
IPCS INTERNATIONAL PROGRAMME
ON CHEMICAL SAFETY

Glossary of terms on chemical safety for use in IPCS publications



Produced under the joint sponsorship of
the United Nations Environment Programme,
the International Labour Organisation,
and the World Health Organization

WORLD HEALTH ORGANIZATION
Geneva 1989

WHO/ICS/89.27

GLOSSARY OF TERMS ON CHEMICAL SAFETY

FOR USE IN IPCS PUBLICATIONS

The International Programme on Chemical Safety (IPCS) is a joint venture of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization. The main objective of the IPCS is to carry out and disseminate evaluations of the effects of chemicals on human health and the quality of the environment. Supporting activities include the development of epidemiological, experimental laboratory, and risk-assessment methods that could produce internationally comparable results, and the development of manpower in the field of toxicology. Other activities carried out by IPCS include the development of know-how for coping with chemical accidents, coordination of laboratory testing and epidemiological studies, and promotion of research on the mechanisms of the biological action of chemicals.

INTRODUCTION

The language of chemical safety is drawn from many sources. These include medicine, toxicology, pharmacology, epidemiology, ecotoxicology and environmental pollution. Its terminology has developed in an unstructured manner with proliferation into multiple terms, some with overlapping, alternative, or even ambiguous meanings. This situation is a source of confusion to both authors and readers of publications on chemical safety and a cause of difficulty in translation into other languages.

To facilitate international communication and comprehension, economy should be exercised in the use of terms and definitions already formulated by various scientific bodies. However, this glossary is not, on the one hand, an exhaustive compilation nor, on the other, a definitive list of approved terms. It is intended to be a guide of terms widely used and adequately defined.

Grateful acknowledgement is made to the experts in the scientific bodies which form the sources for the terms and definitions. In particular the work of the International Epidemiological Association in sponsoring a Dictionary of Epidemiology, ably edited by Dr John M. Last, deserves credit for providing a sound international basis for terminology in this field of science. The glossary has drawn heavily on this publication.

Language and terminology are not static. Comments and suggestions for additions and improvements would be welcomed by the International Programme on Chemical Safety. These should be sent to:

The Manager
International Programme on Chemical Safety
Division of Environmental Health
World Health Organization
1211 Geneva 27
Switzerland

NOTE

Users of the Glossary should note that the terms in the Glossary are defined primarily for use in the Environmental Health Criteria of the International Programme on Chemical Safety (IPCS) and in other IPCS publications, such as those resulting from the activity of the Joint FAO/WHO Expert Meeting on Food Additives (JECFA) and the Joint FAO/WHO Meeting on Pesticide Residues (JMPR). The terms may be used differently by other bodies and in other publications.

abiotic transformation: A process in which a chemical in the environment is modified by non-biological mechanisms (see also *biotransformation*) (WHO, 1979).

absorbed dose (in toxicology): The amount of a chemical absorbed into the body or into organs and tissues of interest (WHO, 1978a).

absorbed dose (in radiation): The energy imparted to matter in a suitably small element of volume by ionizing radiation divided by the mass of that element of volume (ISO, 1972). The SI unit for absorbed dose is joule per kilogram ($J\ kg^{-1}$) and its special name is gray (Gy) (ISO, 1972).

absorption (in colloid and surface chemistry): A process whereby, when two phases are brought into contact, a given component is transferred from one phase to the other (after IUPAC, 1972). Experimental differentiation of absorption and adsorption (q.v.) may be difficult, and sometimes the two processes occur simultaneously; in such cases the term "sorption" is used (WHO, 1979).

absorption (in radiation): A phenomenon in which radiation transfers to matter which it traverses some or all of its energy (ISO, 1972).

acceptable daily intake for man (ADI) (food additives): The acceptable daily intake (ADI) for man, expressed on a body weight basis (mg/kg body weight) is the amount of a food additive that can be taken daily in the diet, even over a lifetime, without risk. It is allocated only to substances for which the available data include either the results of adequate short-term and long-term toxicological investigations, or satisfactory information on the biochemistry and metabolic fate of the compound, or both (Vettorazzi, 1980).

acceptable daily intake (pesticide residues): The acceptable daily intake of a chemical is the daily intake which, during an entire lifetime, appears to be without appreciable risk to the health of the consumer on the basis of all the known facts at the time when a toxicological assessment is carried out. It is expressed in milligrams of the chemical per kilogram of body weight (Vettorazzi, 1980).

acceptable daily intake not specified: An ADI without an explicit indication of the upper limit of intake may be assigned to substances of very low toxicity, especially those that are food constituents or that may be considered as foods or normal metabolites in man. This expression was adopted as a more suitable expression than "ADI not limited", which was previously used. An additive having an "ADI not specified" must meet the criteria of good manufacturing practices. For example, it should have proved technological efficacy and be used at the minimum level of technological efficacy, it should not conceal inferior food quality or adulteration, and it should not create a

nutritional imbalance. The above expression means that, on the basis of available data (chemical, biochemical, and toxicological), the total daily intake of the substance arising from its use or uses at levels necessary to achieve the desired effect and from its acceptable background in food, does not represent a hazard to health. For this reason, and for reasons stated in the individual evaluations, the establishment of an acceptable daily intake expressed in mg/kg body weight is not deemed necessary (Vettorazzi, 1980).

no acceptable daily intake allocated: This expression is applicable to substances for which the available information is not sufficient to establish their safety or when the specifications for identity and purity are not adequate. The fact that an ADI for an additive was not established should not be interpreted as casting doubt on its safety nor should it be considered for its withdrawal for use (Vettorazzi, 1980).

acceptable residue: Acceptable residues in human food that have been established for antibiotics found in foods (Vettorazzi, 1980).

acceptable level of treatment: Acceptable daily intakes are usually expressed as milligrams of the substance in question per kilogram of body weight. There are, however, certain food additives that are more appropriately limited in terms of levels of treatment applied (Vettorazzi, 1980).

