Chapter 9

Chemical emergencies

Purpose of assessment

The purpose of a rapid health assessment in a chemical emergency is to:

- confirm the existence of a chemical emergency,
- identify the characteristics of the chemicals involved as well as the source of release and estimate its type, size, location, and distribution;
- determine the population at risk and the impact on health; and
- assess local health response capacity.

Background

Most chemical accidents occur within the workplace, and may have no direct, large-scale or long-term effects. On such a limited scale, a rapid assessment is a relatively simple undertaking.

However, when a large number of people and a wider area are exposed to a chemical hazard, the assessment becomes a major exercise.

Most accidents occur at the interfaces between transport, storage, processing, use and disposal. This is where there are the fewest controls and the greatest probability of poor practices.

The risks of accidental chemical releases are greater with the number of new hazardous substances produced. First, production, storage, transport, and use of flammable, explosive or toxic chemicals have grown significantly in both developing and developed countries. Second, greater and more centralized productions have increased the quantities of chemicals manufactured and the distances they are transported. Third, population growth close to chemical plants and along transportation routes has meant that there are larger communities in greater number at high risk following a chemical accident.

The health impact of a chemical exposure is determined by the chemical itself, the exposure routes, and the amount of exposure. Exposure pathways vary, depending on the stage of the release. During the release, health effects from dermal exposure and inhalation can be expected. In the post-impact phase, the greater risks are dermal exposure, through contact with contaminated objects, and ingestion of contaminated food or water.

In many countries the ministry of health may not be responsible for managing chemical emergencies. However, the considerable health impact of a major chemical emergency calls for the active involvement of the health sector in the

emergency preparedness process and in the assessment. The health sector should work closely with government agencies responsible for fire and rescue, paramedical services, security, environment, transport and dangerous goods.

Chemical incidents can cause an emergency:

— by acute release (e.g. exposure to corrosive effects of ammonia and gas used as refrigerant); and
— by chronic release (e.g. pyrrolizidine alkaloids found in plants that contaminate staple food crops and produce liver disease).

Also food contamination with chemicals or toxins can produce acute or slow onset emergencies that, either way, have long-term effects.

This protocol will focus on assessing an acute chemical release which requires an immediate response.

As discussed in Chapter 1, a chemical emergency should be first assessed within 24 hours following the incident at the latest. A more comprehensive assessment should be carried out later. Box 4 contains a sample checklist for rapid health assessment in chemical emergencies.

Conducting the assessment

The rapid assessment consists of:

— confirming the existence of a chemical emergency;
— determining the source, site, type, size and distribution of the release;
— identifying the specific types of chemicals and their reaction by-products;
— determining the population at risk and the health impact; and
— assessing existing health response capacity.

Confirming the existence of a chemical emergency

The first alert or rumour that a chemical emergency is occurring may originate from a wide range of sources. A quick visit to the site by a person with knowledge of handling dangerous goods or chemical expertise, taking suitable precautions, is important to verify this information.

The health personnel conducting the assessment should investigate the following questions:

- Has some incident happened involving chemical substances?
- Has some incident happened in or around a chemical installation?
- Has the community noted or have health facilities registered an increase in:
  — irritation of the eyes, the skin, the mucous membranes?
  — coughs, asthma, respiratory distress?
  — neurological illness?

Clinical examination of a sample of cases will help confirm the emergency.

Determining the source, site, type, size, and distribution of the release

This information is essential for defining the populations at risk, the potential range of exposures resulting from the accident, and the measures to be taken.

The exact site and type of incident should be determined, especially since a chemical emergency may involve one or more types of release. Other key characteristics include the size of the release (estimated weight or volume of the chemicals dispersed) and its distribution pattern (which is affected by weather conditions).

Identifying the types of chemicals and their reaction by-products

It is necessary to identify the chemicals involved in order to.

- anticipate their likely harmful effects,
- develop working case definitions of exposed and injured individuals and set criteria for triage;
- determine medical treatment for the injured and need for specific medication, decontamination, and follow-up regimens for those exposed;
- provide protective equipment for rescue personnel, and
- initiate control measures for environmental clean-up.

