortly after taking up such work and subsequently undergo further medical examinations at appropriate intervals." Article 13 provides that circumstances shall be specified, in which, because of the nature or degree of the exposure or a combination of both, the following action shall be taken promptly: (a) the worker shall undergo an appropriate medical examination; (b) the employer shall notify the competent authority in accordance with its requirements; (c) persons competent in radiation protection shall examine the conditions in which the worker's duties are performed; and (d) the employer shall take any necessary remedial action on the basis of the technical findings and the medical advice. In this regard, paragraph 3.76(f) of the BSS 2014 provides that employers, registrants and licensees should ensure, for all workers engaged in activities in which they are or could be subject to occupational exposure, that necessary workers' health surveillance and health services for workers are provided. According to paragraph 3.108 of the BSS 2014, these programmes for workers' health surveillance should be based on the general principles of occupational health and should be designed to assess the initial fitness and continuing fitness of workers for their intended task.

Paragraph 27 of the ILO Radiation Protection Recommendation 1960 (No. 114) provides that, if as the result of such medical advice as is envisaged in Article 14 of the ILO Convention No 115, it is inadvisable to subject a worker to further exposure to ionizing radiations in that worker's employment, every reasonable effort should be made to provide such a worker with suitable alternative employment. In this respect, paragraph 3.112 of the BSS provides that employers

should make all reasonable efforts to provide workers with suitable alternative employment in circumstances for which it has been determined, either by the regulatory body or in the framework of the programme for workers' health surveillance in accordance with the requirements of the BSS, that workers, for health reasons, may no longer continue in employment in which they are or could be subject to occupational exposure. In addition, it may be noted that some of the more recent occupational safety and health instruments (the Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 (No. 148) and the Asbestos Convention, 1986 (No. 162)) indicate that where continued assignment to activities covered by those instruments is found to be medically inadvisable, every effort shall be made, consistent with national practice and conditions, to provide the worker concerned with other means of maintaining their income.

Occupational exposures may arise following accidents, typically among emergency teams acting in the initial phases of an emergency response and among those conducting longer-term recovery operations. In most cases, the exposures can be controlled but it may be necessary to exceed the recognized dose limits. Emergency workers may be deliberately exposed above normal dose limits in the following situations *[66]*:

- while saving life or preventing serious injury;
- while undertaking actions to avert a large collective dose;
- while undertaking actions to prevent the development of catastrophic conditions.

Normally such doses are limited to 0.5 Gy. Those exposed must be fully trained and must volunteer for the operation in question. Another condition is that, before implementing planned operations that are likely to result in exposures above the dose limits, the workers involved should be consulted about the planned operation, informed of the potential hazard and instructed in measures to keep exposures as low as reasonably achievable.

Doses resulting from the emergency exposure should be recorded together with those from normal exposures, but in such a way as to distinguish them from doses from routine practices; they should not be incorporated into the five-year cumulative total dose upon which the application of the dose limits is based. Doses resulting from exposures in emergency situations should be reported to the worker, the occupational physician and the regulatory authority. Such doses would not exclude the worker from subsequent employment involving occupational exposure, subject to medical approval *[67]*.

Treatment of overexposed persons

Based on International Atomic Energy Agency (IAEA) guidance *[67]*, exposures can be divided into three categories according to dose, namely:

- doses close to or just above the dose limits;
- doses well above the dose limits but below the threshold for deterministic effects in a particular organ;
- doses at or above the threshold for deterministic effects.
    - Doses close to the dose limits. Doses close to the dose limits do not normally require any special clinical investigation or therapy, and the role of the occupational health personnel is to counsel the overexposed worker that such an exposure is unlikely to produce adverse health effects. Such an advisory role is undertaken whether or not it is solicited by the worker.

- Doses well above the dose limits. Where the exposure is significantly higher than the dose limits but below the threshold for particular deterministic effects, the role of the occupational physician is to counsel the worker and to determine whether biological dose indicators, such as lymphocyte counts and chromosomal aberration assays, are needed to confirm the dose estimates. A blood sample should be taken by the physician for examination and dose estimation but normally no further action is required.
- Doses at or above the threshold for deterministic effects. If the assessed external doses for the whole body or organs are around the threshold for deterministic effects, therapeutic action may need to be undertaken. As a basis for this decision, the overexposed worker needs to be examined clinically and any abnormal findings or symptoms recorded. Haematological examination will need to be undertaken in order to monitor the clinical course of the overexposure. If the exposure is severe enough to lead to acute radiation syndrome, early transfer to specialized treatment facilities is essential.

The occupational physician should initiate the investigations and treatment of the early symptoms. Immediate life-threatening injuries such as fractures and burns must be treated as a priority before transfer to a specialized centre. The long-term clinical management of such highly-exposed persons would normally require the expertise available at specialized clinics.

Medical record of accidental and emergency exposures. The medical record of accidental and emergency exposures should be as complete as possible. It should contain details of all examinations, treatment and advice given. The occupational health service should participate in the accident investigation to review the adequacy of the response.

Chapter 7.

Occupational safety and health hazards in natural disasters

The main responsibilities of emergency workers during natural disasters include the rescue of survivors and provision of medical help, the evacuation of people from the affected area, recovery of dead bodies, prevention of further damage, clean-up work, provision of food and potable water, maintenance of a good level of hygiene to prevent the spread of epidemics, and supporting the vaccination of the population.