acceptable daily intake not specified (pesticide residues): An ADI without an explicit indication of the upper limit of intake may be assigned to substances of very low toxicity, especially those that are food constituents or that may be considered as foods or normal metabolites in man. This expression was adopted as a more suitable expression than "ADI not limited" which was previously used. An additive having an "ADI not specified" must meet the criteria of good manufacturing practices, for example, it should have proved technological efficacy and be used at the minimum level of technological efficacy, it should not conceal inferior food quality or adulteration, and it should not create a nutritional imbalance. The above expression means that, on the basis of available data (chemical, biochemical, and toxicological), the total daily intake of the substance arising from its use or uses at levels necessary to achieve the desired effect and from its acceptable background in food, does not represent a hazard to health. For this reason, and for reasons stated in the individual evaluations, the establishment of an acceptable daily intake expressed in mg/kg body weight is not deemed necessary (Vettorazzi, 1980).

accumulation: Successive additions of a substance to a target organism, or organ, or to part of the environment, resulting in an increasing quantity or concentration of the substance in the organism, organ, or environment.

accuracy. (i) The closeness of agreement between the "true" value and the measured values (ISO, 1981); (ii) the degree to which a measurement, or an estimate based on measurements, represents the true value of the attribute that is being measured (Last, 1988).

action level. (i) The level of a pollutant at which specified emergency counter-measures, such as the seizure and destruction of contaminated materials, evacuation of the local population or closing down the sources of pollution, are to be taken (UN, 1972); (ii) the level at which some kind of preventive action (not necessarily of an emergency nature) is to be taken; (iii) a level of exposure of workers to airborne harmful substances in workrooms to be determined by the competent authority; it is distinctly below the exposure limit and consequently such exposures below the action level do not usually necessitate application of all the preventive measures, especially of a medical nature, foreseen for exposures exceeding the action level. This level may lie between a third and a half of the exposure limit (ILO, 1977).

acute effects. Effects that occur rapidly following exposure and are of short duration (WHO, 1979).

acute toxicity. The adverse effects occurring within a short time of administration of a single dose or multiple doses given within 24 hours (Hagan, 1959).

acute toxicity test. An experimental animal study in which the adverse effects occur in a short time (from 1-7 days) following the administration of a single or multiple doses of a chemical. The most frequently used acute toxicity test involves determination of the *median lethal dose* (LD_{50}) of the compound. The LD_{50} has been defined as "a statistically derived expression of a single administered dose of a material that can be expected to kill 50% of the animals" (WHO, 1978a).

adsorption. A process whereby one or more components of an interfacial layer between two bulk phases are either enriched or depleted (IUPAC, 1972).

aerodynamic diameter of a particle. The diameter of a spherical particle of unit density that has the same settling velocity in air as the particle in question (IAEA, 1978).

air pollution. The presence of substances in the atmosphere resulting either from human activity or natural processes, present in sufficient concentration, for a sufficient time and under circumstances such as to interfere with the comfort, health, or welfare of persons or the environment (ISO, 1980).

analytic study: A hypothesis-testing method of investigating the association between a given disease or health state or other dependent variable and possible causative factors. In an analytic study, individuals in the study population may be classified according to absence or presence (or future development) of specific disease and according to "attributes" that may influence disease occurrence. Attributes may include age, race, sex, other disease(s), genetic, biochemical, and physiological characteristics, economic status, occupation, residence, and various aspects of the environment or personal behaviour. Three types of analytic study are cross-sectional (prevalence), cohort (prospective), and case control (retrospective) (Last, 1983).

antagonism: The situation in which the combined effect of two or more factors is smaller than the solitary effect of any one of the factors. In bioassay, the term may be used to refer to the situation when a specified response is produced by exposure to either of two factors but not by exposure to both together (Last, 1983).

assay: The quantitative or qualitative evaluation of a hazardous substance; the results of such an evaluation (Last, 1988).

bias: Deviation of results or inferences from the truth, or processes leading to such deviation. Any trend in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that are systematically different from the truth. Among the ways in which deviation from the truth can occur, are the following:

1. Systematic (one-sided) variation of measurements from the true values (synonym: *systematic error*).
2. Variation of statistical summary measures (means, rates, measures of association, etc.) from their true values as a result of systematic variation of measurements, other flaws in data collection, or flaws in study design or analysis.
3. Deviation of inferences from the truth as a result of flaws in study design, data collection, or the analysis or interpretation of results.
4. A tendency of procedures (in study design, data collection, analysis, interpretation, review or publication) to yield results or conclusions that depart from the truth.
5. Prejudice leading to the conscious or unconscious selection of study procedures that depart from the truth in a particular direction, or to one-sidedness in the interpretation of results.

(from Last, 1988).

bioavailability (synonym: *biological availability*, *physiological availability*): The extent to which a chemical substance to which the body is exposed (by ingestion, inhalation, injection, or skin contact) reaches the systemic circulation, and the rate at which this occurs.

It is recognized that the bioavailability (for gastrointestinal absorption) of, for example, both essential and non-essential metals, depends on various factors including the composition of the diet and the type of the chemical compound and its state of dispersion. For instance, the absorption of lead and cadmium is increased if the food is deficient in calcium or iron (WHO, 1979).

bioaccumulation: The process by which the amount of a substance in a living organism (or its parts) increases with time (WHO, 1979).

bioconcentration: A process leading to a higher concentration of a chemical in the organism relative to its environment (WHO, 1979).

biological assessment of exposure: Exposure to chemicals may be assessed by the analysis of specimens taken in the environment (air, water, food, etc.) or of specimens of biological material. Most often, urine and blood are analyzed, but other materials such as expired air, faeces, saliva, bile, hair, and biopsy or autopsy material are sometimes analyzed. In these samples, the content of the xenobiotic(s) or its metabolite(s) is determined and, on this basis, the exposure level (concentration in the air, absorbed amount of the substance) or the probability of health impairment due to exposure is derived. Biochemical changes in the components of an organism can also be used for this purpose (e.g., changes in enzyme activity or in the excretion of metabolic intermediates) if they show a relationship to the exposure (WHO, 1979).

biological assessment of exposure: Mainly used for hygienic evaluation of workplaces (deducing from the analytical results the level of exposure, sometimes even correlations with the concentration in the air, the possible absorption by other routes than inhalation, etc.) and for medical prevention or diagnostics (probability of health impairment at certain values of the exposure test). The definition of biological assessment of exposure should include only the chemical and haematological analyses already mentioned and should not be extended to include indicators of general health or sickness, or functional tests (WHO, 1979).

