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PREPAREDNESS AND ACTION AT POINTS OF ENTRY (PORTS, AIRPORTS, GROUND CROSSINGS)

GUIDANCE FOR DEALING WITH CHEMICALS AND CHEMICAL INCIDENTS AT AIRPORTS, PORTS AND GROUND CROSSINGS

D8.2: Guidance Document

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1 INTRODUCTION

This is Deliverable 8.2 entitled "**Guidance for dealing with chemicals and chemical incidents at airports, ports and ground crossings**" developed under *Work Package 8: Chemical threats at points of entry* of the EU HEALTHY GATEWAYS Joint Action (Grant Agreement Nr. 801493). The EU HEALTHY GATEWAYS Joint Action has received funding from the European Union, in the framework of the Third Health Programme (2014-2020).

1.1 GUIDANCE FOR DEALING WITH CHEMICALS AND CHEMICAL INCIDENTS AT AIRPORTS, PORTS AND GROUND CROSSINGS

This document is a guide intended to assist in the preparedness and response to chemical incidents at ports, airports and ground crossings. It is aimed at assisting public health professionals, health workers at PoE (e.g., port health officers) and any other relevant agencies that may be notified of an incident of public health concern involving chemicals.

This document has been produced to work alongside and complement existing arrangements within Member States (MS), organisations and agencies responsible for responding to incidents involving chemicals, depending on the nature and location (port, airport or ground crossing) of the event. The arrangements for assessing and managing the public health risk associated with these events will depend on the responsibilities assigned to different agencies and the operational arrangements that exist within each MS. The reader should refer to the relevant operational plans and arrangements within their own MS.

1.2 OBJECTIVES

The guidance has been developed as a reference document to meet several inter-related objectives:

- To generate awareness amongst staff at PoE and other relevant agencies and those who might be notified of a chemical incident.
- To provide overview of key topics relevant to preparedness and response to a chemical incident

- To promote constructive dialogue between all stakeholders involved with planning, preparing and responding to incidents.

- To identify under non-crisis conditions, specific issues that could arise and to find practical solutions.

The guidance can be considered solely as a reference document containing information on scientific, technical and other aspects relevant to dealing with chemical incidents. Potential applications of the document may include the preparation and pre-planning phase, under non-crisis conditions, to engage with public health agencies and other relevant stakeholders who are responsible for the development of local, regional and national plans relevant to chemical incidents. In addition, this document could be used for training purposes and contingency planning.

Case studies are provided in Annex 1 which describe example chemical incidents at PoE while guidance notes (GN) in Annex 2 and useful resources in Annex 3 provide additional supporting information to assist in specific aspects of the planning, preparedness, response and recovery from chemical incidents.

2 INTERNATIONAL REQUIREMENTS

The strengthening of health security in Europe as well as at global levels is of paramount importance. Events involving chemicals have the potential to occur at all Points of Entry (ports, airports and ground crossings). The International Health Regulations 2005 and EU Decision on Serious cross-border threats to health (1082/2013/EU) provide a public health framework that enables countries to better prevent, prepare and respond to public health events and emergencies involving chemicals, including those of potential international concern.

2.1 REQUIREMENTS UNDER IHR

The International Health Regulations 2005 (1) represent an agreement between State Parties to work together for global health security. The Regulations provide a unique public health framework that enable countries to better prevent, prepare for and respond to public health events and emergencies of potential international concern. The IHR 2005 is not limited to any specific disease or manner of transmission but covers all diseases and events of international public health concern, including those linked to biological, chemical and radiation hazards. The Regulations cover not only persons but also baggage, cargo, containers, goods, postal parcels, and human remains that are contaminated or carry sources of contamination, so as to constitute a public health risk (Article 1, IHR 2005 (1)).

Countries are required to strengthen their ability to detect, assess, notify and respond to public health threats, including those involving chemicals. IHR capacity requirements are defined in Article 5 as "the capacity to detect, assess, notify and report events"; in Annex 1A on "Core capacity requirements for surveillance and response"; and in Annex 1B on "Core capacity requirements for designated airports, ports and ground crossings". The requirements are described in guidance, and monitoring tools for example, Assessment tool for core capacity requirements at designated airports, ports and ground crossings (2) and more specifically for chemical events in International Health Regulations (2005) and chemical events (3).

The IHR 2005 regulations permit countries to utilize existing national structures and resources to meet these requirements in relation to surveillance, reporting, notification, verification, response and collaboration activities; and activities concerning designated airports, ports and ground crossings. These arrangements should be documented in relevant national, provincial and / or local policies and plans (1).

A report published by WHO in 2012, described implementation of IHR 2005 and includes a regional analysis for Europe (4) (IHR implementation). The analysis of strengths and weaknesses are based on self-reported data submitted by States Parties. Specific country contexts and other sources of information, if available, may also need to be considered in identifying priorities within Member States.

2.1.1 Public Health Incidents of International Concern

Each country is required to assess events occurring within its territory and notify WHO by the most efficient means of communication available, by way of their National Focal Point, and within 24 hours of assessment of public health information, of all events which may constitute a public health emergency of international concern as well as any health measures implemented in response to these events. The responsibility of determining whether an event is within this category lies with the WHO Director-General and requires the convening of a committee of experts – the IHR Emergency Committee (5).

The term Public Health Emergency of International Concern is defined in the IHR 2005 as an extraordinary event which is determined to:

i. constitute a public health risk to other States (countries) through the international spread of disease; and
ii. potentially require a coordinated international response.

This definition implies a situation that: is serious, unusual or unexpected; carries implications for public health beyond the affected country's national border; and may require immediate international action. There is guidance available to assist national authorities to assess public health events that may require notification to WHO (5) (Guidance on IHR Annex 2).

2.1.2 National Focal Point

IHR 2005 requires a country to designate a National Focal Point (NFP), which is a national centre that is accessible at all times (7/24/365) for communication with the WHO IHR Contact Points. The structure and organization of the NFP is specific to each country (6). (Guidance on NFP)

2.1.3 Health security in Europe

The strengthening of health security in Europe as well as at global levels is of paramount importance. Protection of human health is an obligation under Article 168 of the Treaty on the Functioning of the European Union (7). Improving safety and security and protecting citizens against health threats is at the heart of European Union (EU) health policy.

Within the European Union there are arrangements in place for addressing serious cross border threats to health. These are outlined in EU Decision 1082/2013 (8) which provisions support the implementation of IHR 2005.

2.1.4 Chemicals

The purpose of the revised IHR 2005 (1) is to prevent, protect against, control and provide a public health response to the international spread of disease. Their scope is not limited to any specific disease or manner of transmission (as with the previous Regulations), but covers illness or medical conditions, irrespective of aetiology, that present or could present significant harm to humans, including outbreaks of chemical origin.

The chemical industry is one of the largest economic sectors worldwide and while many countries have laws and regulations governing chemical production and use. In addition, many countries have signed international agreements (e.g., Basel, Rotterdam, Stockholm and Minamata Conventions) aimed at controlling the use, trade, movement and disposal of certain chemicals. Furthermore, the international community has agreed on the Strategic Approach to International Chemicals Management (SAICM), which provides the international policy framework to foster the sound management of chemicals and to promote multisectoral and multi-stakeholder approaches in achieving this objective.

Chemical events arising from technological incidents, natural disasters, conflict and terrorism, polluted environments, and contaminated foods and products are common and occur worldwide.

The worldwide production, trade and use of chemicals are predicted to increase further. This is particularly true in developing countries and those with economies in transition, where chemical production, extraction, processing and use are closely tied to economic development. For these countries, the OECD projects a six-fold increase in chemical production by 2050 (9).

Despite the omnipresence of chemicals worldwide and their predicted increase in production and use, many countries lack adequate capacities to deal with the health aspects of chemical events and emergencies. Even where these exist, crisis situations may occur, overwhelming national response capacities and requiring international assistance to be provided. Legislation in countries aimed at the control of chemical production and use, including the management of chemical accidents (e.g., at chemical plants), should reflect the requirements of the IHR 2005 (1), whenever appropriate.

In general, the core capacities needed for chemical events can be grouped into four strategic areas. Strategic areas are made up of a number of capacity-building elements that countries have started to monitor in the process of assessing their readiness to implement the IHR 2005 (1). Important capacity-building elements are discussed in the following sections.

Strategic area	**Important capacity-building elements**
Policy coordination and communication	Designated Focal Points for the IHR in all authorities that have an important role in the management of chemical events, for coordination and communication

Event detection, verification and risk assessment	Tested surveillance system for the detection, verification and risk assessment of chemical events of (potential) international health concern as part of a multi-hazard surveillance strategy
Preparedness and emergency response	Tested response plans taking into account possible event scenarios, addressing priority chemicals, hazardous sites and vulnerable populations (e.g., development of risk maps)
Capacity-building	Access to expertise, i.e., maintaining an updated list and roster of experts and specialized centres, including for: - risk assessment, - exposure modelling, - chemical fate and transport assessment, - biological and environmental monitoring, - (clinical) toxicology, - diagnosis and treatment, - health surveillance. Access to specialized drugs and equipment to be used by experts and/or specialized centres and to be placed strategically to ensure national coverage, including: - antidotes, - personal protective equipment (PPE), - decontamination equipment, - equipment for biological and environmental monitoring. Access to toxicological and environmental laboratories, i.e., laboratories are prepared to accept and analyse human and environmental samples at the time of a chemical emergency and arrangements are in place to ship the samples

Table 1. IHR and chemical events (2015) – Core capacities for chemical events

2.1.5 Points of Entry

The IHR 2005 (1) includes specific measures required at ports, airports and ground crossings to limit the spread of health threats to neighbouring countries, and to prevent unwarranted travel and trade restrictions so that traffic and trade disruption is kept to a minimum.

The IHR 2005 define a Point of Entry as "a passage for international entry or exit of travellers, baggage, cargo, containers, vessels, goods and postal parcels, as well as agencies and areas providing services to them on entry or exit". Under the IHR 2005 countries are requested to maintain effective public health measures and response capacity at designated points of entry in order to:

- protect the health of travellers and populations;
- ensure that ports, airports and ground crossings as well as ships, aircrafts and ground transportation are in a sanitary condition; and
- contain risks at source, respond to emergencies and implement public health recommendations while limiting unnecessary health-based restrictions on international traffic and trade.

Based on a public health risk assessment, countries are required to designate Points of Entry (PoE). The number of designated points of entry varies from country to country. Whilst a certain level of capacity is desirable for all national points of entry, capacities outlined in Annex 1B of the IHR only apply to designated points of entry (1, 3)

At designated airports, ports and ground crossings, capacities are required at all times to:

- provide access to appropriate medical services, including diagnostic facilities, located so as to allow the prompt assessment and care of ill travellers, and adequate staff, equipment and premises;
- provide access, equipment and personnel for the transport of ill travellers to an appropriate facility;
- provide trained personnel for the inspection of vessels;
- ensure a safe environment for travellers using point-of-entry facilities, including potable water supplies, eating establishments, flight-catering facilities, public washrooms, appropriate solid and liquid disposal services and other potential areas, by conducting inspection programmes, as appropriate;
- provide as far as practicable programme and trained personnel for the control of vectors and reservoirs in and near points of entry.

IHR 2005 requires countries to identify the competent authorities to carry out: (i) development of core capacities at designated points of entry; (ii) implementation at points of entry of appropriate levels of hygiene and sanitation as well as ensuring effective vector, rodent and environment control measures and procedures; and (iii) application of health measures at points of entry in affected areas (1).

2.1.6 List of relevant requirements under IHR

With regards to PoE, the most important requirements under IHR include the following:

- The strengthening of health security in Europe as well as at global levels is of paramount importance.
- IHR regulations cover all diseases and events of international public health concern, including those linked to biological, chemical and radiation hazards.
- IHR define core capacities for strengthening the capability of countries to detect, assess, notify and respond to public health threats, including those involved with chemicals and radiation.
- IHR regulations include specific measures 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.
- Protection of human health is an obligation under Article 168 of the Treaty on the Functioning of the European Union (TFEU). Improving safety and security and protecting citizens against health threats is at the heart of European Union (EU) health policy.
- Countries can utilize national structures and resources to undertake surveillance, reporting, notification, verification, response and collaboration activities.
- Countries are required to designate national centres (NFPs) to communicate with European Commission and WHO. The structure and organization of the NFPs is specific to each country.
- Each country is requires to assess events occurring within its territory and notify the European Commission, as defined by the EU Decision on serious cross-border threats to health (1082/2013/EU) and the EURATOM Treaty and WHO by the most efficient means of communication available, by way of their National Focal Points, and within 24 hours of assessment of public health information, of all events which may constitute a public health emergency of international concern as well as any health measures implemented in response to these events.
- This guidance has been developed to generate awareness amongst port health officers and other relevant agencies of the need within Member States to plan, prepare and respond to incidents involving chemical and radiological hazards. The guidance document is intended to act as a repository of links and resources to signpost the reader onto articles, documents and legislation, relevant to the obligations of member states under the IHR and relevant EU legislation. The intention of the guidance is not to make the reader an expert, but is designed to provide an overview of dealing with chemical and radiological incidents and encourage further reading of more specific information.