During natural disasters, the specific risks for emergency workers may be due to the devastation of the area, collapsing buildings and other structures, destruction of electrical installations, and general destruction of infrastructure and communication lines. In addition, the response may require workers to work in confined spaces, with the attendant risks of being seriously injured or trapped by debris, or attacked by aggressive animals.

Natural disasters due to floods, windstorms and tsunamis are associated with the risks of drowning and the spread of waterborne and vector-borne diseases *[67]*. Waterborne diseases are spread when the affected population or emergency workers come into direct contact with contaminated water with high concentrations of bacteria, viruses and other microorganisms – such as when sewage enters the drinking-water supply, or when emergency workers have to work in contaminated surface water. The key waterborne infectious diseases include cholera, typhoid fever, shigellosis, *E. coli* infections, polio, hepatitis A, hepatitis E, rotavirus, leptospirosis and parasitic diseases such as schistosomiasis.

After flooding or following disasters, vector-borne diseases are also a risk where field camps are erected for the care of disaster victims and where the waste management system is disturbed. Standing water serves as a breeding-site for mosquitoes, and rodents are attracted by nutrients in the waste. Diseases that are typically transmitted by mosquitoes are malaria, dengue, yellow fever, Zika virus, St. Louis encephalitis, Japanese encephalitis and West Nile fever. The faeces of rodents may contain large quantities of organisms, permitting the spread of leptospirosis.

Infectious diseases that may affect emergency workers through their contact with survivors include wound infections, diseases that are transmitted by droplet infection such as tuberculosis, gastrointestinal diseases transmitted by smear infections, and bloodborne diseases such as HIV, hepatitis B and hepatitis C. The possibility of infections associated with contact with dead bodies is highest for bloodborne diseases, gastrointestinal diseases and tuberculosis.

Emergency responders such as fire-fighters and other rescue and relief workers deployed in natural disasters may be particularly at risk of respiratory and asthmatic problems. Volcanic eruptions lead to significant releases of ash and gas. Smoke is also generated in wildfires or fires occurring as secondary effects of natural disasters. Landslides and earthquakes lead to

excessive amounts of dust production. All these factors (ash, gas, smoke and dust) cause eye and pulmonary irritation, and in the most severe cases may lead to asphyxiation. Some of the by-products of combustion are often carcinogenic.

Volcanic eruptions, vegetative fires or fires generated as secondary effects of natural disasters cause high heat stress, presenting the possibility of skin injuries and burns. Air pollution caused by dust from collapsed buildings, gas and ash released as a consequence of volcanic eruptions or smoke resulting from fires also make transport accidents more likely.

In pre-hospital health care and in the provision of assistance to disaster victims, emergency workers face an increased risk of exposure to blood and body fluids and to needle-stick injuries. These expose them to a very high risk for HIV, hepatitis B and hepatitis C.

In regions where tuberculosis is prevalent among the population, the possible transmission of infection when in contact with survivors or dead bodies is also a possible risk for emergency workers. Those workers who anticipate possible prolonged exposure to persons with tuberculosis (e.g. those who expect to come into routine contact with populations in clinics, hospitals, prisons or homeless shelters) should have a tuberculin skin test (TST) or TB blood test before departure. If the reaction to the TST or TB blood test is negative, they should have a repeat test 8-10 weeks after returning.

7.1 Occupational safety and health hazards and risks due to floods

Floods are the most common weather-related natural disasters and affect many countries around the world. According to a report by the United Nations Office for Disaster Risk Reduction (UNSDR), between 2005 and 2015, floods accounted for 47% of all weather-related disasters, causing 40% of all deaths due to such disasters, with 89% of such deaths occurring in low-income countries in Africa and Asia. Between 2005 and 2015, many nations faced major floods, including Bangladesh, China, India and Pakistan in Asia and Madagascar, Malawi, Mozambique, Rwanda, South Africa and the United Republic of Tanzania in Africa *[68]*.

Floods can potentially increase the transmission of the following communicable diseases:

- waterborne diseases, such as typhoid fever, cholera, leptospirosis and hepatitis A;
- vector-borne diseases, such as malaria, dengue and dengue haemorrhagic fever, yellow fever, and West Nile fever.

Waterborne diseases

Floods cause an increased risk of infection with waterborne diseases – such as wound infections, dermatitis, conjunctivitis, fungal infections and ear, nose and throat infections – contracted through direct contact with polluted waters. Leptospirosis, a zoonotic bacterial disease, is transmitted directly from contaminated water. Transmission occurs through contact of the skin and mucous membranes with water, damp soil, vegetation or mud contaminated with rodent urine. The occurrence of flooding after heavy rainfall facilitates the spread of the organism due to the proliferation of rodents which shed large amounts of leptospirosis-causing microbes in their urine.

Vector-borne diseases:

Floods may lead indirectly to an increase in vector-borne diseases through the expansion in the number and range of vector habitats. Standing water caused by heavy rainfall or the overflow of rivers can act as a breeding site for mosquitoes, and therefore increase the potential for exposure of the disaster-affected population and emergency workers to infections such as dengue, malaria and West Nile fever. Flooding may initially flush out mosquito breeding, but it comes back when the waters recede. The lag time is usually around 6-8 weeks before the onset of a malaria epidemic.

Risks posed by dead animals and human bodies

Contrary to common belief, there is no evidence that corpses pose a risk of disease "epidemics" after natural disasters. Most agents do not survive long in the human body after death (with the exception of HIV, which can last up to 6 days) and the source of acute infections is more likely to be the survivors. Human remains pose health risks in only a few special cases that require specific precautions, such as deaths from cholera or haemorrhagic fevers *[68]*.