biological cycle: The process through which a chemical substance passes in the biosphere. It may involve transport through the various media (air, water, soil), followed by environmental transformation, and carriage through various ecosystems. Chemical compounds that occur naturally have a natural biological cycle (WHO, 1979).

biological half-life (synonym: **biological half-time**): The time required for the amount of a particular substance in a biological system to be reduced to one-half of its value by biological processes when the rate of removal is approximately exponential (ISO, 1972). For a one-compartment system describing an exponential biological process,

biological half-life = $\log 2/f$ where f = elimination or decay constant.

biological monitoring. The periodic examination of biological specimens (in accordance with the definition of monitoring). It is usually applied to exposure monitoring but can also apply to effect monitoring (WHO, 1979).

biomagnification (or ecological magnification): A sequence of processes in an ecosystem by which higher concentrations are attained in organisms of higher trophic level, i.e., of higher levels in the food chain (Dustman & Stickel, 1969).

biomass. The total amount of biotic material, usually expressed per unit surface area or volume of a medium such as water (WHO, 1979).

biota. Living organisms (WHO, 1979).

biotransformation. A process in which a chemical is modified by a living organism (WHO, 1979).

carcinogen. An agent, chemical, physical or biological, that can act on living tissue in such a way as to cause a malignant neoplasm (WHO, 1980).

carcinogenesis. The induction by chemical, physical, or biological agents, of neoplasms that are usually not observed, an earlier induction of neoplasms that are usually observed, and/or the induction of more neoplasms than are usually found although fundamental differences in the mechanisms may be involved (IARC, 1977).

case control study (synonyms: *case comparison study, case history study, case referent study, retrospective study*): A study that starts with the identification of persons with the disease (or other outcome variable) of interest, and a suitable control (comparison, reference) group of persons without the disease. The relationship of an attribute to the disease is examined by comparing the diseased and nondiseased with regard to how frequently the attribute is present or, if quantitative, the levels of the attribute, in each of the groups.

Such a study can be called "retrospective" because it starts after the onset of disease and looks back to the postulated causal factors. Cases and controls in a case control study may be accumulated "prospectively," that is, as each new case is diagnosed it is entered in the study. Nevertheless, such a study may still be called "retrospective" because it looks back from the outcome to its causes. The terms "cases" and "controls" are sometimes used to describe subjects in a randomized controlled trial but, the term "case control study" should not be used to describe such a study (from Last, 1988).

chemobiokinetics. The process of the uptake of chemical substances by the body, the biotransformation they undergo, the distribution of the substances and their metabolites in the tissues, and the elimination of the substances and their metabolites from the body. Both the amounts and the concentrations of the substances and their metabolites are studied. The term has essentially the same meaning as pharmacokinetics, but the latter term should be restricted to the study of pharmaceutical substances (WHO, 1979).

chronic effects. Effects that develop slowly and have a long duration. They are often, but not always, irreversible. Some irreversible effects may appear a long time after the chemical substance was present in the sensitive tissue. For such delayed or late effects, the latent period (or the "time to occurrence" of an observable effect) may be very long, particularly if the level of exposure is low (WHO, 1979).

chronic toxicity test. A study in which animals are observed during the whole life span (or the major part of the life span) and in which exposure to the test material takes place over the whole observation time or a substantial part thereof. The term "long-term toxicity study" is sometimes used as a synonym for "chronic toxicity study" and sometimes to signify a study that falls in between subacute (short-term toxicity studies) and chronic toxicity studies (WHO, 1978a).

cluster sampling. (i) A method of sampling in which the population is divided into aggregates (or clusters) of items bound together in a certain manner. A sample of these clusters is taken at random and all the items which constitute them are included in the sample (ISO, 1977); (ii) a sampling method in which each unit selected is a group of persons (all persons in a city block, a family, etc.) rather than an individual (Last, 1988).

cohort study (synonyms: *concurrent, follow-up, incidence, longitudinal, prospective study*): The method of epidemiologic study in which subsets of a defined population can be identified who are, have been, or in the future may be exposed or not exposed, or exposed in different degrees, to a factor or factors hypothesized to influence the probability of occurrence of a given disease or other outcome. The alternative terms for a cohort study, i.e., follow-up, longitudinal, and prospective study, describe an essential feature of the method, which is observation of the population for a sufficient number of person-years to generate reliable incidence or mortality rates in the population subsets. This generally implies study of a large population, study for a prolonged period (years), or both (Last, 1988).

compartments. The body is composed of a large number of organs, tissues, cells, and fluids, any one of which could be referred to as a compartment. In chemobiokinetics, a compartment often refers collectively to the organs, tissues, cells, and fluids for which the rates of

uptake and subsequent distribution and elimination are sufficiently similar to preclude kinetic resolution (WHO, 1979).

concentration. A general term referring to the quantity of a material or substance contained in unit quantity of a given medium. When the term concentration is used without further qualification, it now means amount of substance concentration (WHO, 1979).

conditional acceptable daily intake. A conditional acceptable daily intake is one that is established for a pesticide in order to limit its use to those situations where no satisfactory substitutes are available. This definition will be the subject of further discussion. The allocation of conditional ADIs for intentional food additives has been superseded (Vettorazzi, 1980).

confounding:

1. A situation in which the effects of two processes are not separated. The distortion of the apparent effect of an exposure on risk brought about by the association with other factors that can influence the outcome.
2. A relationship between the effects of two or more causal factors as observed in a set of data, such that it is not logically possible to separate the contribution that any single causal factor has made an effect.
3. A situation in which a measure of the effect of an exposure on risk is distorted because of the association of exposure with other factor(s) that influence the outcome under study.

