Toxic effects

Toxic effects can be acute, subchronic, chronic or a combination of the three, as in the Seveso incident (see Annex) *(14)*. The caustic dermal lesions in children who were directly exposed to the toxic plume were an acute effect. The chloracne that appeared in the following days in children can be described as a subchronic effect, while the incidence of lymphopoietic cancers a decade after the incident, slightly greater than expected, suggests the existence of a chronic effect.

The latent period before the health consequences become apparent depends on the exposure, the toxicity of the released agent, and the nature and history of the disease process. The persistence of environmental contamination creates a risk of delayed exposure and health effects.

Stress-related effects

Stress-related effects may be mental or physical. Mental consequences not only entail immediate signs such as anxiety, anger and depression but may also find expression months or years later. An example of the possible influence of post-incident stress on physical health is the mortality study in Seveso *(21)*. This demonstrated that the population of the most contaminated area, which had suffered the greatest psychosocial impact of the incident, showed noticeably higher cardiovascular mortality than a comparable population from an area with similar social, environmental and cultural features.

The psychological consequences of a traumatic experience, including acute or chronic exposure to toxic or noxious substances, depend to a large degree on the exposed person's perception of the severity or danger of the exposure. Despite reassurance, people may interpret incidents involving minor, or even nonexistent human exposure as life threatening. False perceptions of risk may lead to physiological reactions. Post-traumatic stress syndrome after major disasters is a well recognized entity and might mimic toxic illness.

Combination of toxic and stress-related effects

The stress caused by an incident might interact with toxic effects and increase the probability of symptoms or even disease. In this context, it is important to recognize that psychological effects are

health events and that a combination of toxic and stress-related effects might act synergistically.

Measures of health outcome and strategies for health assessment

Health outcomes can be measured in different ways. In general, the following health consequences should be considered:

- functional and physiological changes
- morbidity, including physical and psychological symptoms
- mortality.

Table 2 gives some examples of measures of functional and physiological changes, as well as of symptoms, related to different organ systems. In a clinical setting, these measures are used to make a specific diagnosis of health outcome. They can also be employed in epidemiological studies following an incident. Those used will depend on the incident type. If the nature of the incident and the chemicals involved are well established, the set of outcomes studied should be determined by their biological plausibility, clinical significance and relevance to possible scientific investigations following the incident. The clinical tests and questionnaires used for the measurement should be based, whenever possible, on previously validated and standardized protocols.

Few of the measures listed in Table 2 can be readily applied to a population soon after an incident without conducting a special study. Less precise but existing indicators of population health status must be used. These are often based on routine data collection systems (Table 3). Further, indirect measures of health status can be used, such as reports of complaints from a population to emergency services, data on school or work absenteeism, or data on sales of specific medicines in pharmacies. In practice, the following strategies have to be applied in succession to assess the health effects of chemical incidents:

1. collection and interpretation of existing health data; and
2. organization and conduct of special studies (if needed).

To quantify a population's health status, the health information must be referred to a population at risk and take account of some basic demographic characteristics, such as sex and age.

Table 2. Examples of health outcomes and measures

Organs or systems	Health outcomes or related diagnostic tests
Cardiovascular system	Blood pressure Electrocardiogram Serum cholesterol and triglycerides Fitness testing Cardiovascular symptom questionnaire
Respiratory system	Spirometry (forced expiratory volume in 1 second, forced vital capacity) Bronchial reactivity testing Chest X-ray Bronchial lavage Immunological test, such as IgE for sensitizers
Liver	Liver function tests Serum markers, such as aminotransferases (aspartate aminotransferase, alanine aminotransferase), alkaline phosphase, gamma-glutamyl transpeptidase, bilirubin Ultrasound Liver biopsy
Kidneys	Urinary enzymes and proteins Plasma urea and creatinine
Central and peripheral nervous systems	Batteries of neurobehavioural tests Visual evoked potentials and reflex studies Electrodiagnostic/nerve conduction studies Magnetic resonance imaging Plasma/erythrocyte cholinesterase
Endocrine system	Thyroxine, 3,5,3-tri-iodothyronine, thyroid-stimulating hormone, luteinizing hormone, follicle-stimulating hormone, etc.
Blood	Full blood count Methaemoglobinaemia
Skin	Patch testing Skin biopsy Inspection/photograph
Reproductive organs	Epidemiological questionnaires Sex ratio Sperm counts/morphology and motility Birth weight Spontaneous abortion Stillbirth Congenital defects Congenital anomalies
Mental functioning	General health questionnaire score