However, workers who routinely handle corpses may have a risk of contracting tuberculosis, bloodborne viruses (such as hepatitis B and C and HIV), and gastrointestinal infections (such as rotavirus diarrhoea, salmonellosis, *E. coli*, typhoid/paratyphoid fevers, hepatitis A, shigellosis and cholera). These viruses are acquired in the following ways:

- Tuberculosis can be acquired if the bacillus is aerosolized (residual air in lungs exhaled or fluid from lungs spurted up through nose or mouth during handling of the corpse).
- Exposure to bloodborne viruses occurs as a result of direct contact with non-intact skin of the blood or body fluid, injury from bone fragments and needles, or exposure to the mucous membranes from splashing of blood or body fluid.
- Gastrointestinal infections are more common because dead bodies commonly leak faeces. Transmission occurs through direct contact with the body and soiled clothes or contaminated vehicles or equipment. Dead bodies contaminating the water supply may also cause gastrointestinal infections.

The public and emergency workers alike should be duly informed not to panic, to avoid inappropriate disposal of bodies, and to take adequate precautions in handling the dead.

The other health risks posed by flooding include drowning, injuries or trauma, and hypothermia if one is trapped in floodwaters for lengthy periods. There may also be an increased risk of respiratory tract infections due to exposure to flood waters and rain.

7.2 Tropical storms, hurricanes, cyclones and typhoons

Tropical storms, cyclones, hurricanes and typhoons, although named differently, describe the same type of disaster.
Cyclones, hurricanes and typhoons can be predicted several days in advance. The onset is extensive and often very destructive. These disasters are usually more destructive than floods. In a sudden, brief onslaught, high winds cause major damage to infrastructure and housing, particularly fragile constructions. This is generally followed by heavy rains and floods and, in flat coastal areas, by tidal waves.

The key OSH hazards associated with tropical storms, hurricanes, cyclones and typhoons include the following:

- structural instability with risks from downed lines, live electrical equipment and other utilities (e.g. gas and water);
- noise;
- falls from height or through openings;
- asbestos, lead;
- impact to the eyes and face from flying objects;
- manual handling of materials/weights;
- discovery of unknown chemicals;
- cuts and lacerations;
- slips, trips and falls while working.

7.3 Earthquakes

When an earthquake occurs in a populated area, it may cause deaths and injuries and extensive property damage. Most earthquake-related injuries result from collapsing walls, flying glass and falling objects as a result of the ground shaking, or people trying to move more than a few steps during the shaking. Much of the damage from earthquakes is predictable and preventable *[69]*.

The main OSH hazards for emergency responders during an earthquake include the following:

- injuries resulting from structural instability, slip, trip or fall hazards from holes, protruding rebar, being struck by a falling object, fire, proximity to heavy machinery (e.g. cranes), sharp objects such as glass and debris, secondary collapse from aftershock, vibrations and explosions, and exposed, energized electrical wiring;
- exposure to hazardous chemicals and other hazardous materials (ammonia, battery acid, leaking fuel), natural gas leaks creating a flammable and toxic environment, insufficient oxygen and confined spaces/unfamiliar surroundings;
- biological hazards due to exposure to pathogens from breaks in the sanitary system and exposure to bloodborne pathogens during handling and care of the injured;
- adverse weather conditions;
- noise from equipment (generators/heavy machines);
- exposure to airborne smoke and dust (asbestos, silica, etc.).

The key OSH controls for protection of emergency responders include:

- overseeing all safety and health aspects of response workers by safety/OSH personnel;
- assuring that optimal safety and injury prevention is practiced;
- investigating and documenting all response team injuries and illnesses;
- preparing and maintaining entry permits (e.g. to confined spaces, for electrical work etc.);

- ensuring that appropriate PPE is used;
- developing and implementing daily health and safety plans which address sanitation, hygiene, PPE, decontamination, work/rest cycles, acute medical care, and other relevant concerns;
- assessing risk for identified hazards;
- training in hazard awareness and use of PPE.

7.4 Common occupational safety and health hazards encountered during response activities following natural disasters

7.4.1 Search and rescue team operations

Search and rescue is a critical activity of response to natural disasters. Major sudden-onset natural disasters – such as earthquakes, tsunamis and storms – typically damage infrastructure, cause injury and sometimes massive loss of life, and trap people in debris. An immediate life-saving response is required to rescue those who are trapped and to stabilize or evacuate survivors; the difference between life and death can be a matter of hours. Initial life-saving search and rescue operations need to arrive very fast, should possess specialized skills, and often need heavy or specialized technical equipment. The operational environment where such teams work is often extremely challenging as responders have to work among debris in areas where public services and infrastructure are disrupted or destroyed.

Activities undertaken by search and rescue teams and the associated health and safety hazards and risks for the emergency responders are covered comprehensively in *Generic risk assessments [70].* In sections 2.1 on "Rescues from confined spaces" and 2.1.4 on "Collapsed structures", the publication lists key activities during search and rescue, as well as OSH hazards, risks and control measures, as described below:

1. Provision and handling of equipment to and at the scene of operations

Such activities include hazards due to manual handling of equipment and the key risks include those of musculoskeletal injuries. The responders at highest risk include fire and rescue personnel.

The following controls need to be in place for prevention and control of these risks:

- information, instruction and training in manual handling procedures and assessment;
- team lifting operations where appropriate;
- consideration of the type and amount of equipment required to facilitate rescue operations;
- forward logistics areas or equipment dumps that are suitably located to minimize carrying distances;
- consideration of the use of mechanical lifting aids where appropriate;
- rotation of personnel to reduce fatigue.