(Last, 1988).

confounding variable (synonym: *confounder*): A variable that can cause or prevent the outcome of interest, is not an intermediate variable, and is not associated with the factor under investigation. Such a variable must be controlled in order to obtain an undistorted estimate of the effect of the study factor on risk (Last, 1988).

contaminant. In some contexts (e.g., in relation to gas cleaning equipment), used as a synonym for *pollutant* (ISO, 1979).

controls matched: Controls (persons) who are selected so that they are similar to the study group, or cases, in specific characteristics. Some commonly used matching variables are age, sex, race and socio-economic status (Last, 1988).

count mean diameter. The mean of the diameters of all particles in the population (IAEA, 1978).

count median diameter. The diameter in the population above which there are as many particles with larger diameter as there are particles with smaller diameters (IAEA, 1978).

criteria Validated sets of data used as a basis for judgement (WHO, 1979).

critical concentration for a cell. The concentration at which undesirable (or adverse) functional changes, reversible or irreversible, occur in the cell (Task Group on Metal Toxicity, 1976).

critical effect. The first adverse effect that appears when the critical concentration in the critical organ is reached in an individual (or the adverse effect that occurs as a result of the lowest dose in the critical organ) (WHO, 1979).

critical group. That part of the target population most in need of protection (WHO, 1979).

critical organ (critical tissue) (in toxicology): The particular organ that first attains the critical concentration (of metal) under specified circumstances of exposure and for a given population (Task Group on Metal Toxicology, 1976).

critical organ (in radiation biology): The organ whose damage (by radiation) results in the greatest injury to the individual (or his descendants). The injury may result from inherent radiosensitivity or indispensability of the organ, or from high dose, or from a combination of all three (ICRP, 1965).

critical organ concentration (critical tissue concentration): The mean concentration in the organ (tissue) at the time the most sensitive type of cell reaches the critical concentration (Task Group on Metal Toxicity, 1976).

critical period: A period during the development of a human, animal, or vegetable body, which is of particular importance in the life cycle if the normal full development of some anatomical, physiological, metabolic, or psychological structure or function is to be attained (WHO, 1972).

cross-sectional study (synonyms: disease frequency survey, prevalence study): A study that examines the relationship between diseases (or other health-related characteristics) and other variables of interest as they exist in a defined population at one particular time. The presence or absence of disease and the presence or absence of the other variables (or, if they are quantitative, their level) are determined in each member of the study population or in a representative sample at one particular time. The relationship between a variable and the

disease can be examined (1) in terms of the prevalence of disease in different population subgroups defined according to the presence or absence (or level) of the variables (2) in terms of the presence or absence (or level) of the variables in the diseased versus the nondiseased. Note that disease prevalence rather than incidence is normally recorded in a cross-sectional study. The temporal sequence of cause and effect cannot necessarily be determined in a cross-sectional study. See also *morbidity survey* (Last, 1988).

crude death rate. See *death rate*.

cumulative effect (functional accumulation): Occurs when repeated doses of a toxic substance or harmful radiation summate to give an enhanced effect (WHO, 1979).

cumulative incidence, cumulative incidence rate: The number or proportion of a group of people who experience the onset of a health related event during a specified time interval; this interval is generally the same for all members of the group, but, as in lifetime incidence, it may vary from person to person without reference to age (Last, 1988).

cumulative incidence ratio: The ratio of the cumulative incidence rate in the exposed to the cumulative incidence rate in the unexposed (Last, 1983).

death rate: An estimate of the proportion of a population that dies during a specified period. The numerator is the number of persons dying during the period; the denominator is the size of the population, usually estimated as the mid-year population. The death rate in a population is generally calculated by the formula

$$\frac{\text{Number of deaths during a specified period}}{\text{Number of persons at risk of dying during the period}} \times 10^n$$

This rate is an estimate of the person-time death rate, i.e., the death rate per 10^n person-years. If the rate is low, it is also a good estimate of the cumulative death rate. This rate is also called the crude death rate (Last, 1988).

deposition: The process by which a certain amount of a substance arrives at a particular site (e.g., the deposition of particles on the ciliated epithelium of the bronchial airways) (WHO, 1979).

discharge (or effluent or emission) standard or release limit: The maximum acceptable release of a pollutant from a given source to a specified medium under specified circumstances (WHO, 1979).

dose: The amount of a chemical administered to an organism (WHO, 1978a).

dose rate (in radiation protection): The quantity of energy absorbed per unit of time (WHO, 1979).

dose (exposure)-response relationship: The relationship between administered dose or exposure and the biological change in organisms. It may be expressed as the severity of an effect in one organism (or part of an organism) or as the proportion of a population exposed to a chemical that shows a specific reaction (WHO, 1979).

duplicate portion sampling method (duplicate diet study): This method is frequently used for the same purposes as the total diet study technique. It implies that test persons consume their ordinary diet, but that, for each meal, they prepare a duplicate portion of all food as prepared, served, and consumed (WHO, 1979).

ecotoxicology: The effects of chemical agents on the environment, including, in addition to effects on man, adverse events that take place in the general ecosystem. It is not necessarily related primarily to human health (WHO, 1979).

effect: A biological change in an organism, organ, or tissue (WHO, 1979).

effective half-life: (i) The time required for the amount of a radionuclide in a biological system to be reduced to half its original value. The $T_{1/2}$ eff. is related to the biological half-life ($T_{1/2}$ b) and the physical half-life ($T_{1/2}$ p) by:

$$T_{1/2} \text{ eff.} = \frac{T_{1/2} \text{ b} \times T_{1/2} \text{ p}}{T_{1/2} \text{ b} + T_{1/2} \text{ p}}$$

The clearance curve in a biological system may well be complex and not a simple exponential function. In this case the simple relationship given above is not valid (Wagner, 1968). (ii) The time required for the amount of a particular radionuclide in a system to be reduced to half its value as a consequence of both radioactive decay and other processes such as biological elimination and burnup when the rate of removal is approximately exponential (ISO, 1972).

elimination (in metabolism): The expelling of a substance or other material from the body (or a defined part thereof), usually by a process of extrusion or exclusion but sometimes through metabolic transformation (WHO, 1979).

embryotoxicity: The potential of a substance to induce adverse effects in progeny in the first period of pregnancy between conception and the fetal stage (UNEP/IRPTC, 1982).

emission: The giving off of environmental pollutants from various sources (WHO, 1979).

emission or exposure control: The technical and administrative procedures applied for the reduction or elimination of emissions from the source or of exposure to the target (WHO, 1988).