Table 3. Data on disease occurrence in population

Type of data	Contents of the data set
Vital statistics	Mortality data Birth data
Routine morbidity statistics	Hospital admissions/discharge data Data from sentinel general practitioners Abortion register Malformation register Cancer register
Non-routine health data	Data from health studies under way

Use of existing health data

Epidemiologists need to know about the health data available in the region, their accessibility and their potential for use under the particular circumstances. It must be assumed that the existing data systems are not, in principle, designed for use in emergencies and each of the data types has its advantages and limitations. Combining information from several systems may help to improve the general assessment of the health situation and the impact of the incident on it. The following considerations apply to various types of data.

Mortality data

A rapid assessment of death certificates consists of counting the number of deaths recorded daily and comparing it with the expected number of deaths in the population at risk. A later analysis of death certificates indicates whether an increase in mortality has occurred, whether this increase has continued for some time and whether it has been followed by a period of lower mortality. Assessing cause-specific mortality is problematic since health officials aware of the diseases expected in the aftermath of an incident may introduce classification bias.

Hospital admission data

The following questions have to be answered about hospital admission data.

1. Does the hospital system relate to a specific area; in other words is there a defined referral practice to a specific hospital for the population living in the same area?
2. Can hospital admission data be related to population?
3. Do all hospitals into which patients might have been admitted take part in the recording system?
4. Do all hospitals admit emergency cases, or are emergencies only admitted to a few and the patients distributed later?
5. Is it possible to detect an immediate or a slow, delayed increase in admissions?
6. Are diagnostic criteria recorded for the patients admitted?
7. Is it possible to recognize a small increase in specific diagnoses?

As with mortality data, it should be remembered that small increases in hospital admissions might be disregarded immediately after the incident; a later analysis of the workload of emergency services and non-elective hospital admissions should be conducted. In the acute phase, it has to be decided whether it is possible to ascertain the casualties from the routine records of the hospitals or emergency wards, or whether a special database has to be created. Combined with information on the place where exposure occurred, these data can be used to map health effects. Later, hospital emergency data, overall or cause-specific admissions, or data from subgroups such as elderly people can be analysed by date of admission.

Data from outpatient services, private practice and other primary care facilities

Many health care systems do not have patient recording practices that identify the date of contact. It might be necessary to request that primary health care facilities specially record all new cases and all patients they see. A communication system for such emergencies has to be established in the health care system. In addition, pharmacies might notice an unusual demand for certain products.

Data from disease registers

Some countries have population registers for specific diseases and congenital anomalies. The most common disease registers are for cancer. They can be very helpful during the follow-up phase and can help identify any long-term consequences. Malformation

registers can be invaluable in identifying increases in birth defect rates. There is, however, a danger that if a teratogenic effect is feared, indications for therapeutic abortions will be broadened, possibly influencing the observed malformation rates. In most countries, statistics will record an increase in abortions. Birth certificates and the analysis of births 6–10 months after the event might give some estimates about increased abortion rates, altered sex ratios, birth weight distribution, etc. If an appropriate data system does not exist, the possibility of creating population-based registers for specific conditions should be considered by an ad hoc committee, including experts in both registration and in the natural history of the condition proposed for registration. In principle, one should be cautious before diverting resources for this purpose if they could be more profitably used for others. If it is decided that a population-based register for a given condition is needed, adequate training of its staff should precede implementation.

Other available data

An incident can disturb a population's social and occupational activities. In part, this can be due to the somatic or physiological health effects of the incident. Systematically collected data on school or work absenteeism may be used as an indirect indicator of health impact. Other factors besides health reasons, including rescue operations or preventive measures, may influence the normal activities of the population and bias the health assessment made using this indicator.

As to complaints and annoyance, officials should record the numbers of telephone calls of complaint that they receive from the population. These calls can also be used as a qualitative indication of the concerns of the population.

In many countries, health interview surveys are conducted, and provide useful information about the background health status of the population. The results of such surveys may serve as a reference to the observations made after the incident, provided that the methods used were comparable to those routinely employed *(22)*.

Analysis of routinely collected data

Routinely collected data can be analysed in two different ways: by temporal or geographical aggregation. Temporal comparisons

are usually conducted with time–series procedures but, in the case of an incident, the data can also be split into those collected before and after the event for simple analysis.