2. Extraction of casualties from the scene of operations

Extraction of casualties from the scene also involves manual handling and use of heavy machines. The emergency responder groups at highest risk include fire and rescue personnel and other emergency workers. The key hazards include:

- manual handling activities;
- the presence of body fluids;
- the presence of sharps within medical equipment;
- agitated and distressed casualties;
- multiple casualties.

The main health and safety risks include:

- musculoskeletal injuries;
- biohazard;
- contamination and infection;
- verbal and physical assault of personnel;
- prolonged and repeated exposure to traumatic situations;
- post-traumatic stress.

The following controls need to be in place for the prevention and control of these risks:

- information, instruction and training in manual handling procedures and assessment;
- team lifting operations employed where appropriate;
- information, instruction and training in first aid and casualty handling procedures;
- hazardous area response team personnel/paramedics who provide clinical care and assessment;
- appropriate inoculations (e.g. tetanus, hepatitis B);
- fire and rescue authorities' biohazard equipment and procedures;
- emergency decontamination procedures;
- consideration of the use of mechanical lifting aids/stretchers where appropriate;
- rotation of personnel to reduce fatigue;
- training/liaison with hazardous area response team/paramedic personnel;
- use of PPE;
- fire and rescue personnel not allowed to administer injections/medicines to casualties;
- rescue teams consist of at least two persons;
- provision of occupational health.

3. Accessing confined spaces

A confined space is a place that is substantially enclosed (although not always entirely) and where serious injury can occur from hazardous substances or conditions within the space or

nearby (e.g. lack of oxygen). Confined spaces or oxygen-deficient areas are commonly found in pits, sewers, tanks or areas where large quantities of gases are stored or used. Examples also include wells, storm drains, vats, boilers, silos and tunnels. Structures that have recently burned may also be oxygen-deficient.

The emergency responder groups at highest risk include fire and rescue personnel and other emergency workers. The key hazards include:

- toxic and flammable vapours;
- free-flowing liquids and solids;
- oxygen deficiency or enrichment;
- extreme temperatures;
- fire or explosion.

The main health and safety risks associated with work in confined spaces include:

- entrapment injuries;
- drowning;
- asphyxiation;
- heat exhaustion, heat stress;
- hypothermia;
- claustrophobia;
- inflammable or explosive gas, vapours or mists
- toxic substances.

The following controls need to be in place for the prevention and control of these risks:

- fire and rescue authorities' training and procedures for confined space operations;
- search and rescue procedures for confined space operations;
- provision and use of gas monitoring equipment;
- ventilation equipment;
- safety officers and/or designated supervisory officers oversee confined space operations;
- effective communications;
- only essential personnel allowed to enter confined spaces;
- rescue teams consist of at least two persons.

4. Breeching and breaking, space creation operations

The main emergency responder group at risk include fire and rescue personnel.

These activities involve the use of specialized machines, tools etc. The main hazards include the following:

- heavy dust loads;
- noise;
- vibration;

- moving structural members;
- moving parts on equipment;
- flying shards/debris cast off from equipment and structural members;
- electrical hazards;
- suspended structural elements;
- irrespirable atmospheres due to the presence of hazardous materials, leaking gas and/or oxygen deficiency/enrichment.

The main health and safety risks associated with breeching and breaking work include:

- respiratory distress;
- asphyxiation;
- noise-induced hearing disorders;
- inability to hear warning/evacuation signals;
- hand-arm vibration syndrome;
- secondary collapse;
- entanglement;
- cuts/contusions;
- electrocution;
- entrapment / crush injuries.

The following controls need to be in place for prevention and control of these risks:

- information, instruction and training in use of specialist equipment;
- rotation of crews to reduce exposure;
- noise and vibration management systems to record exposure levels and duration;
- supervision by safety officers;
- use of building scene assessment equipment;
- liaison with on-scene specialist assistance (e.g. search and rescue teams, subject matter advisers, structural engineers);
- provision of shoring equipment;
- predetermined evacuation signal;
- fire and rescue authorities' personal/respiratory protective equipment to consider inclusion of self-contained breathing apparatus/airline/respirators;
- monitoring equipment to locate concealed/ buried cables;
- provision and use of gas monitoring equipment.

7.4.2 Hazards and risks associated with the use of chainsaws and their control

Chainsaws may be required to clear trees and bushes for rescue and response in any emergency situation, and especially during natural disasters. However, use of chainsaws requires safety precautions.

Major hazards and risks with the use of chainsaws include the following:

- The blades can cause severe cuts.
- Chainsaws are heavy and can cause a back injury.
- Noise from the chainsaws can cause hearing loss.
- Chainsaws can kick back and cause an injury.
- Vibration from the chainsaw can cause numbness and injuries to muscles, nerves or tendons.
- Flying debris can cause an eye injury.

The following precautions need to be taken for safe chainsaw operation, as recommended by the Health and Safety Authority of the Republic of Ireland *[33]*:

Before starting the saw

- Check the controls, the chain brake, the chain tension, and all the bolts and handles on the chainsaw to make sure they are functioning properly.
- Ensure that the clutch cover is not broken or exposing the chain or sprocket.
- Sharpen chain teeth.
- When adding fuel to the chainsaw, ensure that the operator is at least 10 feet (3 metres) from any source of ignition.
- Start the saw on the ground with chain brake engaged, and 10 feet (3 metres) from the fuelling area.