enterohepatic circulation: Intestinal reabsorption of material that has been excreted through the bile and transferred back to the liver, making it available for biliary excretion again (WHO, 1979).

environment: The aggregate, at a given moment, of all external conditions and influences to which a system is subjected (ISO, 1975). The term "system" covers all living organisms, including human beings.

environmental health (synonyms: environmental medicine, environmental hygiene): The health aspects of the human environment, including technical and administrative measures for improving the human environment from a health point of view (WHO, 1979).

environmental sanitation: Traditionally used to indicate activities concerned with the improvement of the basic environmental conditions affecting health, i.e., water supply, human and animal waste disposal, protection of food from biological contamination, and housing conditions, all of which are concerned with the quality of the human environment (WHO, 1979).

environmental transformation: Once emitted into the environment, a chemical substance may be transported in the biosphere and undergo various types of chemical changes (WHO, 1979).

epidemiology: The study of the distribution and determinants of health-related states or events in populations, and the application of this study to control of health problems (from Last, 1988).

equivalent diameter (of a particle): The diameter of a spherical particle of the same density that, relative to a given phenomenon or property, would behave as the particle under investigation (ISO, 1979).

excretion: The discharge or elimination of an absorbed or endogenous substance, or of a waste product, via some tissue of the body and its appearance in urine, faeces, or other products normally leaving the body. Excretion of chemical compounds from the body occurs mainly through the kidney and the gut. For volatile compounds, however, elimination by exhalation may be important. Excretion via perspiration and

through hair and nails may also be of importance under special circumstances. Excretion via the gastrointestinal tract may take place by various routes such as the bile, the shedding of intestinal cells, and transport through the intestinal mucosa (WHO, 1979).

excretion rate: The amount or proportion of a substance that is excreted per unit time. It should be noted that according to this definition excretion does not include the passing of a substance through the intestine without absorption. When discussing the total amount of a substance in faeces (including the unabsorbed part), it is preferable to speak about faecal content of substance (Task Group on Metal Accumulation, 1973).

exposed group (in epidemiology): A group whose members have been exposed to a supposed cause of a disease or health state of interest, or possess a characteristic that is a determinant of the health outcome of interest. The abbreviated term "the exposed" is sometimes used.

exposed or non-exposed: Qualitative terms defining the existence of or lack of a hazard in the environment of individuals (WHO, 1988).

exposure: The amount of an environmental agent that has reached the individual (external dose) or has been absorbed into the individual (internal dose, absorbed dose) (WHO, 1979).

exposure assessment: The quantification of the amount of exposure to a hazard for an individual or group (WHO, 1979).

exposure control: see emission or exposure control.

exposure limit: A general term implying the level of exposure that should not be exceeded (WHO, 1979).

extraneous residue limit: An extraneous residue limit is, for a particular commodity, the maximum toxicologically acceptable concentration of a residue unavoidably arising from sources other than the use of a pesticide directly or indirectly for the production of that commodity (WHO, 1976).

extrapolation: The calculation, based on quantitative observations in exposed test species, of predicted dose-effect and dose-response relationships for a chemical in humans and other environmental biota (WHO, 1979).

follow-up study (synonym: cohort study): A study in which individuals or populations, selected on the basis of whether they have been exposed to risk, received a specified preventive or therapeutic procedure, or possess a certain characteristic, are followed to assess the outcome of exposure, the procedure, or effect of the characteristic, e.g., occurrence of disease (from Last, 1988).

food additive: Any non-nutritive substances added intentionally to food, generally in small quantities, to improve its appearance, flavour, texture or storage properties, with the exception of substances which are added to food exclusively for their nutritive properties, but including animal feed adjuncts which may result in residues in human food and components of packaging materials which may find their way into human food, and other contaminants (Vettorazzi, 1980).

food chain: The sequence of transfer of matter and energy in the form of food from organism to organism in ascending or descending trophic levels (WHO, 1979).

food web: A network of *food chains* (WHO, 1979).

gavage: Dose given by intragastric intubation (WHO, 1979).

good agricultural practice in the use of pesticides: Good agricultural practice in the use of pesticide is the officially recommended or authorized usage of pesticides under practical conditions at any stage of production, storage, transport, distribution, and processing of food and other agricultural commodities, bearing in mind the variations in requirements within and between regions and taking into account the minimum quantities necessary to achieve adequate control, the pesticide being applied in such a manner as to leave residues that are the smallest amounts practicable and that are toxicologically acceptable (WHO, 1976).

graded effect: An effect that can usually be measured on a graded scale of intensity or severity and its magnitude related directly to the dose (WHO, 1978a).

guideline level: A guideline level is the maximum concentration of a pesticide residue that might occur after the officially recommended or authorized use of a pesticide for which no acceptable daily intake or temporary acceptable daily intake is established and that need not to be exceeded if good practices are followed. It is expressed in milligrams for the residue per kilogram of food (WHO, 1976).

guides to air quality: Sets of concentrations and exposure times that are associated with specific effects of varying degrees of air pollution on man, animals, vegetation, and on the environment in general (WHO, 1979).

guides to environmental quality: Sets of levels and exposure times that are associated with the specific effects of varying levels of environmental factors on man, animals, vegetation, and the environment in general (WHO, 1979).

hazard: A source of danger: a qualitative term expressing the potential that an environmental agent can harm health (WHO, 1988).

hazard identification: The identification of the substance of concern, its adverse effects, target populations, and conditions of exposure (WHO, 1988).

health: A state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity (WHO, 1978b).

healthy worker effect: A phenomenon observed initially in studies of occupational diseases: workers usually exhibit lower overall death rates than the general population, due to the fact that the severely ill and disabled are ordinarily excluded from employment. Death rates in the general population may be inappropriate for comparison if this effect is not taken into account (Last, 1983).

human ecology: The interrelations between man and his physical, biological, socio-economic, and cultural environment, including the interrelations between himself and other individuals or groups of other species, and the interrelationship between himself and his entire environment. Because of the broad approach, human ecology studies are almost always multidisciplinary (WHO, 1988).

idiosyncrasy: The increased individual sensitivity of an organism to the effect of certain substances (UNEP/IRPTC, 1982).