A cross-sectional (or spatial) analysis of routinely collected data is possible when an incident has a presumably broad geographical impact and the population at risk is large. Splitting the whole study area into different classes of exposure will allow the examination of a dose–response relationship if there are exposure measurements or at least reliable estimates for all geographical units. Data must be available on diagnosis, age, sex and location of residence (by postal code) or place of exposure. Potent confounders in this type of analysis are demographic and socioeconomic differences between areas. While these can produce false positive or false negative results, the lack of individual exposure assessment in aggregated register data relying only on geographical criteria will result in random misclassification; this reduces the strength of association of a real effect. Studies using register data to examine incidents with geographically limited impact and with a small population at risk may present negative or no-effect results for rare events such as deaths from or hospital admissions for specific diseases. This can result from the lack of power due to the small number of cases, and difficulty in distinguishing the increase from random variation in the disease incidence.

Organization and conduct of special studies of health effects

Soon after the incident, a framework should be made, determining which health effects ought to be assessed and how. The data sources mentioned above are not alternatives; they should be examined together to draw a complete picture of the health effects. Any collection of new data requires a study protocol that takes account of the important issues of standardization of methods, adequate population selection, study power and data analysis.

A study of the health effects of an incident should include information on exposure. As described in the previous section, this can be obtained from questionnaires or from the collection of biological samples, which provides markers of exposure additional to the exposure indicators gathered through environmental sampling. Standardization and quality control in biological and physiological measurements have to be guaranteed, as in

any epidemiological study. In addition, appropriate control for all relevant confounders must be ensured.

Screening for prevalent conditions

The attempt to identify everyone in the exposed population who exhibits conditions related to the incident (and to provide such people with medical care, if believed to be needed) corresponds to the conventional definition of screening *(23)*. After an incident, such screening serves political rather than scientific purposes. The absence of any specific hypothesis or clearly defined endpoints will produce new problems: a variety of health disturbances may be detected, with unknown frequency. It is not easy to assess whether an association with the incident exists, and whether any such association is causal; this is difficult to explain to the exposed population and to the political authorities.

Screening focused on specific conditions may be reasonable, if based on a plausible hypothesis. Nevertheless, screening programmes have the same basic principles, potential and limitations after an environmental incident as in any other circumstances. In spite of the chaos that often follows such an event, the basic rules for any screening programme (Box 8) should therefore be kept in mind.

Box 8. Rules for a screening programme

The people involved in any screening programme should:

1. plan procedures for the recruitment of each individual of the population to be screened;
2. periodically estimate the extent of participation and make inquiries to determine the reasons for non-response;
3. be aware of the sensitivity and the specificity of the diagnostic test used;
4. design a protocol for subsequent, more refined, diagnostic procedures (when needed) and the administration of therapy (if required);
5. identify an epidemiologist to be responsible for the programme and ensure coordination with participating clinicians;
6. estimate the expected effectiveness and efficacy of the programme; and
7. make sure that adequate treatment facilities are available for all cases found.

Short- and long-term screening programmes that do not adhere to these principles may do more harm than good. Unnecessary medical examinations or laboratory analyses are a waste of resources and prevent delivery to all the population of procedures that are actually needed.

Once the decision to implement a particular screening programme has been made, it can be used to estimate the prevalence of the condition being investigated. The distinction between screening and prevalence estimation should be borne in mind: screening implies approaching each member of the population while prevalence can be estimated using a sample. If participation in the screening programme is lower than 100%, selection bias may affect estimates of prevalence.

Study designs

The challenge for environmental epidemiology is to link exposure to health data. The section on exposure assessment addressed the possible options and difficulties involved in each part of a study. Health effects can be assessed using routinely collected data (see Table 3) or by conducting special studies. These can be classified according to the general principles of epidemiology into descriptive and analytic studies (see Tables 4 and 5). Descriptive studies use exposure or health data gained from different existing sources and identify differences in health outcomes in discrete exposure groups.

The availability of existing data determines the type of descriptive study to conduct. In contrast, in analytical studies, data collection is determined by the study design selected: the one considered to be optimal for theoretical and practical reasons in a particular post-incident situation. The analytical study is conducted in study groups specially selected for the purpose.