While running the saw

- Clear the area of obstacles that might interfere with cutting the tree or brush.
- Keep hands on the handles and ensure secure footing while operating the chainsaw.
- Do not cut directly overhead or between legs.
- Look up before cutting to check if loose limbs may fall from the tree.
- Be prepared for kickback. Do not cut with the tip of the saw. Keep track of where the tip is.

7.4.3 Hazards due to animal/insect bites and contact with poisonous plants during outdoor work

While responding to natural disasters, emergency workers may come into contact with wild animals, venomous snakes, spiders or scorpions, or insects that may pose serious risks to their health. To prevent such risks, the following protective measures are recommended by USCDC *[31]*:

- use of insect repellent;
- avoidance of peak exposure times/places;
- wearing of appropriate clothing that covers body parts to avoid exposure;
- use of bed nets;

- treatment of clothing, bed nets and gear with insecticides such as permethrin;
- awareness of displacement of wildlife, pets and other animals (do not try to pick up snakes);
- inspection of areas before entering;
- caution as to where one places one's hands and feet (do not put hands into holes, nests etc., and step onto rocks or logs rather than over them);
- wearing of proper foot gear and leather gloves when working in suspect areas.

Response operations for natural disasters in fields and forests may expose emergency responders to contact with certain plants that pose health risks such as skin and respiratory tract allergies, or irritations in the skin and mucous membranes. Common examples of such plants include poison ivy, poison oak and poison sumac *[71]*. The following precautions are recommended by NIOSH to prevent these effects:

- learning to recognize poisonous plants in and around work area;
- using gloves and appropriate clothing (e.g. long pants and long-sleeved shirt);
- washing of affected areas with soap or detergent)
- use of rubbing alcohol to remove oily resin causing the reaction;
- avoidance of burning plants or brush piles that may contain poison ivy, poison oak, or poison sumac; inhaling smoke from burning plants can cause severe allergic respiratory problems.

Chapter 8.

Managing the health and safety of health workers during humanitarian response in conflict situations

The health emergency workforce is made up largely of national health workers but often also includes international health-care providers striving to deliver life-saving interventions during emergencies. The most disturbing challenge for health-care providers during conflicts and emergencies is when they themselves are the victims of attacks that can be real or threatened, targeted or indiscriminate.

Such attacks not only endanger health-care providers; they also deprive people affected by the emergency of urgent care when they need it most. While the consequences of such attacks are as yet largely undocumented, they are presumed to be significant – negatively affecting short-term health-care delivery as well as the longer-term health and well-being of affected populations, health systems, the health workforce and, ultimately, the global public health goals.

According to WHO [7], during the two-year period from January 2014 to December 2015, there were 594 reported attacks on health-care workers that resulted in 959 deaths and 1561 injuries in 19 countries with emergencies. An analysis of collected information revealed that:

- The majority of targets (63%) were health-care facilities.
- More than a quarter of targets were health-care providers (26%), and 6% of targets were health-care transport.
- 366 of the 594 attacks (62%) were reported as intentional, 116 attacks (20%) were described as unintentional, and for 112 of the attacks (19%) intentionality was not reported or was unknown or undetermined.
- Some 53% of attacks were reportedly perpetrated by state actors, 30% by non-state actors, and 17% of the perpetrators remained unknown, unreported or undetermined.

8.1 Management of occupational safety and health in health facilities during conflicts and emergencies

Many factors need to be considered when addressing violence against the delivery of health care and the need for protection of the health and safety of health workers. In addition to the common health and safety risks such as locally-prevalent diseases, road accidents, thermal stress and other conditions that make emergency work dangerous, conflict presents many additional OSH risks that must be addressed.

The following health- and safety-related issues need to be addressed before initiating specific actions to protection of health facilities and workers:

- Community engagement. Gaining people's collaboration and trust is the key for obtaining access to those in need of health care and for the safety of health workers. Emergency services should first assess and monitor how health-care workers and other emergency service providers are seen by armed groups, the authorities and other relevant groups and individuals.
- Simple signs that indicate health-care activities. Signs that indicate health-care activities should be visible.
- Communication for evacuation. Lines of communication for medical evacuations of patients must be established among medical workers, NGOs, the military and other relevant persons prior to operations and then should be maintained throughout. Local community leaders and the authorities need to be included since the evacuation of wounded and sick persons may not necessarily be carried out by medical workers or vehicles.
- Awareness on international humanitarian law, human rights and ethics. Health-care personnel should have a basic understanding of how international humanitarian law, human rights and ethical principles shape their rights and responsibilities in armed conflict and other emergencies. Training should be provided to them covering areas such as upholding the ethical principles of health care and facing medical dilemmas, violence management and prevention, and stress management.
- Communication with civil society leaders. It is essential to strengthen dialogue on protecting health-care services and to reach out to all leaders of civil society, including religious and community leaders, taking account of their importance in society, especially in times of conflict and crisis.

8.1.1 Measures for the safety of health facilities

The factors affecting the safety of health-care facilities should be considered together – including the capacity of the health-care system and infrastructure to absorb shock, the potential impact of disruptions to the supply chain and the well-being of staff and patients.

WHO's Safe Hospitals Programme [72] helps to assess the safety of health facilities, particularly in the event of a natural disaster, but also in the event of violence. One of the key objectives of the programme is to protect health workers, but other objectives cover protection of patients and families, and protection of the physical integrity of hospital buildings, equipment and critical hospital systems. The international Hospital Safety Index has become a global standard and is continually being used in countries to identify actions to address identified weaknesses.