2.2 REQUIREMENTS UNDER EU DECISION ON SERIOUS CROSS-BORDER THREATS TO HEALTH (1082/2013/EU)

Within the European Union there are arrangements in place for addressing serious cross border threats to health. The European Union (EU) Decision (1082/2013/EU) on serious cross border threats to health was adopted by the European Parliament in November 2013, in recognition of the need to strengthen the capacity of Member States to coordinate the public health response to cross border threats, whether from biological, chemical, environmental events or events which have an unknown origin. These are outlined in EU Decision 1082/2013 (8) and support the implementation of IHR 2005. In accordance with the Decision, EU Member States (MSs) are required to:

- Designate a competent public health authority at the national level responsible for alert notification and determining risk management measures.
- Have a contact point at National Level to generate an alert, post a notification in the Early Warning Response System (EWRS) and receive notifications from other Member States.
- Ensure consistency of approaches and measures taken to alert are communicated to the Commission and other Member States as well as consistency in communicating the risks.
- Consulting with other MSs with a view of co-ordinating their efforts on preparedness and response planning within Health Security Committee (HSC).
- Report to the Commission on their national preparedness and response planning
- Make information available from national monitoring systems related to chemicals and environmental hazards events following a cross border event by formalising links with regulatory agencies, monitoring networks and governmental departments to gather information at national level for environmental events.

3 CHEMICAL INCIDENTS

A chemical incident may be defined 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" (Environmental Health in Disasters and Emergencies) (10).

Events affecting Member States may arise from technological incidents, accidents, natural disasters, conflict and terrorism, polluted environments, and contaminated foods and products (WHO (2015) - International Health Regulations and Chemical Events) (3). Chemical incidents that have the potential to affect communities are described in the Manual for the Public Health Management of Chemical Incidents (11). These include:

- *Sudden event involving outdoor release of gas or vapour.*
- *Sudden event involving outdoor release of an aerosol.*
- *Sudden evident release to contact media other than air.*
- *Fire in a large building.*
- *Explosion.*
- *Disease outbreak.*

Examples of incidents at PoEs may include: fires/explosions on ships/aircraft/other vehicles and at PoE; damage to ships/aircraft/vehicles including mechanical and structural failures that have caused loss of cargo and/or chemicals to enter the environment; silent release e.g., leak of chemical cargo or chemical additive such as a pesticide; collisions between vehicles causing pollution to enter into the environment or loss of cargo.

Chemical incidents vary in scale, size and complexity. The response to these incidents may be local, regional, national or international and involve a number of agencies. The process of recovery must also be considered, as the environment must be brought back to how it was before the incident occurred. In addition, chemical incidents may be covert i.e., it may not be immediately apparent that an incident/exposure has occurred.

Chemical incidents are very different from biological emergencies, chemical incidents are by nature complex and often acute i.e., health effects occur very rapidly after the incident has occurred (as opposed to biological incidents, which have a longer time period from first infection to an official outbreak of disease). As such, the response to a chemical incident is time-critical, as chemicals can cause injuries/health effects very quickly, sometimes immediately upon contact e.g., in the case of corrosive chemicals. These injuries will get progressively worse without treatment and in some cases, individuals exposed to a toxic chemical can transfer it to others (secondary contamination – depending on the chemical's properties).

Table 2 provides examples of chemical incidents of public health significance that have occurred at PoE, which are described in more detail as case studies in Annex 1.

POE		Date	Chemicals	Type of the incident
PORTS				
01	Beirut Port, Lebanon	August 2020	Multiple chemicals, including ammonium nitrate and fireworks	Explosion, fire
02	Tianjin port, China	August 2015	Multiple chemicals, including sodium cyanide, ammonium nitrate, sodium carbide	Explosion and large-scale chemical release
03	Mumbai Port, India	July 2010	Chlorine	Chlorine leak
04	Port Santos, Brazil	January 2016	Chloric acid, sodium dichloroisocyanurate	A chemical fire and explosion
05	Portocel port, Brazil	July 2018	Thought to be hydrogen sulphide	Release on a ship
06	Ras Lanuf terminal Libya	June 2018	Oil	Fire
AIRPORTS				
07	London City airport, UK	October 2016	CS gas (tear gas)	Chemical gas leak
08	Hamburg airport, Germany	February 2017	Pepper spray (capsaicin)	Chemical gas leak
09	Esenboğa Airport: Ankara, Turkey	February 2005	Diallyl disulphide	Chemical leak
10	Melbourne airport	November 2016	Hydrofluoric acid	chemical spill
11	Tbilisi International Airport	July 2018	Unknown toxic liquid	Chemical release
12	Chopin Airport, Warsaw, Poland	July 2018	Unknown	Unknown chemical leak in the terminal
GROUND CROSSINGS				
13	Channel Tunnel, UK/France	September 2008	Phenol	Fire

Table 2. Examples of chemical events of public health significance at PoE

When assessing the risk posed by chemical hazards, consideration should be given to sources of chemicals on ships/aircraft/vehicles and at the specific PoE.

3.1 CHEMICALS AT POE

Chemicals can be found in some form at all PoE, most commonly they are used for vehicle operation (e.g., fuel, transport of fuel to terminals – oil, liquid gas etc.), cleaning, maintenance and disinfection of vehicles, fumigants (for example, on grain ships) and carriage of hazardous chemicals as part of a vehicle's cargo. In general, chemicals are more common at ports and airports compared to ground crossings as they tend to be used, stored and transported in larger amounts.

Chemicals exist in many different forms, for instance as liquids; gases, vapours or mists; and dust, fumes, fibres or powders. They can have vastly different physical and chemical properties which can influence how people are exposed to chemicals. Exposure to chemical hazards may result in physical hazards such as asphyxiation, or injuries from explosions, or health hazards, such as the toxic effects of chemicals. These can include local burns or irritation upon contact with skins or eyes, absorption of chemicals into the body causing internal or systemic poisoning or allergic reactions that may be life threatening.

The effects of exposure to hazardous chemicals can range from mild skin irritations to more serious effects such as cancer. Adverse health effects of chemical exposure can be seen immediately after contact (in the case of a chemical burn) or many years after exposure (e.g., lung cancer following exposure to asbestos). They may arise following a single short exposure (from infrequent use of a chemical) or longer-term exposure (from daily use of a chemical in the workplace).

3.2 TRANSPORT OF CHEMICALS

The transport of chemicals is rigorously regulated by both international and national regulations of both the originating and destination countries. Some examples include: EU Directives, International Maritime Organisation International Maritime Dangerous Goods Code (ports) (12); ADR – Agreement concerning the International Carriage of Dangerous Goods by Road (ADR, for Ground Crossings) (13); International Air Transport Association, Dangerous Goods Regulations (14). Most of the hazards present at PoE are focussed on ports/airports and less so on Ground Crossings.

Transport of chemicals is an essential component of the supply chain, moving goods (product, material, substance, waste) from one location to another, locally, nationally or internationally by different means of transport (e.g., road, rail, air, sea, inland waterway, pipeline).

Transport involves the risk of incidents and accidents. If the goods carried possess hazardous properties, there is the risk of release of the hazards (fire, explosion, toxic gas, environmental damage). Dangerous goods are substances that have been tested and assessed against internationally agreed criteria (classification) – and found to be potentially dangerous (hazardous) when transported. They are listed in The Dangerous Goods List and allocated the appropriate UN (hazard) Class and Division (15). Substances are assigned a UN number and proper shipping name. Dangerous goods forbidden from transport under normal conditions of transport.

It is necessary to ensure maximum safety in their transport, so special measures are taken to ensure that all those involved in transport are aware of the dangers and handling of dangerous goods. These include specific requirements for packaging and handling during transport, the labelling of packaging and transport containers, permits and documentation. The guide for safely transporting dangerous goods common to all modes of transport is The United Nations Recommendations on the Transport of Dangerous Goods - Model Regulations on the Transport of Dangerous Goods. Rev.21 (15). They represent basics that allow uniform development of national and international regulations for the various modes of transport of dangerous goods. UN Model Regulations are non-binding and must be transposed to national legislation to be enforceable.

UN Model Regulations provide rules & instruction on:

- *Classification of dangerous goods.*
- *Packaging and tank provision for dangerous goods (what type, size, volumes carried, compatibility/segregation, standards and testing).*
- *Consignment procedures (labelling of packages and vehicles, documentation required).*
- *Training requirements (staff involved in transport).*
- *Emergency response (safety information, instructions).*
- *Compliance assurance (designation of competent authority).*
- *Reporting of accidents.*
- *Security.*

For different ways of transport there are special regulations in place; for example:

- ***ADR** (European Agreement concerning the International Carriage of Dangerous Goods by Road www.unece.org/about-adr) – ground crossings (13);*

- ***RID*** *(International Rule for Transport of Dangerous Substances by Railway); (https://otif.org/fileadmin/new/3-Reference-Text/3B-RID/RID_2021_e_01_July_2021.pdf)*
- ***ADN*** *(European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways); (https://unece.org/about-adn)*
- ***SOLAS/IMDG*** *(International Convention for the Safety of Life at Sea / International Maritime Dangerous Goods Code) – ports;*
- ***IATA/DGR (****International Air Transport Association, Dangerous Goods Regulations www.iata.org/en/publications/dgr) – airports (14).*
- ***Transport of dangerous goods – overview*** *(https://servireach.com/en/consultancy/transportation/)*

3.3 PUBLIC HEALTH RISK ASSESSMENT

In the event of a chemical incident risks to human health and the environment need to be evaluated, this involves identifying the source of contamination and the pathways how a chemical can come into contact with people or other potential receptor(s). In addition to hazards, exposure is also crucial in risk assessment. In the absence of receptors, there is also no exposure and no health risk. For many incidents the cause may be obvious and the incident can be described by what actually happened such as a fire, spill or explosion. However, for other incidents the event may not be quite so apparent, or the contamination may be the result of more than one event.

The physicochemical properties of a chemical, described in **GN01** (Annex 2) can be used to define the behaviour of chemicals and are a useful aide in the risk assessment of chemical releases. Contaminants released into the environment may be subject to a complex set of processes, which include various forms of transport and cross-media uptake. For example, when one environmental media (e.g., air) is contaminated there is always the potential for secondary (indirect) contamination of another medium (e.g., water) if the contaminant source is not contained or mitigated in a timely manner.

Different chemicals may share similar physiochemical properties, which may allow a broad strategy with a concise number of options to be considered for dealing with chemical incidents, even for a mixture of chemicals.

Chemical incidents affect people in a number of ways, for example the effects of explosion or fire as well the toxic effects of chemicals. Chemicals may enter the body through the skin (dermal contact), eyes, lungs (inhalation) or digestive tract (ingestion). The rate of absorption via these paths is different for different chemicals, for example it can be affected by the concentration of the chemical involved, the length of time that the chemical is in contact with the body etc. Within the body itself, the effect depends upon the actual toxicity of the chemical and on the biologically effective dose. The way the dose is accumulated in the target tissue can make a difference to its impact. The toxicity and toxicological properties of a chemical and its reaction or degradation by-products will influence the response and will need to be assessed on a site and incident-specific basis (10).

3.3.1 Source, pathway, receptor

For an individual to be exposed to a substance there must be a pathway linking the source to the person. This is often described as the Source – Pathway – Receptor model, seen in *Figure 1* below. Information about a substance (source), its fate and behaviour in the environment (pathway), and the population at risk (receptor) will need to be gathered, analysed and assessed to determine the risk to human health and the environment.

Figure 1. Source-Pathway-Receptor model

- **What is the source of the contamination?**
  e.g., chemical cargo on a ship/aircraft/vehicle, transporting chemicals, fumigants.
- **How have people been exposed (pathway)?**
  e.g., air, water, food, soil, consumer products.
- **Who is likely to be affected (receptor)?**
  e.g., ship/aircraft crew, vehicle operators, workers at PoE, nearby communities, visitors.

Incidents associated with the release of chemicals may develop quickly and require inter-agency liaison, public health risk assessment and evidence-based decision making. A chemical event in one country can lead to health consequences in another country; for instance, the release of a chemical plume in one country could travel across borders and affect the population of a neighbouring country. Any event requiring a public health risk assessment should be evaluated on a site and incident specific basis.

The prevention and mitigation of chemical incidents and their impact on health requires specialists from many backgrounds. In the event of a chemical incident, it will be necessary to access relevant expertise, for example to assess public health risk and determine the fate and transport of chemicals in the environment (3). Further examples of expertise include exposure modelling, biological and environmental monitoring, clinical toxicology, diagnosis and treatment and health surveillance, as described in International Health Regulations and Chemical events, 2015 (3).

3.3.2 Rapid Risk Assessment

A manual has been developed to assist Member States undertake a rapid risk assessment of acute public health events from any type of hazard. The Rapid Risk Assessment of Acute Public Health Events (16), is aimed primarily at national departments with health protection responsibilities, National Focal Points (NFPs) for the IHR. It may also be useful to others who join multidisciplinary risk assessment teams, such as clinicians, field epidemiologists, veterinarians, chemists, food safety specialists.