incidence: The number of instances of illness commencing, or of persons falling ill, during a given period in a specific population. Incidence is usually expressed as a rate, the denominator being the average number of persons in the specified population during a defined period or the estimated number of persons at the mid-point of that period. The basic distinction between *incidence* and *prevalence* is that whereas incidence refers only to new cases, prevalence refers to all cases, irrespective of whether they are new or old. When the terms incidence and prevalence are used, it should be stated clearly whether the data represent the numbers of instances of the disease recorded or the numbers of persons ill (WHO, 1966).

incidence rate: The rate at which new events occur in a population. The numerator is the number of new events that occur in a defined period; the denominator is the population at risk of experiencing the event during this period, sometimes expressed as person-time. The incidence rate most often used in public health practice is calculated by the formula

$$\frac{\text{Number of new events in a specified period}}{\text{Number of persons exposed to risk during the period}} \times 10^n$$

In a dynamic population, the denominator is the average size of the population, often the estimated population at the mid-period. If the period is a year, this is the annual incidence rate. This rate is an estimate of the person-time incidence rate, i.e., the rate per 10^4 person-years. If the rate is low, as with many chronic diseases, it is also a good estimate of the cumulative incidence rate. In follow-up studies with no censoring, the incidence rate is calculated by dividing the number of new cases in a specified period by the initial size of the cohort of persons being followed; this is equivalent to the cumulative incidence rate during the period. If the number of new cases during a specified period is divided by the sum of the person-time units at risk for all persons during the period, the result is the person-time incidence rate (Last, 1988).

intake. The amount of a substance or material that is taken into the body, regardless of whether or not it is absorbed. The daily intake may be expressed as the amount taken in by a particular exposure route, e.g., ingestion or inhalation. The daily intake from food is the total amount of a given substance taken in during one day through the consumption of food. The daily intake by inhalation is calculated by multiplying the concentration of the substance (or agent) in air by the total amount of air inhaled during one day (24 hours). The total daily intake is the sum of the daily intake by an individual from food, drinking-water, and inhaled air (WHO, 1979).

interpretation of data. The evaluation of all the facts available from a given investigation or study with a view to their significance for health (IRPTC, 1982).

intervention study. An epidemiologic investigation designed to test a hypothesized cause-effect relationship by modifying a supposed causal factor in a population (Last, 1988).

intestinal reabsorption. Absorption further down the intestinal tract of material that has been absorbed before and subsequently excreted into the intestinal tract, usually through the bile (WHO, 1979).

latent period (synonym: *latency*): Delay between exposure to a disease-causing agent and the appearance of manifestations of the disease. After exposure to ionizing radiation, for instance, there is a latent period of five years, on average, before development of leukemia, and more than 20 years before development of certain other malignant conditions. The term "latent period" is often used synonymously with "induction period", that is, the period between exposure to a disease-causing agent and the appearance of manifestations of the disease. It has also been defined as the period from disease initiation to disease detection (Last, 1988).

limit of detection: (i) The smallest amount, or lowest concentration, of a given substance that a given procedure will detect (WHO, 1980); (ii) for a pesticide residue it is the lowest concentration that can be qualitatively detected in a specified commodity (WHO, 1976).

limit of determination (pesticide residue): The limit of determination of a method of analysis is the lowest concentration of a pesticide residue that can be quantitatively measured in the specified commodity with an acceptable degree of certainty (WHO, 1976).

mainstream smoke (tobacco smoking): The smoke that is inhaled.

mass mean diameter: The diameter of a particle with a mass equal to the mean mass of all the particles in the population (IAEA, 1978).

mass median diameter: The diameter of a particle with the median mass (IAEA, 1978).

maximum residue limit: The maximum concentration of a pesticide residue resulting from the use of a pesticide according to good agricultural practice directly or indirectly for the production and/or protection of the commodity for which the limit is recommended. The maximum residue limit should be legally recognized. It is expressed in milligrams of the residue per kilogram of the commodity (WHO, 1976).

mean life (synonym: mean time, turnover time): The average lifetime of an atomic or nuclear system in a specified state. For an exponentially decaying system, it is the average time for the number of atoms or nuclei in a specified state to decrease by a factor of e (ISO, 1972).

metabolic half-life (synonym: metabolic half-time): The time required for one half of the quantity of the compound in the body to be metabolically transformed into a modified chemical compound (WHO, 1979).

metabolic model: An analysis and theoretical reconstruction of the way in which the body deals with a specific substance, showing the proportion of the intake that is absorbed, the proportion that is stored and in what tissues, the proportion and rate of breakdown in the body and the subsequent fate of the metabolic products, and the proportion of the substance and the rate at which it is eliminated by different organs (WHO, 1979).

metabolic transformation (synonym: biotransformation): The chemical transformation of substances that takes place within an organism (WHO, 1979).

metabolism: In general, the sum total of all physical and chemical processes that take place within an organism; in a narrower sense, the

physical and chemical changes that take place in a given chemical substance within an organism. It includes the uptake and distribution within the body of chemical compounds, the changes (biotransformations) undergone by such substances, and the elimination of the compounds and of their metabolites (WHO, 1979).

metabolite: A substance resulting from chemical transformation in an organism (WHO, 1979).

model: A formalized expression of a theory or the causal situation which is regarded as having generated observed data. In statistical analyses the model is generally expressed in symbols, that is to say in a mathematical form, but diagrammatic models are also found (Kendall & Buckland, 1982).

monitoring (for health, environmental, and associated technical purposes): The repetitive and continued observation, measurement, and evaluation of health and/or environmental or technical data for defined purposes, according to prearranged schedules in space and time, and using comparable methods for sensing and data collection (WHO, 1980).

morbidity: Any departure, subjective or objective, from a state of physiological or psychological well-being. In this sense, *sickness*, *illness*, and *morbid condition* are similarly defined and synonymous (Last, 1988).