In the planning of a special study on health effects, a central issue is the question of adequate selection of populations to be studied and the requisite health outcome definition. Table 2 provides some examples of target organs and health measures that could be studied. Usually, physiological or functional measurements are combined with questionnaire data. It is important to be aware of existing questionnaires and to be able to adapt them to the situation as quickly as possible. To do so, the epidemiologists involved need to have access to validated questionnaires on symptoms for different organs or systems, when they exist. A

Table 4. Linking health and exposure data through descriptive studies

Health data	Exposure data	Study design	Analysis	Results
Symptoms and signs in the population	Individual, qualitative	Survey/ cross-sectional	Comparison of different exposure groups	Frequency of symptoms (including annoyance/ anxiety) in different exposure groups
Biological measurements	Individual, qualitative and/or quantitative	Cross-sectional (random sample or cluster sample)	Comparison of different exposure groups	Correlation between markers of health effects and markers of exposure
Disease occurrence	Population-wide	Temporal aggregation	Time–series	Change in rates
		Spatial aggregation	Spatial comparisons	Difference between areas exposed and not exposed
Mortality, birth weight, etc.	Population-wide	Temporal aggregation	Time–series	Short-term changes in mortality, birth weight, etc.
		Spatial aggregation	Spatial comparisons	Difference between exposure groups

publication of European Concerted Action "Air Pollution Epidemiology" *(24)* gives an overview of symptom questionnaires for respiratory effects. Less standardization exists in the assessment of neurological symptoms. Other common health symptoms (such as headache, sickness and vomiting) may be measured in population surveys on general health status.

Further, a study of health effects should measure the psychological impact of the incident. As mentioned, anxiety or stress can be considered adverse health effects or as effect modifiers when somatic symptoms are considered.

Table 5. Linking health and exposure data through analytical studies

Study design	Exposure data	Health data	Analysis	Results
Panel	Individual	Biological markers, symptoms, signs, disease occurrence	Correlation between exposure, exposure indicators and observed changes in health indicators	Short-term health effect
Cohort	Group exposure or individual	Mortality, disease incidence, reproductive outcomes	Comparison of rates between different exposure groups	Incidence of long-term effect, relative risk in various exposure groups
Case-control	Individual	Rare disease outcomes (such as cancer, malformation)	Comparison of exposure history between cases and referents	Confirmation of association between specific outcome and exposure

The collection of data on functional, physiological and other objectively detected changes in health requires a special study. Well standardized methods for population studies of lung function or bronchial reactivity exist and have been tested in various epidemiological studies *(25,26)* . The same is true for neurological effects or other systemic effects. In Seveso (see Annex), clearly defined criteria were used to diagnose skin effects *(27)*.

Analytical studies

The usual classification of analytical study designs in environmental epidemiology include panel, cohort and case-control (case-reference) studies *(28)*. In assessing an environmental incident, these study types are not clearly different; a panel study would follow the groups selected from the at-risk and reference populations, and would then be later integrated into a cohort study. A descriptive study can identify cases or exposed groups and provide the basis for an analytical study.

Panel studies are used for the short-term follow-up of a group of people whose health and exposure are closely monitored. The health data may be collected as repeated measurements of health events (a few times a day, daily or weekly) or physiological changes (measured by, for example, self-reported symptoms in a diary or respiratory function tests) and correlated with exposure measurements made at the same time. Each person serves as his or her own control, although a reference panel should be investigated at the same time to adjust for the possible confounding effects of time-dependent factors not related to the exposure (such as weather or reports by the mass media on the incident).

A cohort study is designed for the long-term follow-up of a population selected on the basis of common exposure. The incidence of a particular disease or symptoms of functional impairment is monitored in the population over a long time. The establishment of an exposure register is crucial to setting up a proper cohort study. The control group is often difficult to define. Adequate comparable data on the same population before the event is usually not available. The classification of the study population into groups with different levels of exposure is essential for the analysis. The importance of a good estimate of actual exposure at an individual level cannot be overemphasized. Although some misclassification may be unavoidable, estimates of individual exposure must be sufficiently precise to control and limit biases caused by misclassification.

Case-control (or case-reference) studies, in which cases represent the people with a health condition supposedly related to an incident, are often difficult to perform after chemical incidents. Such a study requires a good case definition (based solely on health status) and this poses a problem if the effects are diffuse and poorly defined. Nevertheless, such studies may be useful for assessing the association of certain health outcomes with the specific characteristics of the incident and the exposure, such as exposure level, time and location or personal activity determining the dose of the chemical. At a later stage, a case-control study can verify the effectiveness of treatment and protective measures, or investigate the factors giving rise to susceptibility. The identification of appropriate control or reference group(s) is crucial to the study's validity. The selection of subjects for the control group must not depend on exposure status. The only factor

known to differentiate the cases and controls should be the presence and absence of the health condition of interest, respectively.