This systematic approach outlined in the document to helps to:

- identify evidence-based control measures,
- rank the suitability and feasibility of control measures,
- ensure that control measures are proportional to the risk posed to public health.

In the rapidly changing environment of a chemical incident, it is important to quickly determine the nature of the risk and respond appropriately. With new information, the risk assessment must be updated and control measures adapted. With more information, there will be reduced uncertainty and improved control measures.

3.3.3 Risk Assessment

The risk assessment process generally begins with problem formulation and includes four additional steps: i) hazard identification, ii) hazard characterization, iii) exposure assessment and iv) risk characterization. This process is described by the World Health Organisation (17). The four key stages of risk assessment are outlined below in Figure 2:

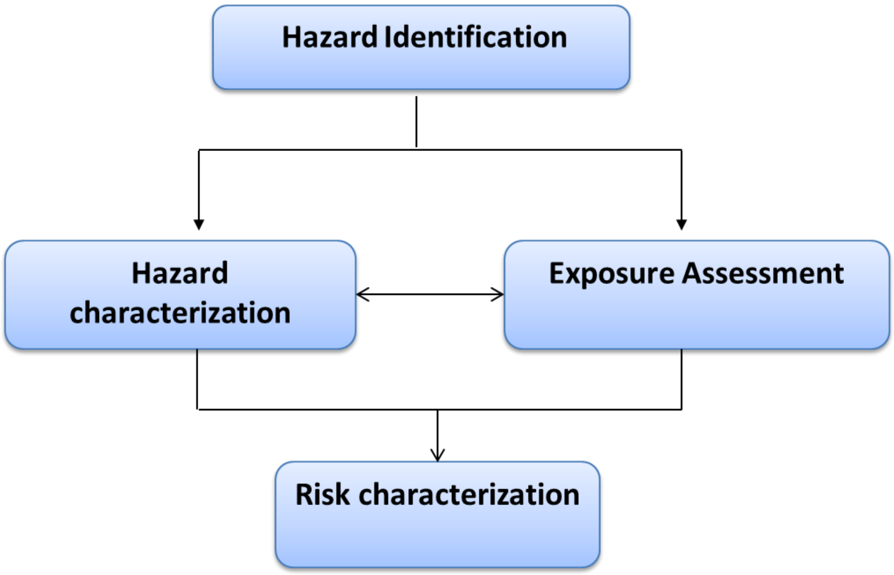

Figure 2. The risk assessment process. Source: WHO Risk Assessment Toolkit (6).

Risk assessment informs risk management and risk communication (e.g., advice to the public to reduce the burden of disease); therefore, exposure assessment is important to subsequent risk management and risk communication efforts. From a public health perspective, the priorities are to protect people from harm and ensure treatment is provided to those potentially exposed or at risk. During cross-border incidents it is important to be aware of the similarities and differences in approaches to exposure assessment between Member States. Incident plans within Member States should be consulted to determine the preparedness, resilience and response arrangements, including the risk assessment of chemical events of public health significance. The European Commission has established a mechanism to ensure the rapid exchange of information in instances where it is assessed that there may be a wider health impact to neighbouring countries as defined by Decision 1082/2013/EU (8) and the International Health Regulations (3).

A risk management platform (Early Warning and Response System, EWRS) is used to communicate alerts for all public health hazards (excluding radiation), which meet a specific threshold which indicates that they present a serious cross border threat to health, as defined by Decision 1082/2013 (8). These reports are made by the designated competent public health authority at the national level responsible for alert notification and determining risk management measures. Following an alert made via the EWRS platform, the EU Health Security Committee (HSC) or EC may request an independent rapid risk assessment. In addition, a risk assessment tier, the Rapid Alerting System for Chemicals (RASCHEM), which is owned and run by the European Commission, has been developed for use by poison control centres and public health authorities so that they can rapidly communicate technical information on chemical incidents and poisonings. See GN04 for further information.

3.3.3.1 Hazard identification

The first step is to identify the chemical involved in the incident: what is it? Is it hazardous to humans? Every chemical has its own unique identifier numbers, such as CAS number or EC number. To protect people and the environment, countries and organizations have developed laws and regulations that require information to be prepared and transmitted to those using chemicals through labels and Safety Data Sheets. Whilst existing laws were similar there were many differences (e.g., labels). In 1992 UNCED established a programme that included a global harmonised system (GHS) labelling and classification of chemicals. See Figure 3 below for examples of GHS labels and classes.

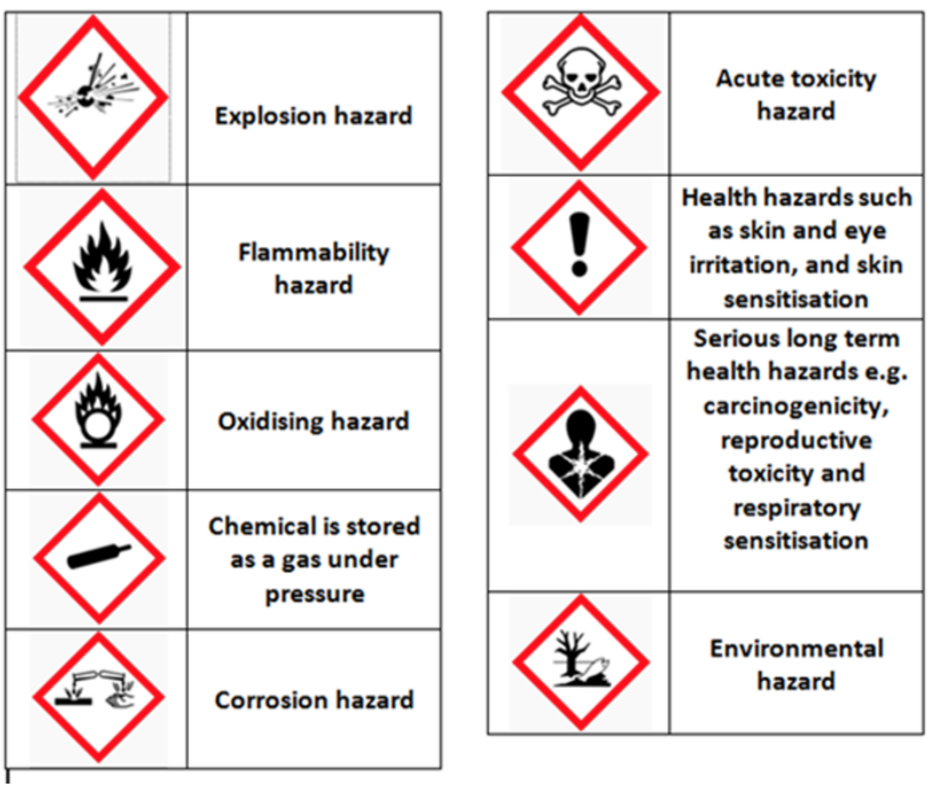

Figure 3. Standardised Chemical Hazards symbols and definitions, under the CLP regulations (18)

3.3.3.2 Hazard characterisation

The main aim of characterising the hazard is to assess what properties the chemical possesses which have the potential to cause adverse health effects? For example, toxicological properties depend on the dose of the chemical and the level of exposure.

Also relevant is the relationship between the dose of the chemical and the response i.e., is there an exposure level, below which no health effects are observed? If there is a threshold level, any amount of exposure below this level will not cause harm to the individual exposed. If there is no safe level, the chemical can be considered a genotoxic carcinogen and will always pose a risk.

3.3.3.3 Exposure Assessment

Issues for consideration in Exposure Assessment include: determining whether people are in contact with or are likely to come in contact with, a potentially hazardous chemical. For people that have been exposed to the chemical, determine:

- How much of the chemical they have been exposed to?
- By what route they have been exposed (airways/dermal absorption/ingestion)?
- Through what media (air/soil/water) they have been exposed?
- How long have they been exposed (short/medium/long term) and how long is the exposure likely to continue for?

Factors influencing exposure include: whether the release is in a rural or urban environment, as urban areas are more densely while a chemical release in rural areas has a higher risk of contaminating water sources or crops/livestock; whether the chemical is released indoors or outdoors (indoor release would lead to higher concentrations of the chemical less chance of it dissipating in the air. Dry conditions/wet conditions can also affect exposure, as rainfall may increase the amount of a chemical removed through wet deposition from the atmosphere and subsequently deposited on various surfaces. Wind speed and direction will also influence how far a plume contaminated by chemicals will travel, how concentrated it will be and subsequently the levels of chemical deposited. Chemical properties (e.g., whether a chemical has low volatility/ high volatility determines if it will evaporate and become airborne, increasing risk of exposure) determine environmental behaviour of a chemical, e.g. some chemicals remain close to the surface of soil/grass whilst other may be more mobile in soil, determining how persistent a chemical is in the environment possible leaching from the soil to water supplies would also need to be considered. The type of surfaces presents in the area of release, as some chemicals will soak into an absorbent surface and persist longer than those which are not absorbed.

3.3.3.4 Risk Characterisation

Risk characterisation involves a qualitative or quantitative statement about the estimated exposure relative to the most appropriate health-based data (e.g., guidance value or media-specific quality guideline value). It is generally derived by comparing the estimated exposure with a standard / guideline value. Regulatory agencies set scientifically based standards aimed at protecting human health and standards exists for chemicals in: air, water, food, soil and cosmetics. Comparison of a predicted human exposure against the standards helps to characterise the significance of the Risk.

This can then be mapped onto a grid as per Figure 4 below which colour codes risk severity according to the likelihood that a chemical incident will occur. Low risk is managed according to standard response, routine control programmes and regulation. For Moderate risk, roles and responsibilities must be defined and specific monitoring or control measures are required. For High risk, senior management attention is required and may require command and control structures. Additional measures may have significant consequences. For Very high risk, an immediate response and senior management attention is required, it is highly likely that implementation of control measures will have serious consequences.

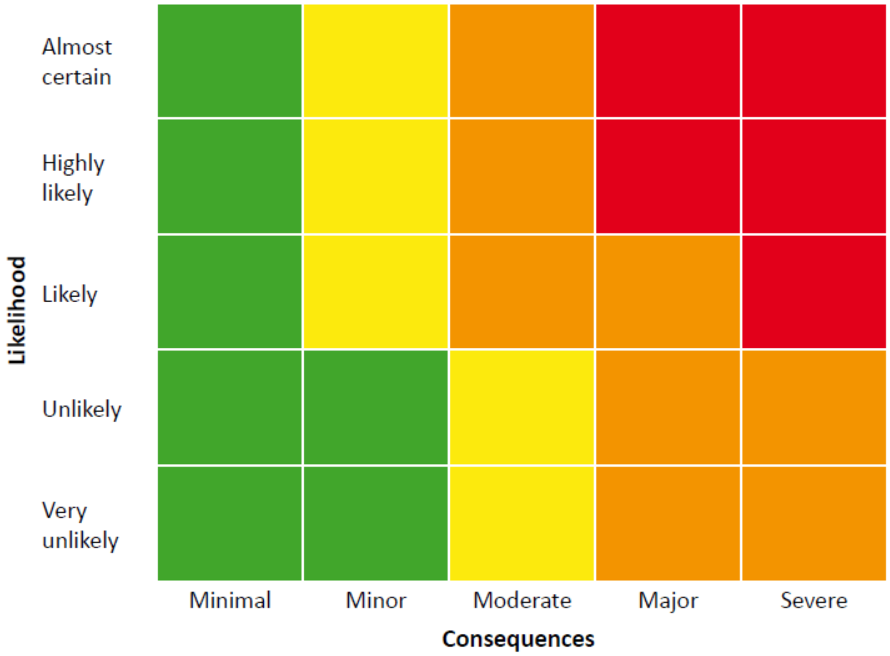

Figure 4. Example of a risk characterisation grid (16)

3.4 PUBLIC HEALTH IMPACT

Chemicals released into the environment many cause direct/ indirect contamination and pose a further risk to public health. The impact of this contamination will depend on the:

- Toxicity of the chemical.
- Time period and route of exposure (inhalation, ingestion, dermal contact).
- Physicochemical properties of the chemical (which determines how it behaves in the environment).
- Degradation properties of the chemical.
- The presence of protective environment/media (e.g., buildings).

Both health and environmental control measures may be needed to manage the incident and minimise the public health effects. There are three main ways to manage exposure; by removing the chemical from use (e.g., replace with a less hazardous alternative), preventing exposure e.g., through use of PPE and by reducing the use of the chemical and hence the risk of exposure.

4 PLANNING, PREPAREDNESS AND RESPONSE

4.1 PLANNING AND PREPAREDNESS

Planning and preparedness activities are key elements of IHR 2005 and are supported by requirements set out in EU legislation. These require the setting up and maintenance of an effective emergency response infrastructure (1, 8).