The WHO Expert Committee on Health Statistics noted in its Sixth report (1959) that morbidity could be measured in terms of three units: (i) persons who were ill; (ii) the illnesses (periods or spells of illnesses) that these persons experienced; and (iii) the duration (days, weeks, etc.) of these illnesses (Last, 1988).

morbidity survey: A method for the estimation of the prevalence and/or incidence of disease or diseases in a population. A morbidity survey is usually designed simply to ascertain the facts as to disease distribution, and not to test a hypothesis (Last, 1988).

mortality rate: See *death rate*.

multiple (or multiphasic) screening: This procedure has evolved by combining single screening tests, and is the logical corollary of mass screening. Where much time and effort has been spent by a population in attending for a single test (e.g., mass radiography), it is natural to consider the economy of offering other tests at the same time. Multiple (or multiphasic) screening implies the administration of a number of tests, in combination, to large groups of people (Wilson & Jungner, 1968).

multistage cluster sampling: Cluster sampling with more than two stages, each sampling being made on aggregates (or clusters) in which the clusters already obtained by the preceding sampling have been divided (ISO, 1977).

multistage sampling: A type of sampling in which the sample is selected by stages, the sampling units at each stage being subsampled from the larger units chosen at the previous state (ISO, 1977).

mutagenicity: The property of a physical, chemical, or biological agent to induce mutations in living tissue (WHO, 1979).

mutagen: An agent that induces mutation (WHO, 1979).

mutation: Any heritable change in genetic material. This may be a chemical transformation of an individual gene (a gene or point mutation), which alters its function. On the other hand, this change may involve a rearrangement, or a gain or loss of part of a chromosome, which may be microscopically visible. This is designated a chromosomal mutation (WHO, 1979).

natural occurrence: The occurrence in nature of a compound, when there are no man-made sources of the compound. The contamination of nature by some compounds may be so widespread that it is virtually impossible at the present time to get access to biota with a natural level and only "normal" levels can be measured, i.e., the levels that are usually prevalent at places where there is no obvious local contamination (WHO, 1979).

no-observed-adverse-effect level: The greatest concentration or amount of a chemical, found by experiment or observation, that causes no detectable adverse alteration of morphology, functional capacity, growth, development, or life span of the target (WHO, 1979).

nutritional table method: A method of evaluating the dietary intake of a large number of people. The accuracy of the method largely depends on the accuracy with which records of the food consumption can be established and the accuracy of the nutritional tables specifying the concentration of various nutrients, vitamins, and essential and non-essential substances including pesticide residues. For each record of quantity of food consumed during a certain time period, the daily intake of the substance in question is calculated by multiplying the substance concentration in the food item (as obtained from the nutritional table) by the quantity of food consumed and dividing by the time of observation (WHO, 1979).

objective environment: The actual physical, chemical, and social environment as described by objective measurements, such as noise levels in decibels and concentrations of air pollutants (WHO, 1979).

occupational environment: The environment at a work place (WHO, 1979).

occurrence (synonym: *frequency*): In epidemiology, a general term describing the frequency of a disease or other attribute or event in a population without distinguishing between *incidence* and *prevalence* (Last, 1988).

odds: The ratio of the probability of occurrence of an event to that of non-occurrence, or the ratio of the probability that something is so, to the probability that it is not so (from Last, 1983).

odds ratio (synonym: *cross-product ratio, relative odds*): The ratio of two odds. The term "odds" is defined differently according to the situation under discussion. Consider the following notation for the distribution of a binary exposure and a disease in a population or a sample.

	Exposed	Unexposed
Disease	a	b
No disease	c	d

The odds ratio (cross-product ratio) is ad/bc .

The *exposure-odds ratio* for a set of case control data is the ratio of the odds in favour of exposure among the cases (a/b) to the odds in favour of exposure among non-cases (c/d). This reduces to ad/bc . With incident cases, unbiased subject selection, and a "rare" disease (say, under 2% cumulative incidence rate over the study period), ad/bc is an approximate estimate of the risk ratio. With incident cases, unbiased subject selection, and density sampling of controls, ad/bc is an estimate of the ratio of the person-time incidence rates (forces of morbidity) in the exposed and unexposed (no rarity assumption is required for this).

The *disease-odds (rate-odds) ratio* for a cohort or cross-section is the ratio of the odds in favour of disease among the exposed (a/c) to the odds in favour of disease among the unexposed (b/d). This reduces to ad/bc and hence is equal to the exposure-odds ratio for the cohort or cross-section.

The *prevalence-odds ratio* refers to an odds ratio derived cross-sectionally, as, for example, an odds ratio derived from studies of prevalent (rather than incident) cases.

The *risk-odds ratio* is the ratio of the odds in favour of getting disease, if exposed, to the odds in favour of getting disease if not exposed. The odds ratio derived from a cohort study is an estimate of this (Last, 1983).

pesticide residue: A pesticide residue is any substance or mixture of substances in food for man or animals resulting from the use of a pesticide and includes any specified derivatives, such as degradation and conversion products, metabolites, reaction products, and impurities that are considered to be of toxicological significance (WHO, 1976).

point source: A single source, usually in a defined location (WHO, 1979).

pollutant: Any undesirable solid, liquid, or gaseous matter in a gaseous, liquid, or solid medium (ISO, 1977). For the meaning of "undesirable" in air pollution contexts, see *pollution*. A *primary pollutant* is a pollutant emitted into the atmosphere from an identifiable source. A *secondary pollutant* is a pollutant formed by chemical reaction in the atmosphere (WHO, 1980).

pollution: The introduction of pollutants into a solid, liquid, or gaseous medium, the presence of pollutants in a solid, liquid, or gaseous medium, or any undesirable modification of the composition of a solid, liquid, or gaseous medium (ISO, 1979). For air pollution, an undesirable modification is one that has injurious or deleterious effects.

population (general usage): The total number of persons inhabiting a country, town, or other area. A population may also be defined by some other characteristic (such as biological, legal, social, or economic) than living in a particular area, e.g., the male population, the gainfully occupied population.

population (statistics): The totality of items under consideration. Every clearly defined part of a population is called a "subpopulation". In the case of a random variable, the probability distribution is considered as defining the population of that variable (ISO, 1977). The term Population Segment is sometimes used as a synonym for subpopulation.

population at risk: The number of people who can develop the adverse health effect under study and who are potentially exposed to the risk factor of interest. For example, all people in a population who have not developed immunity to an infectious disease are at risk of developing the disease, if they are exposed. Similarly, people already having chronic disease are excluded from the population at risk in studies of the incidence of the disease (WHO, 1979).