Table 5 summarizes options for the design of analytical studies and the analysis of the data collected. In each study, an effort should be made to obtain quantitative indicators of exposure for the individuals included. If only qualitative indicators can be obtained, the scope of the analysis is reduced; a gradient of the effects between exposure categories can be demonstrated, but quantitative estimates of the exposure–response relationship are impossible.

Selection of study groups

The availability of population data (Box 9) determines the definition of at-risk and control populations. The epidemiologist has to decide whether the health of all members of these populations can be assessed or whether it is more appropriate to study (random) population samples. If the population at risk is small, all members of this group can be evaluated for health and exposure. The examination of all subjects in an exposed community may even be desired by the public and justified on ethical grounds. The expansion of the study group beyond a clearly defined population at risk (through the combination of subjects certainly exposed with people of doubtful exposure status, for example) will dilute the association between the exposure and health outcomes and is not recommended. The control group may consist of a sample taken from the reference population; to ensure sufficient power of the study, the size of this sample may sometimes exceed that of the population at risk.

Selection of study sample

The sample size depends on the incidence of the targeted outcome and its relative increase due to exposure (relative risk). Detecting an increase of a rare disease requires a larger sample size than is necessary for a common condition. Similarly, the study of a weaker factor (causing a smaller change in the health of the affected population) needs a larger sample size. Owing to the inherent variability of disease incidence and prevalence, it is advisable to test the consistency of the observed difference in several subgroups of the whole sample (different areas, age groups, sex, etc.). To determine the sample size, published tables and

Box 9. Sources of demographic information useful for the definition of study population and sample frame

Population register

Advantages

It can provide reliable, up-to-date data on the number and demographic structure of each community, fast and effectively if computerized.

Disadvantages

It is expensive to establish and maintain, and there are concerns related to data confidentiality (especially if they are not kept on computer).

Population census

Advantages

Censuses are conducted every ten years in most European countries. They give relatively precise pictures of the entire population of the country at the specified times. Between the census years, the estimates are adjusted, utilizing data on population movements (births, deaths, migration).

Disadvantages

Permanent changes of place of residence are registered in some countries but not in others. Temporal mobility of the population (seasonal or weekly, for example) is very difficult to register.

Voting lists

Voting lists are created on the basis of address registers and (sometimes) updated according to the place of stay during the period of voting.

Advantage

Voting lists provide a reliable source of information on the part of the population authorized to vote on a community level.

Disadvantage

People below a certain age and, often, those with foreign citizenship are excluded. In some communities, those not authorized to vote may constitute a substantial proportion of the permanent residents.

Box 9 (contd)

Inventory of housing units, or households

Advantages

An inventory provides approximate information on the spatial distribution of the population. The address list may constitute a sampling frame for a population survey following the incident.

Disadvantage

The numerical estimates of the population size are not reliable, owing to the possible variations in household size.

Telephone directories

Advantage

Telephone directories offer advantages similar to those of the household inventories.

Disadvantage

Their use may lead to a biased identification of the target population in communities or countries where the private telephone is not universal.

Lists of schools (and students)

Advantage

These lists are a reliable source of information on schoolchildren.

Disadvantage

Possible discrepancies between the location of the school and students' place of residence may influence the precision of their classification as the members of the population at risk.

formulas or widely available computer packages, including EpiInfo, can be used *(29)*.

The people selecting the sample for a study should consider that non-availability for a study being conducted rapidly in the period immediately after an incident may be greater than in a normal research situation. This consideration should influence sample size. To assess possible selection bias, the characteristics of the non-respondents should be recorded. It may be necessary to follow at least a part of this group to evaluate the extent to

which their non-availability resulted from the exposure and/or health reasons possibly related to the incident.

Selection of a control (or reference) group

When the health effects on an exposed population are analysed, they need to be compared with reference values. These can be based on the data on the same population, recorded before the incident, or from another population (from national statistics or special surveys, for example), assuming that there are no major differences between the two. If this is not the case, ensuring the comparability of populations included in the study requires particular attention.

In environmental epidemiology, the dose–response relationship is of particular importance. Defining nonexposed or control groups is often difficult. Because they usually live in a different place than the exposed population, these groups might differ from it in many ways that are difficult to control for. The establishment of an exposure gradient can make the analysis more relevant and reliable. This can support the notion of a causal association between the incident and the deterioration in health, if the people who have been "more exposed" show a stronger or more frequent reaction. This approach helps to avoid potential biases introduced by using only nonexposed control groups.