At the national level, procedures are required to ensure that the public health management of any incident is effective and comprehensive. At the local level, public-health authorities need to identify situations where incidents may occur, and assess the likely health risks to exposed people, property and the environment. The public health sector needs to be fully involved in the planning and preparedness process, including emergency plan development and implementation. Many organizations will be involved in the planning and response phases to an incident.

A list of organisations involved in the planning and management of chemical incidents are described in the WHO document Environmental Health in Emergencies and Disasters (chemical incidents, chapter 12, (10)).

In relation to chemical events, Article 4 (2) of the European Decision 1082/2013/EU (8) on serious cross border threats to health, lays down the information on preparedness and response planning at a national level and requires that Member States provide this information to the European Commission every three years. Member States are also required to inform the Commission of substantial revisions of their national preparedness and response planning (Article 4 (3)).

There is a template used to provide information to the Commission on preparedness and response planning in relation to serious cross-border threats to health, this information is defined in Implementing Decision 2014/504/EU (8). In order to avoid duplicate reporting, the information already provided by Member States to the World Health Organization (WHO) in relation to implementation of the core capacities for preparedness and response planning should be used for the purpose of reporting (19).

4.1.1 Planning at designated Points of Entry

IHR (2005) compliance requires that a public health emergency contingency plan (PHECP) is developed and maintained in designated Points of Entry (PoE), for responding to events that may constitute a public health emergency of international concern (PHEIC). WHO has developed a guidance document to assist the National Public Health Authority responsible for driving IHR (2005) compliance (20) (IHR 2005: A guide for public health emergency contingency planning at designated points of entry).

4.1.2 Public health emergency plan

The International Health Regulations 2005 (1) requires a public health emergency plan (PHECP) to be developed and maintained in designated Points of Entry (PoE). The Guide for Public Health Emergency Contingency Planning at Designated Points of Entry (20) provides a recommended approach, structure and logical set of considerations for the National PoE Health Authority (NaPHA) to guide local PoE health officers (PHOs) and emergency planners responsible for PoE to develop a PHECP at a designated PoE. Among these considerations, it is important to have a detailed risk profile of all potential hazards at the PoE**.** For chemicals, this involves creating and maintaining lists of the priority chemicals stored, used or transported on site should be included. Hazardous site on or near the PoE should also be mapped and included in the plan (e.g., fuel stores, chemical stores, cargo warehouses). The plan should be interoperable with other existing plans such as: national health and emergency management legislation and policies; national and local plans for public health emergency response; civil defence or civil protection legislation and policies (20).

The broad objectives/priorities of an emergency preparedness plan should be (in order):

- To save (protect) life.
- To reduce damage and loss.
- To assist/support the investigation.
- To resume normal operations.

Public health emergency contingency plans for designated PoE should be flexible and adaptable to match a wide variety of public health contingencies, (especially emerging diseases), ensure broad consideration of existing national and local plans, including public and private sector plans, laws, regulations and policies; plan to develop surge capacity on an "as required" basis so that it can be engaged when needed, rather than as a "permanent" function; ensure full respect for the dignity, human rights and fundamental freedoms of persons as per IHR 2005 (1); place equal focus on readiness, response and recovery; and ensure budgeting for regular exercising, refreshing and maintenance of plans.

Planning and preparedness activities are key elements of IHR 2005 and EU legislation and require the setting up and maintenance of an effective emergency response infrastructure (1, 8).

4.1.3 Chemical preparedness plan

While there may be some type of national plan or programme in place that already covers certain aspects of the IHR, it often overlooks chemicals. There may also be some legal and technical instruments or plans already in place for responding to chemical events and emergencies. In this case, a decision should be made as to where the integrated national chemical response plan will "reside", based on the specific context in each country.

The national plan for chemical events under the IHR could then be a combination of a number of different types including, for example:

- an integrated response plan for all types of chemical events, adopted by all relevant organizations or agencies. Among other requirements, this plan should clearly define the roles and responsibilities of the different actors under the IHR 2005 (1) as well as other relevant legislation.
- a plan combined with a pre-existing public health emergency plan (e.g., for outbreaks of food poisoning or infectious diseases). As such plans may already exist for other hazards covered by the IHR 2005 (1), it would require the integration of the roles and responsibilities for chemical events.
- a plan linked to emergency plans for registered hazardous installations regulated under national law that already partially address chemicals. These plans normally do not address the IHR 2005 (1).

Whichever framework is developed, the national plan should include arrangements for scaling up the response, for command and control, risk assessment and communication, training and exercises, public crisis communication, and health sector communication once an alert has been received from the surveillance system.

The national plan should be developed in close cooperation among, and with input from, all the stakeholders who will need to interact during a chemical event. Under the IHR, this plan would also need to involve authorities dealing with the travel of persons and the transport of baggage, cargo, containers, goods, postal parcels, and human remains that are chemically contaminated or carry sources of chemical contamination.

The following are topics that should be contained in a chemical plan: the roles and responsibilities of the organisations/actors who would be involved (and how they would work together), a list of priority chemicals in the airport, a list and location of nearby hazardous installations and should involve input from fire services and other specialists in hazardous materials in the planning. These are elaborated in further detail in Table 3 below and can be found in more detail in the Chemical Preparedness Assessment Tool (Deliverable 8.2).

Description of Point of Entry	• Address • Site activities: e.g., chemical transport, fumigation of cargo • Site operation hours: e.g., 24/7 • Staffing levels: e.g., normal working hours 1500 staff on site; approx. 100 staff at other times. • Domino potential: e.g., Nearby industrial sites names of companies • Site has pipelines which in the event of a major incident could give rise to offsite effects: 1 LPG and 1 crude oil.
Nearby receptors	• Nearest residential areas: e.g., address, distance/direction from PoE • Holiday/leisure parks • Schools: Name, location • Sensitive receptors: e.g., Nursery, hospital, elderly care home • Industrial/commercial sites • Transport hubs: e.g., major stations nearby
A map of the site and nearby receptors is suggested	A map
Chemical Inventory (Principle chemical hazards)	• List major chemicals transported/stored at site Include: • Amount of chemical stored/transported • Major hazards posed by each chemical • Physical description

	• Physicochemical properties e.g., density, Toxicological profile • Initial medical management steps to take
Initial risk assessment and public health actions	• Potential incidents which could occur on site (given the hazardous chemicals listed earlier): e.g., fire, explosion, leak of benzene • Initial actions to take: e.g., sirens activated, who will be informed, shelter/evacuation advice circulated to the local area
A list of Key contacts in the case of an incident	• National public health authority • Specialist fire service response • Expert advice • Chemical advice • Toxicology/medic (treatment advice) • Environmental advice

Table 3. Examples of important considerations in a Public Health Emergency plan

The Point of Entry must ensure that any preparedness plan is coordinated with emergency service response plans, as well as those of other relevant organisations. Examples include ship/aircraft/vehicle operators, navigation service providers, police, national, regional and local community entities, hospitals and rescue teams. The plans should be tested regularly (every few years or so), for example through training and exercises. This allows validation of the existing plan (is the plan fit for purpose? Are there any gaps remaining?), development of staff competencies and practice in carrying out their role in the plan (Are staff aware of their role and confident in carrying out their tasks?) and testing established procedures within the plan. The results of these tests should be recorded so that plans can be adapted and updated if necessary.

4.2 SURVEILLANCE AND DETECTION

The effective collection of relevant information can inform and guide the public health response to all acute public health events including: unknown, unusual or unexpected disease or disease patterns as well as hazards that could potentially pose a risk to human health. All Member States have surveillance systems that detect outbreaks of infectious diseases. As a result of the emphasis in the IHR on strengthening this core capacity, many Member States have expanded these systems to include public health events caused by other hazards (20). Surveillance systems detect public health events through:

- **Indicator-based surveillance** comprises the collection of specific predetermined or standardised types of data (indicators) such as detection of specific diseases, concentrations of specific chemicals in human samples, in food or the environment. It may also include planned non-targeted testing or laboratory analysis, such as in cases where the intention is to screen a water or food sample for the presence of all chemicals. A commonly adopted indicator-based surveillance project is the surveillance of blood lead concentration, usually in particular populations of concern, commonly children. Lead is ubiquitous in the environment and exposure to even very low concentrations can result in systemic toxicity; blood lead concentration is also a relatively simple assay. Poison centre could be involved in such surveillance through passive or active engagement in possible cases and communication between relevant stakeholders.
- **Event-based surveillance (EBS)** is the organized and rapid capture of information on potential public health risk that may have significant impact or be the result of an incident or event. Unlike traditional surveillance, EBS is based on the capture of unstructured reports rather than the routine capture of data (21). This type of surveillance is very suitable also to provide an overview of chemical and environmental events within a country, whether acute or chronic exposure is involved. Data collected by EBS is usually structured according to a minimum dataset including such information as: (i) when/where the event happened, (ii) what has been reported, (iii) how many people have been affected, (iv) severity of the public health impact, e.g., deaths, and (v) contact details of the reporting team to enable further dialogue/ investigation.
- **Syndromic surveillance** is the near real-time collection, analysis, interpretation and dissemination of health-related data in order to enable early indication of the impact (or absence of impact) of potential health threats that may require public health action.
- **Poison centres** are well placed to detect potential or actual chemical incidents of public health concern via protocols to detect signals and report to public health agencies. The poison information centre may act as a key source of information for action in case of public health response to chemical incidents. They should therefore aim to be prepared to provide adequate information rapidly in the acute phases, including maintaining information on all chemicals likely to be involved in accidents in the region, not forgetting

the less frequently used industrial chemicals and reactive intermediates. Poison information centres may also be involved in toxicovigilance activities in particular populations where indicator of syndromic surveillance is being used to investigation potential outbreaks in a vulnerable, exposed or high-risk population, for instance.

Guidance has been developed to provide national health authorities, and stakeholders supporting them, with information for implementing or enhancing the all-hazards early warning and response (22) within national surveillance systems (23).

Poisons centres can play a particularly important role in the detection and response to a chemical event. A sudden high frequency of enquiries reporting a specific set of clinical features, and/or associated with a specific product or location, could be the signal of a chemical event. Most poisons centres engage in toxicovigilance, which is the active process of looking for emerging toxicological problems, where a link may be established between observed signs and symptoms and a specific chemical (3).

Organisations and agencies operating at PoE collect information relating to their respective duties. Some of this information is of interest to human public health, whilst other information related to hazards that are not known to adversely affect human health may be of lesser interest. It is therefore necessary to have clear criteria for defining the type of events that must be communicated to public health surveillance systems. The key guiding concept is the public health risk. The selection criteria for identifying events to be covered by surveillance should consider the requirements set out in IHR 2005, EU legislation and also the local context.

Guidance has been developed to strengthen communications and coordination between points of entry and the national health surveillance system (25). This identifies sources of information common to most PoE and also lists those sources available at PoE, detailed below in Table 4.

Source		Description
Ports	**Maritime Declaration of Health**	For ships on international voyages, the master of the ship, before arrival at its first port of call-in territory of a State Party, shall ascertain the state of health on board, and, except when that State Party does not require it, the master shall, on arrival, or in advance, complete and deliver to the competent authority a maritime declaration of health (IHR article 37, IHR annex 8).
	Ship Sanitation Certificates	Ships should be inspected regularly to certify that they are free of infection and contamination, including vectors and reservoirs (IHR article 39).
	Ship's illness medical log	For each voyage, a standardised illness medical log recording all illnesses should be maintained daily by a designated crew member. It should include all cases of communicable diseases, syndromes, or other events that occurred during the voyage.
Airports	**Aircraft General Declaration**	The pilot in command of an aircraft or the pilot's agent, in flight or upon landing at the first airport in the territory of the State Party, shall, except when that State Party does not require it, complete and deliver to the competent authority the Health Part of the Aircraft General Declaration (IHR article 38, IHR annex 9).
	Passenger Name List	("Passenger Manifest") in case of an event aboard an aircraft, State Parties can require the aircraft conveyer to present the PNL, which should provide the names of all the passengers aboard the aircraft (12).
	Public Health Passenger locator form	When a public health risk has been identified and States Parties request information for contact tracing, passengers and crew may be asked to complete a public health passenger locator form (12).
	Health Declarations from Passengers	When a specific event occurs, States Parties can require such a declaration from visitors arriving and departing by air.
Ground Crossings	The IHR do not stipulate health documents for conveyances at ground crossings, but systematic health checks of travellers at ground crossings are sometimes conducted as part of health checks on immigrants. Other sources of public health surveillance data include the drivers of the conveyances, the conveyance operators, or migrant detention centres and border guards. Operational procedures and railway association guidelines could also be considered. While ships and airplanes usually have medical staff or trained non-medical staff able to detect events on board and inform the ports or airports, ground conveyances generally lack this type of staff training and involvement.	

Table 4. Sources of information relevant to surveillance of chemical incidents at PoE

In accordance with IHR 2005 (1), officers in command of ships, or their agent are required to inform the port control as early as possible any cases of illness indicative of a disease of an infectious nature or evidence of public health risk on board. This information must be immediately relayed to the competent authority for the port. In urgent circumstances, such information should be communicated directly by the officers or pilots to the relevant port authority (IHR article 28). Vessel operators are required to facilitate the provision of relevant public health information requested by the State Party (IHR Annex 4, (20)).