The International Committee of the Red Cross in its report Protecting health care, key recommendations addresses violence against health-care facilities and recommends the following measures [73]:

- Contingency plan. A contingency plan should be drawn up together with a checklist of the supplies and services which are needed in order to guarantee self-sufficiency for about 10 days. It is crucial to build up a good working relationship with several suppliers, as reliance on a single source is too risky. Sufficient resources should be allocated to formulating plans and holding drills to enable the entire staff to prepare for emergencies. The facility's contingency plans should match with existing regional or national plans.

- Evacuation plans and risk assessments. Fire and other risks should be monitored and all members of staff should be familiar with evacuation plans. The use of plastic film on windows and protective walls outside critical areas reduces damage from explosions. It is also essential to arrange for an alternative water supply, along with several types of power source.
- Access control. To better control access and entry, perimeter walls with control points should be erected around the entire health-care facility. Initial security screening and medical triage should be clearly separated. Guards should be employed only for security duties and at control points, and not for triage.
- Early warning system. An early warning system adapted to difficult emergency situations should be put in place.
- Critical utilities located in a safe place. Locating important utilities safely will reduce their vulnerability to attack and ensure backup.
- Information communication systems, Alternative communication methods should be put in place in case normal communication channels break down.
- Other vital measures include the following:
  - storing goods in secure areas, where they are protected from hazards and looting;
  - using oxygen concentrators rather than cylinders;
  - incinerating waste and isolating dangerous material.

8.1.2 Measures for protection of people working in health facilities

- Staff roles and responsibilities should be clarified to ensure the requisite flexibility during emergencies.
- Health-care personnel should be offered training in emergency preparedness and stress management. This training could include fire drills, risk assessment and risk management, elements of protection, negotiation, communication, managing people's expectations, self-defence, psychological support, first aid and self-care. In addition, guidance and training should be provided on appropriate staff behaviour inside and outside the facility in order to defuse aggression.
- Health-care facilities need to protect their patients while paying due heed to the risks that may be associated with some of them. If possible, grouping patients according their affiliation should be avoided, and patients who pose a high security risk should be discharged as soon as it is feasible to do so.
- Health-care managers should consider the needs of patients' relatives. Their consent should be sought before major surgical procedures, such as amputations, are performed and the relatives should, if necessary, be provided with psychosocial support. While it may sometimes be advisable to limit the number of visitors, waiting rooms should be available for patients' relatives.
- Maintaining regular communication and good relations with the local community increases a facility's safety and acceptance by building a sense of ownership. Persons in charge of a hospital or clinic should regularly try to ascertain what the local community thinks of it and whether precautionary measures are seen as barriers.

- Engaging with the media may improve the safety of a hospital or clinic. Informing the general public and relevant actors about its services can increase the acceptance of health care thanks to an awareness that it is delivered impartially. A proactive media strategy, including guidelines on responsible behaviour on social media, should be developed, and regular contact should be established with the press to reduce tension and misunderstandings in the event of an emergency or crisis. However, the need for information-sharing must always be weighed against ethical considerations, confidentiality and the facility's safety.
- A temporary relocation of health-care services may be the only solution if security risks become intolerable. Any temporary relocation should be planned carefully and a strategy should be worked out to guide management during the preparatory phase, as well as during the transfer of services, patients and staff. It is useful to consult local providers, authorities, community leaders, staff, patients and NGOs when setting up a temporary health-care facility. Before choosing a new location, a security and site analysis should be conducted and the following factors should be considered: community acceptance, accessibility to staff and the population, availability of quality health-care services and the presence of potential partners.

8.1.3 Management of stress during conflicts

In addition to physical injuries, working in conflicts poses serious risk of stress among workers. Stress can be a form of self-protection when it is a normal and useful reaction to a given situation. However, it may lead to higher and more serious levels of stress. Three kinds of severe stress are felt by people working in armed conflicts and other emergencies. They may be harmful if they are not recognized and dealt with. They are:

- basic stress, which is the result of an abrupt shift to an unfamiliar context;
- cumulative stress, which is caused by a number of factors, including concern for one's own safety (this can build up slowly or rapidly, and is often foreseeable);
- traumatic stress, which is caused by an unexpected and violent event accompanied by a threat of physical or psychological harm to the person or to someone close to him/her. PTSD is a delayed response to acute psychological trauma. Both traumatic stress and PTSD require professional help at the earliest opportunity.

The IASC guidelines on mental health and psychosocial support in emergency settings include the following actions [74]:

Personal general well-being of health and other emergency workers during conflicts

Providing care for the wounded and sick in armed conflicts and other emergencies can be extremely stressful. Emergency workers must take measures to secure their own well-being in order to continue to fulfil their responsibilities. With respect to general well-being, the following actions are required:

- follow local security guidelines if they exist;
- do everything to ensure your own safety;
- do not take unnecessary risks;
- be aware of changes in the context;

- have enough rest;
- know your limits;
- eat regularly and avoid alcohol and drugs;
- fit into the team and do not isolate yourself;
- talk to friends and colleagues about what concerns you, especially if you are feeling stressed;
- take exercise;
- pay attention to personal hygiene.

Minimum response plan to prevent and manage problems in mental health and psychosocial well-being

The plan should include the following:

- Ensure the availability of a concrete plan to protect and promote the well-being of emergency workers during the specific emergency.
- Prepare emergency workers for their jobs and for the emergency context.
- Facilitate a healthy working environment.
- Address potential work-related stressors.
- Ensure access to health care and psychosocial support for emergency workers.
- Provide support to emergency workers who have experienced or witnessed extreme and potentially traumatic events.