In addition, reference values can be collected after the incident through observation of a reference population that is comparable to the exposed one except for the occurrence of the incident. Identical data collection procedures should be planned for both the population at risk and the reference population or, depending on the type of health effect observed after the incident, data from routine reporting of health events should be used. An example of the use of routine data is found in the follow-up study of cancer incidence conducted after the Seveso accident (see Annex) *(30)*.

Special considerations in sample selection for a follow-up study

A specific problem of cohort studies is losses to follow-up. People may leave the area of the incident and that loss may bias the study results, if those more exposed or those experiencing health problems attributed to the exposure are more likely to leave, for example. Mechanisms are required for flagging and tracing the

cohort members. To ensure as complete a follow-up as possible, a means of communication with these people should be established.

The exposed group followed does not have to represent the entire population at risk. It can be more effective to include a subgroup with better exposure estimates and greater chances for good participation rates in the follow-up, such as only permanent residents listed in the official register. This method was used in the follow-up of the Seveso accident *(21)*. Other groups that might have been specially exposed but are not resident in the affected area should also be followed. These include rescue workers, fire-fighters, police officers and those involved in clearing the site after the incident.

Sample selection schemes

A survey based on simple random sampling provides the best (unbiased) estimates of the distribution of the exposure and health parameters in the population. Including only (randomly) selected members of the exposed population in the study may raise ethical problems. At the same time, one must avoid conducting the study with volunteers. This may give heavily biased results; for example, only those with visible health impacts may report for the study.

A sampling scheme can be implemented if an appropriate sampling frame is easily available, for example, as a result of special activities at the preparatory stage. A practical scheme, often the most feasible in the post-incident situation, is systematic random sampling: for example selecting every nth patient admitted to the clinic or hospital (according to the admission book). In some situations, sampling frames and methods prepared for another study can be used. Those of a study already under way were used in assessing the health impacts of the Schweizerhalle incident (see Annex). This was also the case in the assessment of the psychological consequences associated with the Amsterdam aircraft disaster, where the existing health interview survey included an appropriate set of questions addressing issues related to the accident *(31)*.

In an emergency, cluster sampling may be more practical than simple random sampling. Data can be collected from all residents of a neighbourhood or from all students of a school with less time and effort than from the same number of subjects living at various addresses or studying at several schools. If the studied characteristics (level of exposure or health status) vary much less

within the cluster than between various clusters, however, the estimates based on the cluster sample may be biased. The risk of such bias decreases if the number of clusters is large: for example, if households constitute the clusters and these units are randomly selected from the address register covering the whole population.

If subgroups of the population at risk can be defined with different characteristics possibly related to the exposure or to the health reaction to the incident, a stratified sampling scheme is advisable. The sampling frame must be available for each of the strata. If the study addresses the exposure or health effect estimates for each of the strata, not just the population as a whole, a sufficiently large sample is needed from each stratum; this means an increase in the size of the total sample.

Data analysis and interpretation of results

As in all epidemiological studies, competent, careful and critical analysis of the data and its interpretation is a central requirement of studies following environmental incidents. All possible alternative explanations should be taken into account. A description of the requirements for data processing and analysis can be found in numerous publications *(28)*. After the data are collected, epidemiologists with basic training in statistical methods should quickly make an initial analysis, using EpiInfo *(13)* or other simple computer packages for data processing and analysis. More advanced interpretation may require the participation of experienced biostatisticians.

Box 10. Health assessment – summary

- The use of existing, routinely collected data should always be considered the method of choice in assessing the health consequences of an incident.
- If necessary, special data collection should be designed, strictly following the requirements of design methodology for epidemiological studies.
- Exposure information is needed to assess the link between health and exposure due to the incident. It may be necessary to include elements of exposure assessment in the health study.
- The timely analysis of data and its critical interpretation are central to the epidemiologist's activity following the incident.

The study results, including negative results, must be reported to a wide scientific community in order for them to be accessible to those who have to deal with similar problems. Each step of the investigative process – including decisions to omit data, participants or potential sources of variation – has to be documented accurately. The method of analysis, including the statistical model with its underlying assumptions, should be stated. The results should be presented as an association – if possible, as a dose–response relationship – with discussion of all potential biases that could reasonably be expected to affect the validity of the results.