If evidence of a public health risk is found on board a vessel and the competent authority is not able to carry out the control measures required, the affected vessel may nevertheless be allowed to depart, on condition that, at the time of departure, the competent authority informs its counterpart at the next known PoE of the evidence found and of the control measures required. In the case of a ship, this information shall be noted in the Ship Sanitation Control Certificate (IHR article 27). The next PoE must also be informed if any travellers have been placed under public health observation but allowed to continue their international voyage (IHR article 30, (20)).

States Parties are obliged to collect and handle health information containing personal identifiers in a confidential manner. However, States Parties may disclose and process personal data when it is essential for the purposes of assessing and managing a public health risk, subject to particular conditions (IHR article 45, (20)).

4.3 PUBLIC HEALTH RESPONSE

Annex 1 of the IHR 2005 (1), asks countries to utilize existing national structures and resources to meet their core capacity requirements for response and coordination.

- At the local community level and/or primary public health response level, the necessary capacities include those: (i) to detect events involving disease or death above expected levels; (ii) to report all available essential information immediately to the appropriate level of health-care response; and (iii) to implement preliminary control measures immediately.
- At the intermediate public health response levels, the necessary capacities include those to: (i) confirm the reported events and to support or implement additional control measures and (ii) to assess reported events immediately and, if found urgent, to report all essential information to the national level.
- At the national level, the necessary capacities are those required to: (i) assess all reports of urgent events within 48 hours and (ii) to notify WHO immediately through the IHR

(2005) National Focal Point (IHR/NFP) when the assessment indicates the event is notifiable (Annex 2 of the Regulations).

At the national level, capacities are also required: i) to determine rapidly the control measures needed to prevent domestic and international spread; ii) to provide support through specialized staff, laboratory, analysis of samples and logistical assistance; iii) to provide on-site assistance as required to supplement local investigations; iv) to provide a direct operational link with senior health and other officials to approve rapidly and to implement containment and control measures; v) to provide direct liaison with other relevant government ministries; vi) to provide links with hospitals, clinics, airports, ports, ground crossings, laboratories and other key operational areas for the dissemination of information and recommendations received from WHO/EU; vii) to establish, operate and maintain a national public health emergency response plan; and viii) to provide the foregoing on a 24-hour basis.

Planning is an essential activity and serves to prevent, reduce or mitigate the impact of incidents, including setting out how incidents are responded to. Events should be managed in accordance with pre-defined contingency arrangements, intergovernmental agreements and the national and regional rules and regulation. In terms of response to chemical incidents, Civil contingency response - Responders include: Police, ambulance, fire and rescue services; Local authority emergency planners; Port health authorities/local authorities; Environment Agencies; Harbour/airport authority; Utility companies (water, electricity, gas); the voluntary sector and one or more public health agency covering Chemical, Biological, Radiological (CBR) expertise, or a combination of 2 or more. In the UK, the UK Health Security Agency provides advice on CBR, but that arrangement may differ between European Member States.

In terms of the Public Health incident response, initially a dynamic risk assessment must be undertaken, detailing the potential health effects of the chemicals released and the risk to public health (including sensitive receptors). Advice must be provided on the need to shelter /evacuate and other relevant public health messages, requirements for decontamination of people, vehicles and buildings and clinical advice. Those directly involved on scene include those responsible for: public safety; fire and rescue services; on-site medical care, decontamination and transportation of casualties for emergency care; containment and utilisation of equipment on site; detection, identification and monitoring of hazardous material; On-going monitoring and sampling of hazardous material.

There are also many other actors involved in the response who are not on scene. These include those responsible for: providing chemical advice, engagement with health professionals (including hospitals, community care, General Practitioners (GP's) and mental health services), ports/airports/Ground Crossings, transport or public health, community leadership, voluntary services and the National Focal Point (NFP) (as defined by the International Health Regulations 2005, European Decision of serious cross border health threats (Decision 1082/2013/EU)).

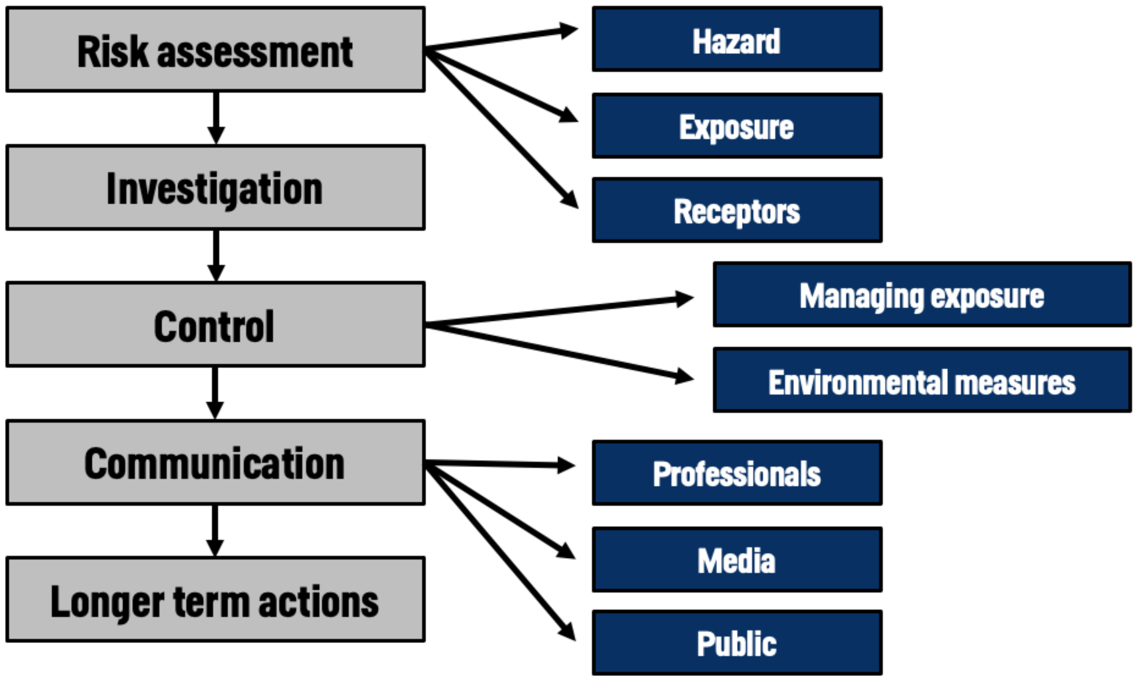

Figure 5. Public health response to an incident

There are simple methods to prevent chemical incidents from occurring in the first place, examples of these include:

- reducing the amount of stored toxic and flammable chemicals and promoting safer alternatives,
- remove the use of the hazardous chemical, if possible,
- safe location of chemical stores at the airport,
- building in technical controls and redundancy to provide safe use of chemicals and management of waste.

However, it may not possible to completely prevent a chemical incident from occurring, so plans must be made in order to sufficiently prepare those responding to do so quickly and effectively.

4.4 GUIDELINES FOR PLANNING, PREPAREDNESS AND RESPONSE AT POE

To conclude, here are some guidelines for planning, preparedness and response at Points of entry:

- *IHR 2005 (1) compliance requires that a public health emergency contingency plan (PHECP) is developed and maintained in designated Points of Entry (PoE), for responding to events that may constitute a public health emergency of international concern (PHEIC).*
- *Planning and preparedness activities are key elements of IHR 2005 and EU legislation and require the setting up and maintenance of an effective emergency response infrastructure (1, 8).*
- *Annex 1 of the IHR 2005 asks countries to utilize existing national structures and resources to meet their core capacity requirements for response and coordination.*

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6 ANNEXES

Annex 1: Case Studies of chemical incidents at PoE

Case studies at ports

01	
PoE	PORT
Location	Beirut Port, Lebanon
Date	4th August 2020
Chemical(s)	Multiple chemicals, including ammonium nitrate and fireworks
Type of the incident	Explosion, fire
Health effects	>200 killed, >5000 injured
Incident description	A fire and explosion devastated the port area of Beirut, Lebanon, killing at least 200 and injuring over 5000. It is thought that an initial fire at a warehouse ignited a consignment of fireworks, which detonated more than 2500 tonnes of ammonium nitrate being stored at the port. The blast wave produced by the explosion levelled nearby buildings and caused extensive damage across the city. Hospitals were quickly overwhelmed and it is estimated that 300,000 were left temporarily homeless due to the damage. Damage was estimated to reach $10-15 billion.
Reference and sources	https://www.thesun.co.uk/news/12316011/beirut-explosion-bbc-journalist-sent-flying-live-on-air/ https://reliefweb.int/sites/reliefweb.int/files/resources/BeirutRapidDamageandNeedsAssessmentAugust2020EN.pdf https://www.thesun.co.uk/news/12316011/beirut-explosion-bbc-journalist-sent-flying-live-on-air/ https://www.bbc.co.uk/news/world-middle-east-53668493
Pictures	 Explosion at Beirut port. Source: https://www.thesun.co.uk/news/12316011/beirut-explosion-bbc-journalist-sent-flying-live-on-air/

02	
PoE	PORT
Location	Tianjin port, China
Date	12th August 2015
Chemical(s)	Multiple chemicals, including sodium cyanide, ammonium nitrate, sodium carbide
Type of the incident	Explosion and large-scale chemical release
Health effects	Over 170 killed, over 700 injured
Incident description	Two massive explosions in the port of Tianjin, northern China (a significant industrial port near Beijing and is a gateway for goods (including metals and steel) to and from the capital and China's industrial north), killed more than a hundred people, left hundreds more injured and devastated large areas of the city. The blasts took place at a warehouse at the port which contained hazardous and flammable chemicals, including calcium carbide, sodium cyanide, potassium nitrate, ammonium nitrate and sodium nitrate. It is thought that the initial fire was caused by nitrocellulose, which was allowed to dry out, overheat and self-ignited. The water used to put out the fire initially, may have reacted with calcium carbide, known to be at the site, to create the highly explosive acetylene. An acetylene blast could then have detonated the other chemicals (ammonium nitrate) to create the much larger blasts. The blast occurred late at night and was felt several kilometres from the port. The area next to the port was densely populated and the closest residential properties were 600m away and unaware of the hazards at the nearby site. Investigations into the incident concluded that warehouses were located closer to homes than permitted, they stored much more hazardous material than authorised and that there were a number of failures by management and regulators. The investigation concluded that the accident was caused by spontaneous combustion of a container of dry nitrocellulose. The second larger explosion was estimated to involve 800 tonnes of ammonium nitrate
Reference and sources	https://www.bbc.co.uk/news/world-asia-china-33844084 https://www.bbc.co.uk/news/world-asia-china-33890903 CDC NIOSH - Calcium carbide: https://www.cdc.gov/niosh/ipcsneng/neng0406.html CDC NIOSH - Sodium cyanide: https://www.cdc.gov/niosh/ershdb/emergencyresponsecard_29750036.html CDC NIOSH - Ammonium nitrate: https://www.cdc.gov/niosh/ipcsneng/neng0216.html CDC NIOSH - Nitrocellulose: https://www.cdc.gov/niosh/ipcsneng/neng1560.html
Pictures	 Tianjin port, China. Source: https://www.bbc.co.uk/news/world-asia-china-33890903  Aftermath of the blast in Tianjin port. Source: https://www.independent.co.uk/news/world/asia/tianjin-explosion-photos-china-chemical-factory-accident-crater-revealed-a7199591.html

03	
PoE	PORT
Location	Mumbai Port, India
Date	14th July 2010
Chemical(s)	Chlorine
Type of the incident	Chlorine leak
Health effects	Over 120 injured, many critically
Incident description	On the morning of 14 July 2010, chlorine leak incidence was reported at Haji Bunder hazardous cargo warehouse in the Mumbai Port Trust (MPT), Sewri, affecting over 120 people in the neighbourhood, including students, laborers, port workers and fire fighters, of whom 70 were reported critical. 1,2 Many students from LBS College hostel that is barely 100 m from the site of leak were affected. Those who were sleeping were the most affected and they started vomiting. It was learnt that the chlorine cylinders have been abandoned by an importer in 1997, according to MPT officials, the leak occurred from one of 141 cylinders stored at the storage place. For over 6 hours, rescue and relief teams struggled to control the situation and it took fire officials, Bombay's Municipal Corporation teams, and chemical experts from nearby industries, to identify, seal, and clamp the leaking of other cylinders. Fire fighters created water curtains in the area diluting the gas cloud that was spreading because of the leakage. The neutralization process of the remaining chlorine filled cylinders using caustic soda and water was carried out by the National Disaster Response Force (NDRF) and other emergency responders. It is reported that MPT did not have a chlorine neutralization tank to control such conditions. It was also observed that no safety guidelines were observed or safety systems maintained at the facility.
Reference and sources	https://timesofindia.indiatimes.com/city/mumbai/Chlorine-leak-in-Mumbai-port-area-sparks-panic/articleshow/6169587.cms Chlorine leak on Mumbai Port Trust's Sewri yard: A case study. Rakesh Kumar Sharma, Raman Chawla, and Surendra Kumar. J Pharm Bioallied Sci. 2010 Jul-Sep; 2(3): 161–165. Chemical Compendium - Chlorine: health effects, incident management and toxicology, Public Health England: https://www.gov.uk/government/publications/chlorine-properties-incdent-management-and-toxicology
Pictures	 Chlorine leak at Mumbai port. Source: http://www.daijiworld.com/printArticles.aspx?sectionID=81217&sectionName=news