The identity, quantity, and ambient air concentrations of the chemical(s) can be determined through.

- product labels (product name, UN Hazard Classification and UN Substance Identification number);
- contacting companies in charge of the manufacture, storage, transport, use or disposal of the chemicals;
- contacting chemical information centres; and
- environmental sampling.

The collection of samples from the environment (air, water, food, soil, foliage) is important, since many unknown by-products may be produced in fires and explosions

Determining the population at risk and the health impact

Determine the population at risk. Gather information on the proximity and size of residential neighbourhoods, the location and numbers of high-risk populations (e.g. individuals with chronic illnesses, pregnant women, and infants).

Evaluate toxicological risks and human exposure pathways Environmental exposure and body burden assessments are usually not feasible during the acute phase of the accident. These require complex sampling and labour-intensive analytical procedures.

Describe morbidity and mortality For this to be done systematically, it is essential that a working case definition is developed, and consistently applied During the actual emergency, it is not feasible to conduct a survey However, it

is important to collect information on whether there has been increased morbidity or mortality caused by the release

Analysing the information

Time: When did the cases occur? Is their number increasing?

- Plot the daily number of cases on a graph
- If the chemical accident has affected a wide area, plot a separate graph for each affected community.
- Survey known exposed groups.

Place: Where have cases occurred? Are new cases being reported from other areas? Are there accessible, equipped, and safe health facilities in the affected areas?

- Map the cases geographically.
- Use maps that have health facilities identified

Person: Which groups are at greatest risk?

- Examine data on age, sex, occupation, and residence to identify highest risk groups.
- Estimate the numbers of hospital admissions and outpatient attendances for affected areas and specific facilities.

Drawing initial conclusions

- Has a chemical release occurred?
- Has the causative chemical(s) been identified?
- What are the main risks for human health?
- How many cases or deaths so far?
- What is the geographical distribution of the cases?
- What is the size of the population at risk?
- Do the effects of the accident appear to be spreading?

Assessing local response capacity

The response capacity of health services should be assessed with particular attention to determine the following.

— availability of first-line and backup emergency medical services (including health personnel and facilities);
— availability of protective equipment;
— use of clear diagnostic criteria, standard treatment regimens, and compliance with them;
— availability of specific medication (e.g. antidotes);
— availability of facilities for decontaminating exposed individuals (including health workers), and
— vulnerability of the health facilities to the chemical

Presenting results

In presenting the results of your assessment, indicate the following information

- Define, quantify, and map the populations at risk or already affected by the release or both

- Determine the likely health effects of the chemical release.
- Estimate the number of cases and deaths, and expected hospital admissions and outpatient attendances for the affected areas and specific facilities
- Estimate needs for outside assistance, based on preliminary findings (e g. qualified technical personnel, drugs, logistics, and communications support).

Give recommendations on

— appropriate triage and case management,
— environmental control strategies to prevent further spread of chemical contaminants;
— the need for population evacuation and how to proceed: means of information and communication with community and relevant organizations, destination of evacuees, means of transport, and routes of evacuation;
— appropriate care for those evacuated to temporary shelters; and
— collection, identification, and management of dead victims.

Box 4. **Sample checklist for rapid health assessment in chemical emergencies**

The following checklist will be of value in assessing and reporting on chemical emergencies

1. General information
1.1 date and time of the release
1.2 chemical released
1.3 location of the release
— country
— region
— community
1.4 population centres closest to the release
1.5 time of the assessment

2. Morbidity and mortality
2 1 number of casualties
— mildly affected
— seriously affected
2.2 number of deaths

3. Site of the release
3.1 source
3.2 location of source and address
3.3 Are similar episodes being reported elsewhere?

4. Type(s) of release (describe)
4.1 atmospheric dispersion
4.2 explosion
4.3 fire
4.4 spill
4.5 other

5. Size of release
5.1 quantity of chemicals in the plant or storage site
— weight (kilograms or tonnes)
— volume (m^3 or litres)
5.2 amount of the leakage from a pipeline or a chemical tank (litres, tonnes or flow rate)