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Appendix Toolkit

TOOL Urine colour chart

Heat stress is an important occupational health hazard while working outdoors, as well as indoors, with the use of personal protective clothing. The colour of the urine provides adequate information on the associated state of hydration in a rapid and easy manner and hence can prompt the emergency response worker to take adequate water and fluids as well as other precautions to prevent the impacts of heat stress.

The urine colour chart is a simple visual aid developed by NIOSH, USA, for monitoring hydration status. The chart displays different hydration levels by using different blends of colour, ranging from pale yellow to deep amber. Although the urine chart is a good indicator of hydration status for most workers with normal pale yellow to deep amber urine, urine colour can also be affected by diet, medications and illnesses or disorders, as provided in the table depicting causes of abnormal colours in urine.

The urine colour chart is available in Appendix B of the document *NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments* by Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H and Turner N. Cincinnati (OH): U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2016-106.

Weblink: https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf, accessed 25 September 2017.

TOOL Heat index

The heat index, as included in the NIOSH, USA, document *NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments*, consists of charting of temperatures with relative humidity. It provides useful information on the likelihood of heat disorders that may occur due to long exposure to heat and/or strenuous activity, and provides risks levels in four grades of risk – extreme danger, danger, extreme caution and caution – displayed as different shades of colours. The National Oceanic and Atmospheric Administration (NOAA), USA, issues heat alerts based on the heat index values.

The document/heat index includes risk levels as classified by OSHA, USA, for worksites. These risk levels may help emergency response managers to monitor weather and issue instructions for precautions and controls against heat stress. The information should be useful for emergency workers working in hot environments (e.g. outdoor in tropical regions during the day) as well as health-care workers working in health facilities in tropical regions.

The heat index is available in Appendix C of the document *NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments* by Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H and Turner N. Cincinnati (OH): U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2016-106.

Weblink: https://www.cdc.gov/niosh/docs/2016-106/pdfs/2016-106.pdf, accessed 25 September 2017.

TOOL Water disinfection techniques in field

The information on the traveler's health webpage of USCDC provides comprehensive guidance on different types of water disinfection techniques, compares advantages and disadvantages of the various common methods, and guides the selection of an appropriate method.

The information should be of help to emergency response workers who are deployed in remote areas for selecting and using an appropriate method of water disinfection to protect them from waterborne diseases.

Weblink: https://wwwnc.cdc.gov/travel/yellowbook/2016/the-pre-travel-consultation/water-disinfection-for-travelers, accessed 35 September 2017.

TOOL Safe use of ladders

During response management, emergency workers may have to climb up buildings, trees, walls etc. to rescue casualties or respond to the emergency. Working in these conditions often involves the use of ladders. Such situations pose serious risks of injuries due to falls from heights. The risk of injuries due to falls increase progressively from six feet above the ground, and any work above that level would require the use of ladders.

A brief guide on the safe use of ladders and stepladders by the Health and Safety Executive of the United Kingdom covers precautions to be taken when using ladders. This information should be of practical use for emergency responders in adopting safe ladder usage practices.

Source: Safe use of ladders and stepladders, a brief guide. London: Health and Safety Executive; 2014.

Weblink: http://www.hse.gov.uk/pubns/indg455.pdf, accessed 25 September 2014.

TOOL Personal stress management during emergencies

Psychological stress during emergencies is one of the major occupational health and safety hazards for emergency workers. Psychological first aid (PFA) involves humane, supportive and practical help to fellow human beings suffering serious crisis events. It gives a framework for supporting people in ways that respect their dignity, culture and abilities. PFA covers both social and psychological support.

The coverage on "Caring for yourself and your colleagues" provides simple practical guidance on practical measures to prevent stress through healthy work and life habits. This information should be useful to emergency response workers during different stages of response.

Source: Psychological first aid: guide for field workers. Published by the World Health Organization in collaboration with the War Trauma Foundation and World Vision International, Geneva, 2011.

Weblink:http://apps.who.int/iris/bitstream/10665/44615/1/9789241548205_eng.pdf, accessed 25 September 2017.

http://apps.who.int/iris/biteam/10665/44615/1/9789241548205_eng.pdf

TOOL Personal preparedness checklist for emergency workers

The *Handbook for emergency field operations* by the World Health Organization covers different aspects of emergency field operations and includes a mission readiness checklist for emergency staff. The checklist includes various areas such as: family welfare, banking information, business and finance, vehicle repair and maintenance, home security repairs and maintenance, transportation and communication skills, geopolitical and cultural awareness, health and WHO administrative issues.

These practical areas need to be addressed by the emergency worker before deployment to the area of emergency. This should also be of great help in addressing stress before deployment. The checklist may be suitably adapted for use by administrators to monitor preparedness of their team members as well as by individual response workers.

Source: Handbook for emergency field operations. Geneva: World Health Organization; 1999.

Weblink: http://www.who.int/hac/techguidance/tools/7661.pdf, accessed 25 September 2017.

TOOL Recognition and assessment of workplace violence in health facilities

Workplace violence in health facilities is being noticed across the world. Although any facility may be affected by violence due to multiple causes, there are certain features and certain organizations, workers' groups, workers and workplace conditions that facilitate and perpetuate violence. The document *Framework guidelines for addressing workplace violence in the health sector* has sections on workplace violence recognition and workplace risk assessment. The document includes information on identification of organizations at risk, vulnerable groups, characteristics of potential perpetuators and victims, and workplace situations that pose high risks of workplace violence.