04	
PoE	PORT
Location	Port Santos, Brazil
Date	15th January 2016
Chemical(s)	Chloric acid, sodium dichloroisocyanurate
Type of the incident	A chemical explosion
Health effects	At least 66 injured, thousands exposed
Incident description	A chemical explosion at a cargo warehouse in Brazil spread toxic gas over the country's biggest port. The company owners said the containers in Santos were full of acid and a disinfectant which came into contact with rainwater, causing a reaction. The area's mayor said at least 66 people were taken to hospital with breathing difficulties. Officials said the fire had been controlled but that there is still smoke in the area. The cargo terminal and nearby homes were evacuated and residents were asked to stay inside. The container terminal was operated by Localfrio, a logistics company, in Guaruja, an area on the eastern side of Santos, in Sao Paulo state. A spokeswoman for the company, which exports chemicals used for refrigeration and general cargo, said the containers were filled with chloric acid and sodium dichloroisocyanurate - a cleaning and disinfectant agent. Firefighters said rainwater had seeped into the containers causing a chemical reaction. Local Mayor Mario Antonieta de Brito asked people to stay out of the rain which could "contain chemical elements that can burn the skin".
Reference and sources	https://www.bbc.co.uk/news/world-latin-america-35320083 CDC NIOSH - Sodium dichloroisocyanurate: https://www.cdc.gov/niosh/ipcsneng/neng0437.html PubChem - Chloric acid: https://pubchem.ncbi.nlm.nih.gov/compound/chloric_acid
Pictures	 Port Santos, Brazil. Source: https://www.bbc.co.uk/news/world-latin-america-35320083

05	
PoE	PORT
Location	Portocel port, Brazil
Date	24th July 2018
Chemical(s)	Thought to be hydrogen sulphide
Type of the incident	
Health effects	Three killed, one injured
Incident description	Three port workers died and one was hospitalized after they inhaled toxic gas in a cargo hold of bulk carrier SEPETIBA BAY, docked at Portocel port, Brazil, in the morning Jul 24. The ship is offloading wood which was treated for protection with gas, according to local Trade Union. One worker went down to the hold and lost conscience, the other three tried to help him, but were also poisoned. One of them managed somehow to climb back to the cargo deck, though badly intoxicated, but the other three did not survive. It is thought that the gas was toxic hydrogen sulphide, which can be released due to decomposition of the wood (which can occur if the wood is wet). According to the port, the wood was transported without any chemical treatment, as it was due to be made into cellulose.
Reference and sources	http://hisz.rsoe.hu/alertmap/database/index.php?pageid=event_desc&edis_id=HZ-20180725-64020-BRA https://felixstowedocker.blogspot.com/2018/07/the-tragic-episode-recalls-port-risk.html https://www.marinha.mil.br/sinopse/ministerio-do-trabalho-e-marinha-vao-investigar-acidente-em-navio https://g1.globo.com/es/espirito-santo/noticia/2018/07/25/gas-toxico-e-investigado-como-causa-de-mortes-em-porto-do-es.ghtml Public Health England chemical compendium - hydrogen sulphide: https://www.gov.uk/government/publications/hydrogen-sulphide-properties-incident-management-and-toxicology
Pictures	 Portocel port, Brazil. Source: https://g1.globo.com/es/espirito-santo/noticia/2018/07/25/gas-toxico-e-investigado-como-causa-de-mortes-em-porto-do-es.ghtml

06	
PoE	PORT
Location	Ras Lanuf terminal Libya
Date	18/6/2018
Chemical(s)	Oil
Type of the incident	Fire
Health effects	Unknown
Incident description	AN ARMED assault caused catastrophic damage to two oil storage tanks at the Ras Lanuf terminal in Libya. The National Oil Company (NOC) said two of the five tanks are ablaze, reducing storage capacity at the site from 950,000 bbl to 550,000. It warned there is a risk that oil will leak form one of the ruined tanks and spread the blaze to the three that remain. NOC said a militia led by Ibrahim Jadhran was responsible for the destruction. One employee was shot during the incursion, and the company has wished him a speedy recovery. While a number of other employees were robbed by armed mercenaries fighting alongside the militia, all employees have been evacuated to safety. "NOC calls again for the immediate withdrawal of Ibrahim Jhadran and his gangs from the port, cessation of military operations and the provision of support and assistance to fire-fighting teams trying to reach the tanks still ablaze. This incident will result in the loss of hundreds of millions of dollars in construction costs, and billions in lost sales opportunities. Rebuilding the tanks may take years, especially in current security circumstances."
Reference and sources	https://www.thechemicalengineer.com/news/militia-causes-catastrophic-damage-at-libyan-oil-port/ Toxicological review of the products of combustion, J.C. Wakefield, Public Health England: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/458052/HPA-CHaPD-004_for_website.pdf
Pictures	 Oil fire at Ras Lanuf. Source: https://www.thechemicalengineer.com/news/militia-causes-catastrophic-damage-at-libyan-oil-port/

Case studies at airports

07	
PoE	AIRPORT
Location	London City airport, UK
Date	21st October 2016
Chemical(s)	CS gas (tear gas)
Type of the incident	
Health effects	28 injured (2 hospitalised)
Incident description	Dozens of passengers treated for breathing difficulties after chemical alert, leading to temporary airport closure and flight delays. Police investigating the suspected chemical incident which led to the evacuation of London City airport have discovered what is “believed to be a CS gas spray”, a spokesman said. The find came after police and firefighters scoured the airport following the alert, which saw dozens of passengers treated for breathing difficulties. The Met police said it was investigating whether the CS gas had been “discarded by a passenger prior to check-in”. Two casualties were taken to hospital and 25 were treated at the scene, London ambulance service said. A spokesman for London fire brigade said it was called to the airport at 4.11pm to “reports of a chemical incident”. A “full evacuation of the airport terminal” saw around 500 members of the public and airport staff forced to leave. The airport, which reopened after being declared safe at around 7pm, was said to have closed after an alarm was activated.
Reference and sources	https://www.theguardian.com/uk-news/2016/oct/21/london-city-airport-evacuated-after-fire-alarm https://www.telegraph.co.uk/news/2016/10/21/london-city-airport-evacuated-after-chemical-incident/ Public health England chemical compendium, CS gas: general information and incident management: https://www.gov.uk/government/publications/cs-gas-incident-management
Pictures	 London City Airport, UK. Source: https://www.theguardian.com/uk-news/2016/oct/21/london-city-airport-evacuated-after-fire-alarm

08	
PoE	AIRPORT
Location	Hamburg airport, Germany
Date	12th February 2017
Chemical(s)	Pepper spray (capsaicin)
Type of the incident	Chemical gas leak
Health effects	68 injured (9 hospitalised)
Incident description	Hamburg airport has been evacuated after fire crews were called to reports of at least 68 people suffering from breathing difficulties following a potentially toxic chemical gas leak. A police spokesman confirmed a suspicious gas or toxin - which is believed to have been pepper spray - was found during a security check after staff and passengers complained of irritated eyes and airways. Reports claim a small irritant gas cartridge was found in a trash can in the security area, suggesting a passenger or staff member sprayed the gas then disposed of the tin. The alarm was raised late this morning after several people reported smelling nasty odours and complaining of having breathing problems, severe coughing and burning eyes. Rescue services quickly evacuated the airport between terminals one and two - sending hundreds of passengers and employees to wait in the opposite parking area in sub-zero temperatures to keep the access roads clear.
Reference and sources	https://www.express.co.uk/news/world/766317/Hamburg-airport-germany-evacuated-passengers-breathing-difficulties PubChem - Capsaicin hazard information: https://pubchem.ncbi.nlm.nih.gov/compound/Capsaicin
Pictures	 Hamburg airport, Germany. Source: https://www.express.co.uk/news/world/766317/Hamburg-airport-germany-evacuated-passengers-breathing-difficulties

09	
PoE	AIRPORT
Location	Esenboğa Airport: Ankara, Turkey
Date	11th February 2005
Chemical(s)	Diallyl disulphide
Type of the incident	Chemical leak
Health effects	43 injured
Incident description	On the 11th of February 2005 at 11.40 am, a suspicious-smelling package caused panic at Ankara Esenboğa Airport in Turkey. Five workers and an employee from the Airlines Company who were unloading plane's cargo hold suddenly coughed, vomited and felt burning in their throats after they carried a leaky package. Consequently, the authorities thought that it might contain a chemical weapon (sulphur mustard or cyanide) because of the bad, bitter smell. As such, this situation was notified to the Security Forces. Casualties were transferred to a nearby government hospital and the package was reported to the police department. The airport remained open, but firefighters and security personnel were called in as a precaution before the package was identified. The cargo department and unit workers were quarantined, although the number of affected increased to 43 affected employees, who were also taken to the same hospital, with similar symptoms like nausea, vomiting, eye irritation, itching, rhinorrhoea and throat irritation. The Emergency Room of the hospital was evacuated for the airport casualties and other emergency patients were transferred or evacuated to alternative hospitals nearby. Contaminated samples were analysed and found to contain diallyl disulphide, a component of garlic oil. It was later established that there were several barrels of garlic oil being transported via the airport and that one of them had leaked and contaminated other cargo. The distinct smell and immediate onset of symptoms led to the fear that it may have a been a chemical weapon.
Reference and sources	Kenar, L. et al. - Chemical release at the airport and lessons learned from the medical perspective, J Haz Mat, (2007), 144, p. 396-399
Pictures	 Esenboğa Airport: Ankara, Turkey. Source: http://www.esenbogaairport.com/

10	
PoE	AIRPORT
Location	Melbourne airport
Date	23rd November 2016
Chemical(s)	Hydrofluoric acid
Type of the incident	chemical spill
Health effects	8 injured
Incident description	Eight people have been rushed to hospital after a 'chemical spill' at Melbourne Airport. Paramedics and the Metropolitan Fire Brigade were called to the airport at about 9.30am on 23rd November following a hydrofluoric acid spill, a spokesperson for the brigade said. Seven fire trucks and 25 fire fighters were needed to contain the 'hazmat situation.' In a statement the Melbourne fire brigade said a shipment of cartons containing hydrofluoric acid had been leaking. The eight people affected were workers at the airport. Firefighters have been transferring the leaking containers into hazmat drums and are expected to be on the scene for some time. Ambulance Victoria Regional Health Commander Jon Byrne said: 'Two ambulances, an ambulance bus, an ambulance vehicle with extra protective equipment and a health commander were sent to the airport. 'We have assessed eight people who were nearby. One person who came into contact with the chemical is being taken by ambulance to The Royal Melbourne Hospital in a stable condition. 'Seven others are being taken in an ambulance bus to The Northern Hospital in a stable condition,' Mr Byrne said. Police are also assisting with the matter, which is ongoing. A spokesperson for Melbourne Airport said flights had not been affected by the spill.
Reference and sources	https://www.theguardian.com/australia-news/2016/nov/23/melbourne-airport-workers-hospitalised-after-shipment-leaks-hydrofluoric-acid https://www.dailymail.co.uk/news/article-3962904/Eight-people-rushed-hospital-chemical-spill-Melbourne-Airport.html Public Health England Chemical Compendium, Hydrogen fluoride/Hydrofluoric acid: https://www.gov.uk/government/publications/hydrogen-fluoride-health-effects-incident-management-and-toxicology
Pictures	 Source: https://www.dailymail.co.uk/news/article-3962904/Eight-people-rushed-hospital-chemical-spill-Melbourne-Airport.html

11	
PoE	AIRPORT
Location	Tbilisi International Airport
Date	2nd July 2018
Chemical(s)	Unknown toxic liquid
Type of the incident	
Health effects	8 injured
Incident description	A citizen of the Russian Federation poured a toxic liquid on the territory of the Tbilisi International Airport, as a result of which, eight people sought medical help. "As a result of the operational-search and investigation activities carried out by the counterintelligence department staff, Russian citizen Dmitry B was detained as an accused. Dmitry B found on July 2, 2018 in the Tbilisi International Airport in the departure hall at the cashier's office of one of the airlines, poured liquid containing a substance hazardous to health" the Georgian State Security Service reported. On the record, you can see a 40-year-old man throwing something into the room, then attacking the cashier. The victims were observed symptoms such as vomiting, clouding of consciousness, rashes, irritation of the mucous membranes of the eyes and oral cavity, which indicate poisoning. According to doctors, the condition of all hospitalized is stable, so they were discharged from the clinic.
Reference and sources	http://mignews.com.ua/world/19698077.html https://focus.ua/world/401188/ World Health Organisation - Signs of a chemical release: https://www.who.int/environmental_health_emergencies/deliberate_events/warning_signs_May2017_en.pdf
Pictures	 Tbilisi International Airport. Source: https://focus.ua/world/401188/