6. Distribution of release
6.1 meteorological conditions
— temperature
— wind direction
— wind speed (metres per second)
— rainfall
— sunshine or cloud
— weather stability
6.2 geographical characteristics
— valleys
— mountains

Box 4. **Continued**

— lakes, other waters

6.3 define risk zone
- — size (square kilometres)
- — area where personal protection is needed
- — type of protective clothes needed
- — type of respiratory protection

7. Define the populations at risk

7.1 number of individuals close to the release

7.2 number of individual houses close to the release

7.3 Are any of the following close to the release?
- — schools
- — day-care centres
- — hospitals
- — shopping centres
- — public buildings
- — other vulnerable sites

7.4 Is evacuation needed? If so, where?

8. Identification of the chemicals and their by-products

8.1 observations related to the release
- — colour
- — odour
- — signs and symptoms of exposed humans
- — signs of exposed animals and plants
- — other observations

8.2 information on the chemicals released
- — correct technical name
- — trade name(s) of the chemical(s)
- — generic name(s)
- — synonyms
- — UN number, Chemical Abstracts Service Registry number (CAS number)
- — placards (on vehicle)
- — UN hazard classification
- — names of the by-products
- — information source (individuals' names, chemical centres or written documents, data sheets)

8.3 environmental samples collected
- — what samples were collected
- — qualitative results of chemical analysis (chemicals identified)
- — quantitative results (concentration of chemicals in the environment)

9. Toxicological evaluation

9.1 safety information on the chemicals released

9.2 available information on the chemicals in databases and emergency response plan

9.3 physical and chemical properties of the chemicals
- — molecular formula (to be completed later)
- — molecular weight
- — conversion factor (mg/m^3 = *x* parts per million)
- — density
- — vapour pressure
- — boiling point
- — flammability point
- — critical temperature
- — explosiveness
- — solubility in water and other liquids

9.4 likely toxic effects of released chemicals
- — irritation
- — suffocation
- — chemical burns
- — dermal effects
- — effects on eyes
- — acute systemic effects
- — chronic effects
- — most critical health effects
- — significant concentrations in air may cause death, serious

Box 4. **Continued**

symptoms, mild symptoms, or no symptoms
9.5 likely exposure route
— inhalation
— dermal absorption
— ingestion (contaminated water, food)
9.6 sources of further information
— data sheets
— text books
— databases
9.7 possibilities for body burden measurement
— blood samples
— urine samples
— other samples
9.8 list of laboratories where analyses can be carried out
— names of laboratories, addresses, and phone numbers
— backup laboratories

10. Appropriate treatment regimens

10.1 describe (list) symptoms
10.2 describe standardized treatment
— maintenance of vital functions
— decontamination and enhancement of elimination
— general symptomatic treatment
— specific antidotes and their dose
— other specific poisoning treatment
10.3 psychological support (management of stress reaction)
10.4 registry of casualties

11. Emergency medical care and health service needs and capabilities

11.1 identify places where treatment can be given
— hospitals
— health centres
— field hospitals and temporary health centres
— public buildings (schools)
11.2 identify available human resources for therapy and first aid
— doctors
— nurses
— other health personnel
— volunteers
11.3 transport capabilities
— ambulances and other cars
— air transport capabilities
— transport routes available (map)

12. Environmental health assessment

12.1 water supply
— analysis of water safety for chemicals
— analysis of substitute water for chemicals and bacteria
— state of emergency water supply
12.2 food supply
— analysis of food contamination
— availability of safe food
12.3 suitable shelters

13. General response operations

13.1 overall command
13.2 sectors involved (e.g. police and fire brigade)
13.3 public information and communications
— awareness
— reassurance
— instructions
13.4 management of fatalities
— rescue operations for the dead
— morgue
— identification of dead victims
— burials.