This information should help policy-makers, planners, administrators and managers to identify workplace characteristics, vulnerable populations and workplace conditions that may pose risks for workplace violence in the health sector. This should help them to develop appropriate and relevant policies, strategies and plans to prevent and manage workplace violence in health sector.

Source: Framework guidelines for addressing workplace violence in the health sector. Joint programme on workplace violence in the health sector. Published by the International Labour Organization in collaboration with the International Council of Nurses, World Health Organization and Public Services International, 2002.

Weblink: http://apps.who.int/iris/bitstream/10665/42617/1/9221134466.pdf, accessed 25 September 2017.

TOOL Incident Command System

The eTool on the Incident Command System (ICS) by OSHA, USA, is a useful web resource created to provide information about the Incident Command System and the unified command. The eTool covers different aspects of the ICS in a comprehensive manner that includes need, scope and definition, organizational structure, roles and responsibilities, safety aspects during preparedness, implementation and after incidents.

The information should be useful to help emergency response planners and administrators to understand the concept of ICS in emergencies and should help in planning the occupational safety and health of emergency response workers.

Weblink: https://training.fema.gov/emiweb/is/icsresource/assets/reviewmaterials.pdf, accessed 11 October 2017.

TOOL Five keys to safer food

The Five Keys to Safer Food resources (e.g. manual, poster, audiovisual presentations etc.) are developed by the World Health Organization. The information incorporates all the messages of the rules for safe food preparation under simpler headings that are more easily remembered and also provides more details on the reasoning behind the suggested measures. The core messages of the Five Keys to Safer Food are: (1) keep clean, (2) separate raw and cooked, (3) cook thoroughly, (4) keep food at safe temperatures, and (5) use safe water and raw materials.

The information that is provided in the manual as well as other media (e.g. audiovisual aid, posters, pamphlets etc.) would be very helpful in disseminating food safety messages across the emergency response workforce. It should be helpful to administrators and managers in planning, implementing and monitoring food safety measures during the response and to individual emergency workers in adopting safe and hygienic food-handling and preparation practices.

Source: Five keys to safer food manual. Geneva: World Health Organization; 2006.

Weblinks: http://apps.who.int/iris/bitstream/10665/43546/1/9789241594639_eng.pdf?ua=1, accessed 25 September 2017.

Five keys to safer food (audiovisual presentation)

https://www.youtube.com/watch?v=ONkKy68HEIM, accessed 25 September 2017.

TOOL Online courses on health and safety in emergencies

Online courses by the DisasterReady organization cover a wide range of topics on health, safety and security in emergencies. These include areas of practical importance such as mental health and psychological support – including psychological first aid, Ebola awareness, malaria matters, health care in danger, the legal framework, fire safety, basic field security etc.

The courses are open to everyone and consist of short presentations in easy-to-understand language with audio-visuals.

Weblink: https://www.disasterready.org/, accessed 25 September 2017.

TOOL Hand hygiene resources

Hand hygiene is the key element in protection against biological hazards during routine functioning as well as during outbreaks and emergencies. Hand hygiene should be implemented as a systematic programme consisting of the rationale for use in clinical settings, correct methodology, use of different hand hygiene materials, awareness among users and monitoring in the workplace.

The key WHO resources on hand hygiene are noted here. These resources should be useful to emergency programme managers and responders for creating awareness of the need for hand hygiene practices during outbreaks and emergencies as well as routine working conditions.

WHO guidelines on hand hygiene in health care. Geneva: World Health Organization; 2009.
Weblink: http://apps.who.int/iris/bitstream/10665/44102/1/9789241597906_eng.pdf

Hand hygiene-related videos and podcasts.
Weblink: http://www.who.int/gpsc/5may/video/en/

Hand hygiene-related tools and resources.
Weblink: http://www.who.int/gpsc/5may/tools/en/

WHO audio-visuals on hand hygiene.

No action today, no cure tomorrow
Weblink: https://www.youtube.com/watch?v=kOKeFv5VvY4

Hand washing technique
Weblink: https://www.youtube.com/watch?v=3PmVJQUCm4E

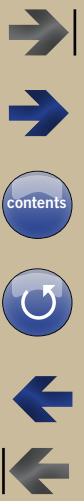
(All resources accessed 25 September 2017)

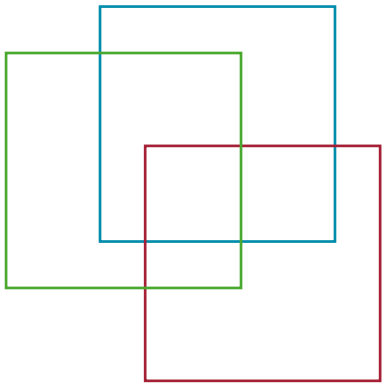
TOOL Online training on emergency responders' health monitoring and surveillance

This educational training course, designed by USCDC, covers information on the health monitoring and surveillance framework during emergencies – referred to as the Emergency Responder Health Monitoring and Surveillance (ERHMS) system. The system includes specific recommendations and tools for all phases of a response, including the predeployment, deployment and post-deployment phases.

The training should be useful for officials associated with the occupational safety and health of emergency response workers (e.g. emergency managers, emergency responders, medical personnel, health and safety representatives, epidemiologists etc.).

Weblink: https://emergency.cdc.gov/training/erhmscourse/index.asp, accessed 25 September 2017.





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