12	
PoE	AIRPORT
Location	Chopin Airport, Warsaw, Poland
Date	8/7/2018
Chemical(s)	Unknown
Type of the incident	
Health effects	14 injured
Incident description	Sixteen people were evacuated from the premises of Chopin airport and subsequently, fourteen were hospitalised after an unknown toxic substance leaked at the main cargo terminal located near the Chopin airport in Warsaw, Wojciech Kapczyński from the Warsaw headquarters of the State Fire Service told Poland's IAR news agency. The individuals complained of headache and nausea. Eleven firefighter squads managed to contain the leakage and clear the site, Poland's PAP news agency said. A specialised chemical and ecological rescue group is also on site to identify the substance.
Reference and sources	http://www.thenews.pl/1/9/Artykul/371985,14-hospitalised-after-chemical-leak-near-Warsaw%E2%80%99s-Chopin-airport- https://sputniknews.com/europe/201807081066158622-toxic-substances-warsaw-airport/ World Health Organisation - Signs of a chemical release: https://www.who.int/environmental_health_emergencies/deliberate_events/warning_signs_May2017_en.pdf
Pictures	 Chpon airport, Warsaw, Poland. Source: https://sputniknews.com/europe/201807081066158622-toxic-substances-warsaw-airport/

Case studies at Ground Crossings

13	
PoE	GROUND CROSSINGS
Location	Channel Tunnel, UK/France
Date	11th September, 2008
Chemical(s)	Phenol
Type of the incident	Fire
Health effects	14 injured
Incident description	The Channel Tunnel closed after a fire broke out on a freight train about seven miles from Calais. Thirty-two people on board were led to safety, 14 of whom had suffered minor injuries, including smoke inhalation. The blaze broke out on a lorry on board the shuttle train at about 1400 GMT, about 11km (7 miles) from the French entrance, the operator Eurotunnel said. The fire has been contained but all trains have been suspended and thousands of passengers are stranded. The fire was detected about four-fifths of the way through the 50km-long north tunnel on a freight shuttle travelling from Folkestone to Calais. The French Interior Ministry said the lorry, which is understood to have overturned on the train, was carrying the chemical phenol, a toxic product used by the pharmaceutical industry. The incident resulted in "minor injuries" but no-one was seriously hurt, Eurotunnel officials said.
Reference and sources	http://news.bbc.co.uk/1/hi/world/europe/7610919.stm#map https://www.theguardian.com/uk/2008/sep/11/channel.tunnel.fire Toxicological review of the products of combustion, J.C. Wakefield, Public Health England: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/458052/HPA-CHaPD-004_for_website.pdf Phenol: health effects, incident management and toxicology, Public Health England chemical compendium: https://www.gov.uk/government/publications/phenol-properties-incident-management-and-toxicology
Pictures	 Location of the fire. Source: http://news.bbc.co.uk/1/hi/world/europe/7610919.stm#map

Annex 2: Guidance notes

Guidance Note 01: Physicochemical properties

In the event of a chemical incident, the risks to human health and the environment need to be evaluated; this involves identifying the source of contamination and the pathways by which a chemical can come into contact with people or other potential receptor(s), which is crucial for tailoring an effective response. The precise public health risk and hazard to humans will depend on the toxicity, dose, route, duration of exposure and the potential for toxic degradation products.

Other important considerations include distance from the source of the contamination or incident and understanding how the chemical behaves in the environment, as the physicochemical properties (i.e., the physical and chemical properties) are of key importance in influencing decisions on assessing the risks. A summary of important physicochemical properties is listed below in Table 1. Further information can be found in Wyke *et al.* 2014 (1).

Physicochemical property	Description
Physical form	Whether the chemical is a solid, liquid or gas will influence how it will behave in the environment. Gases will spread out until they are evenly distributed, liquids will flow with gravity and solids are relatively easy to contain. However, care must be taken with fibres, dust or smoke, which can be rapidly dispersed. Temperature and weather conditions may affect the behaviour of a chemical, for example if water temperature decreases, oils may solidify rather than spread across the surface of water or move in dense patches travelling under the influence of waves/tides. Or if air temperature increases, this may vaporise a chemical with a low boiling point, changing the contaminant into a gas.
Persistence	This depends heavily on the environment that the chemical is released into, with factors such as the local microbial population, sunlight exposure, temperature and pH affecting the half-life of a chemical. Chemicals with a low persistence may be left to disperse naturally, whereas highly persistent chemicals are more likely to require removal from the environment.

Vapour Density	This is of particular importance to chemical spills on the water, as the density of the chemical relative to that of seawater will dictate whether the chemical is a 'sinker' or a 'floater', which would change the method of remediation. Density can be temperature dependent, so the behaviour of chemicals may change with the weather. Volatile gases which are also heavier than air can collect in low-lying spaces such as basements, cellars, or in holds of ships and are more likely to lead to exposure to the public in inhabitable areas
Water solubility	The ability of a material (solid, liquid or gas) to dissolve in water. Materials can be insoluble, sparingly soluble or insoluble. Water soluble materials (such as acids) may be more easily dispersed in water and have a greater potential to pollute water environments. Many waters insoluble materials (such as petrol) may be spread by the movement of the sea. Water-based decontamination of surfaces may be more effective if a chemical is water soluble; whereas removal options or active decontamination may be more appropriate for non-water-soluble chemicals. Also of note is that the hydrophobicity of organic compounds is higher in seawater than in freshwater.
Bioavailability/ bioaccumulation	Bioavailability refers to the amount of chemical which can enter local organisms, while bioaccumulation refers to the extent that a chemical can build-up and remain in an organism over time. Bioaccumulation depends on the water solubility of the chemicals, as highly soluble chemicals will be rapidly excreted from animals while chemicals with low water solubility (lipophilic) are harder to excrete and remain inside animals for longer. This can have impacts on the food chain as chemicals which bioaccumulate can persist in e.g., plankton, which are eaten by small fish and in turn eaten by larger fish. This has the effect of concentrating the chemical up the food chain (biomagnification).
Vapour pressure	This is how readily a chemical will evaporate and volatilise in the environment. This is particularly important when dealing with chemicals that will float on seawater, as highly volatile chemicals will be rapidly evaporated and dispersed whereas those of low volatility may be more likely to persist on the water surface, increasing the chances of exposure.

Toxicity	One of the most important properties when evaluating public health risk toxicity is the degree to which a substance can damage a living organism. Toxicity needs to be assessed based on the site and specifics of the chemical incident, as incidents e.g., at sea, involving mildly toxic chemicals may not require any intervention. However, if the same chemical was released in an enclosed space (e.g. on board a vessel), the response would be quite different. Another factor to take into account is the potential for breakdown products from a chemical, which may be more or less toxic than the original chemical released. This process may occur naturally or as a result of remediation and can drastically change the response required e.g. a rapid response to a release of a fairly non-toxic chemical may be demanded, if the by-products are highly toxic.

Table 1. A summary of important physicochemical properties of chemicals relevant to a release (1).

References

1. Wyke S., Peña-Fernández A., Brooke N. and Duarte-Davidson R. The importance of evaluating the physicochemical and toxicological properties of a contaminant for remediating environments affected by chemical incidents. *Environment International,* 2014, Nov;72:109-18. Available from: http://www.sciencedirect.com/science/article/pii/S0160412014001445

Guidance Note 02: Identifying a chemical incident (on-site)

A chemical release may not always be immediately apparent given the fact that many agents are odourless and colourless, and some cause no immediately noticeable effects or symptoms (1). However, chemical incident has the potential to cause injuries or death extremely quickly and as such require a timely response. The initial response to a chemical incident is to save as many lives as possible. First responders must be aware of their role and responsibilities, what they can do to save lives safely, and the most effective time in which the actions need to be achieved. The initial response starts from the first call to the emergency service, or a self-presenter at a health facility (hospital). The role of the first responder in identifying a potential CBRN incident and giving the correct advice, as well as dispatching the right resources are critical (this would include the call handler). (2)

Visual indicators of a chemical incident (1)

- Dead or distressed people.
- Multiple individuals with unexplained signs of skin, eye or airway irritation, nausea, vomiting, twitching, sweating, pinpoint pupils, runny nose, disorientation, breathing difficulties and convulsions.
- The presence of hazardous material, unusual material or equipment or hazardous chemical symbols.
- Unexplained vapour or mist cloud; oily droplets or films on surfaces or water.
- Withered plants and vegetation.
- Unusual number of dead or dying animals in the area.
- Low-lying clouds or fog unrelated to weather.
- Unusual or unauthorized spraying in the area.
- Unexplained odours (e.g. garlic, bitter almonds, peach kernels, newly mown hay or grass, horseradish).
- Activated emergency warning systems.
- Explosion with little or no structural damage.

Information for those on scene (2)

- Is protective equipment or other specific resources required?
- What information do you have on the chemical incident?
- Establish communication with other emergency services and relevant experts
- Assess the risks posed to responders and members of the public
- Is there any information available on the scene e.g., identity of the chemical?

The types of information required to inform an initial risk assessment include:

- Are visual indicators of chemical release present?
- Casualty numbers (walking/not walking).
- Severity and type of symptoms.
- Weather conditions.
- Hazards present or suspected.
- Location of the incident.
- Environment (building, open space, underground).
- Presence of perpetrators.
- Rapid agent detection and identification.
- Cordons to control entry and exit for the affected area.

References

1. WHO – Warning signs of a chemical release https://www.who.int/environmental_health_emergencies/deliberate_events/warning_signs_May2017_en.pdf?ua=1
2. JESIP Joint Doctrine - https://www.jesip.org.uk/uploads/media/pdf/Joint%20Doctrine/JESIP_Joint_Doctrine_Guide_OCT21.pdf

Guidance Note 03: Event-Based Surveillance (EBS) of chemical incidents

The number of chemicals in our society and in our daily lives continues to increase. Accompanying this is an increasing risk of human exposure to and injury from hazardous substances. Performing regular, structured surveillance of chemical incidents allows a greater awareness of the types of chemical hazards causing injury and the frequency of their occurrence, as well as providing a better understanding of exposures. Surveillance is a key activity required under the International Health Regulations core capacities (IHR, 2005). As outlined in the IHR (2005), 'surveillance' refers to the systematic ongoing collection, collation and analysis of data for public health purposes and the timely dissemination of public health information for assessment and public health response as necessary (1).

Event-based surveillance (EBS) is a functional component of the early warning and response process and encompasses the organised collection, monitoring, assessment and interpretation of mainly unstructured information (from formal and informal sources, e.g., official news websites and social media) regarding chemical incidents or hazards, which may represent an acute risk to human health (2). EBS can be used to heighten situational awareness for current chemical incidents occurring globally (i.e., types of agents involved and the level of morbidity/mortality they cause). The method provides a rapid and simple means of detecting and identifying chemical incidents, it can be set up rapidly and with minimal cost, the outputs of which can be used to identify emerging risks and inform preparedness planning, response and training for chemical incidents (e.g., case studies and exercise scenarios).

For example, a set list of websites (see Table 1) is checked regularly to detect relevant chemical incidents. Incidents which have a public health impact (two or more members of the public injured) can be logged in a spreadsheet or database, which can then be forwarded to those with an interest in chemical incidents e.g., port health officials, public health authority. The incidents can serve as lessons learned to improve preparedness and response to chemical incidents at Points of Entry.

Website	Link	Brief description
BBC News	https://www.bbc.co.uk/news	Search terms include: 'chemical', 'toxic', 'poison' and 'explosion'

MediSYS	https://medisys.newsbrief.eu/medisys/category edition/symptoms/en/chemical.html	Also check the following pages: 'chemical accident', chemical threat' and 'toxic'
ProMedMail	https://promedmail.org/	Search terms include: 'chemical', 'toxic' and 'poison'
RSOE EDIS	http://hisz.rsoe.hu/alertmap/index2.php?area=eu	Check map for all markers of HAZMAT, explosion, fires and CBRN incidents
HealthMap	https://www.healthmap.org/en/	Search using terms: 'poisoning' and 'environmental'
GPHIN	https://gphin.canada.ca/ *requires registration for access*	Search globally for events: within 48 hours; involving 'Environmental', 'Chemical', 'Product' and 'substance abuse' categories
InformationAware	http://www.informationaware.com/special-project/search	Search for events involving: 'Chemical spill', 'Factory explosion' and 'Industrial explosion'
Twitter	https://twitter.com/search-advanced?lang=en-gb	Search terms: 'chemical', 'toxic' and 'poison'
Google News	https://www.google.co.uk	Perform google search for 'chemical', 'toxic' and 'poison', then select 'News' tab.
Google Alerts	https://www.google.co.uk/alerts	Create automated email updates using the search terms: 'chemical', 'toxic' and 'poison'

Table 1. List of websites used for chemical incident EBS (2).

While there are many benefits of using this method, there are also some drawbacks. EBS is referred to as a 'quick and dirty' method, i.e., while EBS rapidly picks up potential chemical incidents, it relies on using news websites and accuracy is sometimes questionable. It is often very difficult to follow up on the identified incidents, sometimes the final numbers of casualties cannot be found or sometimes the chemical agent causing the incident is not known. Nonetheless, through this method, the majority of the case studies presented in the Healthy Gateways Guidance document were detected.

References

1. WHO (2016) - International Health Regulations, 2005, available from: http://apps.who.int/iris/bitstream/10665/246107/1/9789241580496-eng.pdf?ua=1
2. Global Event-Based Surveillance of Chemical Incidents. T Gaulton, C Hague, D Cole, E Thomas and R Duarte-Davidson. J Exp Sci and Env Epi. 2021. Nov 8:1-7. doi: 10.1038/s41370-021-00384-8.

Guidance Note 04: Alerting and notification of chemical incidents

Chemical incidents of international concern

Chemical incidents can impact on society in a number of ways; these effects can be further confounded if the event involves more than one country. The European Parliament and the Council of the European Union adopted a Decision on serious cross border threats to health, which came into force on the 6 November 2013 (1). The Decision sets provisions on notification, ad-hoc monitoring and coordination of public health measures following serious cross border threats to health from biological, chemical and environmental hazards (although not radiation) as well as events that have an unknown origin. It applies to all European Union Member States.

In accordance with the Decision, EU Member States (MSs) are required to:

- Designate a competent public health authority at the national level responsible for alert notification and determining risk management measures.
- Have a contact point at National Level to generate an alert, post a notification in the Early Warning Response System (EWRS) and receive notifications from other Member States.
- Ensure consistency of approaches and measures taken to alert are communicated to the Commission and other Member States as well as consistency in communicating the risks.
- Consulting with other MSs with a view of coordinating their efforts on preparedness and response planning within Health Security Committee (HSC).
- Report to the Commission on their national preparedness and response planning.
- Make information available from national monitoring systems related to chemicals and environmental hazards events following a cross border event by formalising links with regulatory agencies, monitoring networks and governmental departments to gather information at national level for environmental events.

Incident plans within Member States should be consulted to determine the preparedness, resilience and response arrangements, including the risk assessment, of chemical events of public health significance. Timely notification and alerting of member State Authorities is an important facet of response coordination. Two IT platforms are able to support the risk assessment and risk management of cross border chemical public health threats.

The EU Commission has established a mechanism to ensure the rapid exchange of information in instances where it is assessed that there may be a wider health impact to neighbouring countries as defined by Decision 1082/2013/EU (1) and the International Health Regulations (2). A risk management platform (Early Warning and Response System, EWRS) is used to communicate alerts for all public health hazards (excluding radiation), which meet specific threshold which indicates that they present a serious cross border threat to health, as defined by the Decision (1). These reports are made by the designate competent public health authority at the national level responsible for alert notification and determining risk management measures. The system also serves to link other sectors in the Commission (e.g., Food and Feed), as well as other union agencies and international bodies (e.g., World Health Organization) via co-notification features. Other relevant European alert systems such as, Rapid Alert System for Food and Feed (RASFF), Rapid Alert System for Consumer Products (besides food, pharmaceutical and medical products, RAPEX are linked to avoid duplication and overlap of activities in Member States.

Following an alert made via the EWRS platform, the EU Health Security Committee (HSC) or EC may request an independent rapid risk assessment. The EC Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) can provide a rapid public health assessment of chemical hazards, where the incident falls, either wholly or partially, outside the mandate of other authorities (e.g., European Food Standards Agency, etc).

Resources that can be developed to support Member States

- Hazard Statement – short half page document to be produced in 1-2 hours on key aspects of hazard or threat to consider.
- Case Definition – short half page document to be produced in 1-2 hours providing a summary of key features of injuries related to the threat that may help MSs identify those affected.
- Chemical Emergency Risk Management Monograph (CERM) – longer document that help inform the hazard statement, case definition and RRA. Aimed at all levels of responder from crisis manager to emergency physician.
- Rapid Risk Assessment (RRA) – rapid assessment of emerging threat using data derived from Hazard Statement, Case Definition, CERMs and expert opinion.
- Further information on RASCHEM/ECHMENET can be found at: http://ec.europa.eu/chafea/documents/health/leaflet/echemnet-leaflet.pdf

References

1. European Commission (2013) - Decision No 1082/2013/EU on serious cross-border threats to health, available from:
http://ec.europa.eu/health/preparedness_response/docs/decision_serious_crossborder_threats_22102013_en.pdf
2. WHO (2016) - International Health Regulations, 2005, available from:
http://apps.who.int/iris/bitstream/10665/246107/1/9789241580496-eng.pdf?ua=1

Guidance Note 05: Recovery from a chemical incident

Recovery is defined as the process of rebuilding, restoring and rehabilitating the community following an emergency. There are no exact boundaries between the emergency response to an incident and the recovery and remediation phase, as the latter usually lasts as long as the effects of the incident can be expected to persist and continues until the area is returned to normal living. It is vital therefore that decisions and actions taken during the acute or emergency response phase considers an early return to normal living and facilitate recovery, remediation and rehabilitating the community following an emergency to return to normal.

Remediation, recovery or decontamination of the environment is the process of removing, neutralising or limiting exposure to a hazardous substance from: structures, articles and equipment; the environment and people following exposure to that substance. Understanding the issues associated with recovery of inhabited areas (urban or rural areas and different surface types), food production systems and water environments (public or private drinking water supply, recreational waters) has underpinned a series of Recovery Handbooks developed by the UK Health Security agency (UKHSA) for Chemical, Biological and Radiation (CBR) Incidents.

The Recovery Handbooks have evaluated the evidence base for recovery options that should be considered following a CBR incident or accident, reviewing and examining historical and recent CBR incidents that have required remediation in order to gain a better understanding of:

- What procedures and protocols (recovery options) are used for decontamination, remediation and recovery?
- Problems or constraints associated with the implemented recovery options.

Including:

- public health/ health protection (including psychological effects)
- technical (i.e., specialist equipment)
- waste
- social (i.e., disruption)

- cost

Recovery Handbooks

The Chemical, Radiation and Biological recovery handbooks are aimed at national and local authorities, central government departments and agencies, environmental and health protection experts, emergency services, industry and others who may be involved in developing a recovery strategy following a CBR incident. The handbooks focus on environmental decontamination and provide guidance and checklists on how to manage the recovery associated aspects of CBR incidents.

The Recovery Handbooks are all similar (to aid user operability) and contain scientific and technical information on different procedures and protocols (recovery options) for decontamination, remediation and recovery. The Handbooks are based on an extensive evaluation of the evidence base for all recommended recovery options and an analysis of the factors influencing recovery. The Handbooks also contain a compendia of comprehensive recovery option sheets; guidance on planning in advance of an incident; decision-aiding frameworks for each environment, decision trees; look-up tables and several worked examples. Sources of CBR release considered in the Recovery Handbooks include industrial accidents and can be applied to deliberate release. The Handbooks can be used as preparatory tools, under non-crisis conditions to engage stakeholders and to develop local and regional plans. It is recommended that the Recovery Handbooks are used as part of the decision-making process in developing a recovery strategy following an incident. In addition, the Handbooks may be useful for training purposes and during emergency exercises. Steps to consider when developing a recovery strategy (using the Recovery Handbooks) include:

Table 1: Steps for developing a recovery strategy	
1	Obtain information relevant to the incident, identify environment/area contaminated and properties of the contaminant
2	Identify potentially applicable recovery options for the contaminated environment/areas/ surface type. Some options can be eliminated at this stage based on common sense (i.e. snow and ice removal is a recovery option that wouldn't necessarily be applicable during summertime)
3	Consider applicability of options for the contaminant in the affected environment/ surface type. Some recovery options may be eliminated at this stage if they are applicable for persistent contaminants (years) and the agent involved in the incident has a short persistence (days).
4	Consider key considerations and constraints. Some recovery options may be eliminated during this step if the constraints outweigh the benefits of implementing the option.
5	Consider effectiveness of options. Some recovery options may be eliminated during this step if there is limited efficacy for the agent involved.
6	Consider detailed information on remaining options, including information on waste produced. Some recovery options may be eliminated at this step as the generation of waste is an important factor to consider. The potential volume of waste produced by implementing a recovery option needs to be carefully considered as disposal and treatment of the contaminated waste would also incur costs. Volumes of waste produced by implementing a recovery option would need to be considered carefully as disposal and treatment of contaminated waste will also incur costs.
7	Consider all information in the recovery options datasheet and determine if the recovery option is still applicable (on a site and incident specific basis)
8	Select and combine options to develop recovery strategy
Steps 4-6 are combined in the decision-aiding framework for the Chemical and Biological recovery handbooks.	

Interactive support tools for Recovery

To complement the Recovery Handbooks, interactive support tools (for chemical and radiation incidents) have been developed to help with the decision-making process for developing a recovery strategy. Guidance and templates for recording and reporting decisions on recovery are also available. These resources are intended to assist the recovery working group in their evaluation of recovery options (remediation techniques) that are likely to be the most appropriate, applicable and effective on a site- and incident-specific basis:

- chemical recovery navigation tool
- chemical recovery record form
- e-learning module: principles of recovery and remediation
- guidance on recovery after a chemical, biological or radiation (CBRN) incident, including HazMat

References

The UK Recovery Handbook for Chemical Incidents (https://www.gov.uk/government/publications/uk-recovery-handbook-for-chemical-incidents-and-associated-publications)

Annex 3: Useful resources

Chemicals	
CBRN incidents: clinical management and health protection (UK government Guidance)	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/712888/Chemical_biological_radiological_and_nuclear_incidents_clinical_management_and_health_protection.pdf
CDC NIOSH pocket guide to chemical hazards	https://www.cdc.gov/niosh/npg/
Compendium of chemical hazards: composed of i) general information on chemicals ii) a toxicological overview iii) Incident management	https://www.gov.uk/government/collections/chemical-hazards-compendium
ECHA - chemical classification database	https://echa.europa.eu/web/guest/information-on-chemicals/cl-inventory-database
EMARS – Major Accident Reporting System (Database of investigations of chemical incidents).	https://emars.jrc.ec.europa.eu/en/emars/content
International Health Regulations (IHR, 2005), Third Edition.	https://www.who.int/publications/i/item/9789241580496
IHR and Chemical Events	https://www.who.int/publications/i/item/9789241509589
Rapid Risk Assessment of Acute Public Health Events (2012)	https://www.who.int/publications/i/item/rapid-risk-assessment-of-acute-public-health-events
WHO International Programme on Chemical Safety (IPCS) - INCHEM inventory	http://www.inchem.org/
WHO – Joint External Evaluation Tool	https://apps.who.int/iris/bitstream/handle/10665/259961/9789241550222-eng.pdf

WHO Human Health Risk Assessment Toolkit: Chemical Hazards (2010).	https://apps.who.int/iris/handle/10665/44458
WHO Manual for the Public Health Management of Chemical Incidents	http://apps.who.int/iris/bitstream/10665/44127/1/9789241598149_eng.pdf
UK Recovery Handbook for chemical incidents.	https://www.gov.uk/government/collections/recovery-remediation-and-environmental-decontamination
PoE	
International health regulations (2005): a guide for public health emergency contingency planning at designated points of entry	https://www.who.int/publications/i/item/international-health-regulations-(-2005)-a-guide-for-public-health-emergency-contingency-planning-at-designated-points-of-entry
ACI Emergency Preparedness and Contingency Planning Handbook	https://applications.icao.int/tools/RSP_ikit/story_content/external_files/Emergency_Preparedness_Handbook_First_Edition2014_FinalLR_NoPswd.pdf
ADR - Agreement concerning the International Carriage of Dangerous Goods by Road	https://unece.org/transportdangerous-goods/adr-2021-files
Coordinated public health surveillance between points of entry and national health surveillance systems: advising principles	https://apps.who.int/iris/handle/10665/144805
UN Recommendations on the Transport of Dangerous Goods - Model Regulations	https://unece.org/rev-21-2019
WHO (2002) - Environmental health in emergencies and disasters	https://apps.who.int/iris/handle/10665/42561
IATA/DGR (International Air Transport Association, Dangerous Goods Regulations	www.iata.org/en/publications/dgr
RID (International Rule for Transport of Dangerous Substances by Railway);	https://otif.org/fileadmin/new/3-Reference-Text/3B-RID/RID_2021_e_01_July_2021.pdf

ADN (European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways)	https://unece.org/transport/documents/2021/01/european-agreement-concerning-international-carriage-dangerous-goods
SOLAS/IMDG (International Convention for the Safety of Life at Sea / International Maritime Dangerous Goods Code)	https://www.imo.org/en/KnowledgeCentre/ConferencesMeetings/Pages/SOLAS.aspx