population critical concentration (PCC): The concentration of a chemical in the critical organ (toxicology) at which a specified percentage of the exposed population has reached their individual critical organ concentrations. The percentage indicated by PCC-10 for 10%, PCC-50 for 50% etc. (similar to the use of the term LC_{50}) (Kjellström et al., 1984).

potential daily intake. The potential daily intake of a pesticide is the theoretical intake calculated on the basis of the maximum residue limits and/or extraneous residue limits and the per caput consumption of the relevant food commodities per day. The same concept applies to food additive intakes (Vettorazzi, 1980).

potentiation. The joint action of two or more chemicals on an organism is more than additive (WHO, 1978a).

precision. The closeness of agreement between the results obtained by applying the experimental procedure several times under prescribed conditions (ISO, 1977).

prevalence. The number of instances of a given disease or other condition in a given population at a designated time; sometimes used to mean prevalence rate. When used without qualification, the term usually refers to the situation at a specified point in time (point prevalence).

prevalence, annual (an occasionally used index): The total number of persons with the disease or attribute at any time during a year. It includes cases of the disease arising before but extending into or through the year as well as those having their inception during the year.

prevalence, lifetime. The total number of persons known to have had the disease or attribute for at least part of their life.

prevalence, period. The total number of persons known to have had the disease or attribute at any time during a specified period.

prevalence, point. The number of persons with a disease or an attribute at a specified point in time (Last, 1988).

prevalence rate (ratio). The total number of individuals who have an attribute or disease at a particular time (or during a particular period) divided by the population at risk of having the attribute or disease at this point in time or midway through the period. A problem may arise with calculating period prevalence rates because of the difficulty of defining the most appropriate denominator (Last, 1988).

primary pollutant. See *pollutant*.

primary protection standard. An accepted maximum level of a pollutant (or its indicator) in the target, or some part thereof, or an accepted maximum intake of a pollutant or nuisance into the target under specified circumstances (UN, 1972).

proportionate mortality rate, ratio (PMR): Number of deaths from a given cause in a specified time period, per 100 or 1000 total deaths in the same time period. Can give rise to misleading conclusions if used to compare mortality experience of populations with different distributions of causes of death (Last, 1988).

public health impact assessment: Application of risk assessment procedures to a specific target population. The size of the populations needs to be known. The end product is a quantitative statement about the number of people affected in the specific target populations (WHO, 1988).

prospective cohort study: See *cohort study*.

quantal effect: An effect that can be expressed only as "occurring" or "not occurring" (Finney, 1971). Typical examples of quantal effects are death or occurrence of a tumour.

radioactive half-life: (i) For a single radioactive decay process, the time required for the activity to decrease to half its value by that process (ISO, 1972); (ii) the time taken for the activity of an amount of radioactive nuclide to fall to half its initial value (ICRU, 1980).

rate: A measure of the frequency of a phenomenon. An expression of the frequency with which an event occurs in a defined population (from Last, 1988).

rate difference (RD): The absolute difference between two rates, for example, the difference in incidence rate between a population group exposed to a causal factor and a population group not exposed to the factor:

$$RD = I_e - I_u$$

where I_e = incidence rate among exposed, and I_u = incidence rate among unexposed. In comparisons of exposed and unexposed groups, the term excess rate may be used as a synonym for rate difference (Last, 1988).

rate ratio (RR): The ratio of two rates. The term is used in epidemiologic research with a precise meaning, i.e., the ratio of the rate in the exposed population to the rate in the unexposed population:

$$RR = \frac{I_e}{I_u}$$

where I_e is the incidence rate among exposed and I_u is the incidence rate among unexposed (Last, 1988).

reference population. The standard against which a population that is being studied can be compared (Last, 1988).

relative risk. (i) The ratio of the *risk* of disease or death among the exposed to the risk among the unexposed; this usage is synonymous with *risk ratio*; (ii) alternatively, the ratio of the cumulative incidence rate in the exposed to the cumulative incidence rate in the unexposed, i.e., the cumulative incidence ratio, and (iii) the term "relative risk" has also been used synonymously with "odds ratio" and, in some biostatistical articles, has been used for the ratio of *forces of morbidity*. The use of the term "relative risk" for several different quantities arises from the fact that for "rare" diseases (e.g., most cancers) all the quantities approximate one another. For common occurrences (e.g., neonatal mortality in infants under 1500-g birth weight), the approximations do not hold (Last, 1988).

replicate sampling. The act of taking several samples concurrently under comparable conditions (WHO, 1979).

replication. During the course of an experiment or survey, replication is the determination of a value more than once, so as to obtain a better estimation of the variation. Replication should be distinguished from repetition by the fact that replication of an experiment denotes repeated determinations carried out, as far as possible, at one place and one period of time. The successive determinations, including the first, are called replicates (ISO, 1977).

reproductive effects. The adverse effects of a chemical on any aspects of reproduction in an organism (WHO, 1979).

response. The proportion of an exposed population with an effect or the proportion of a group of individuals that demonstrate a defined effect in a given time (e.g., death) (WHO, 1979).

retention. The amount of substance that is left of the deposited amount after a certain time. If the retention follows a course in relation to time that is a first-order process, it may be described in terms of biological half-life (WHO, 1979).

retrospective study. A research design which is used to test etiologic hypotheses in which inferences about exposure to the putative causal factor(s) are derived from data relating to characteristics of the persons under study or to events or experiences in their past. The essential feature is that some of the persons under study have the disease or other outcome condition of interest, and their characteristics and past experiences are compared with those of other, unaffected persons. Persons who differ in the severity of the disease may also be compared (from Last, 1983).

risk: The probability that an event will occur, e.g., that an individual will become ill or die within a stated period of time or age. Also, a nontechnical term encompassing a variety of measures of the probability of a (generally) unfavourable outcome (Last, 1988).

risk assessment: A combination of hazard identification, risk estimation, exposure and risk characterization (WHO, 1988).

risk assessment management process: A global term for the whole activity from hazard identification to risk management (WHO, 1988).

risk characterization: The outcome of hazards identification and risk estimation applied to a specific use or occurrence of an environmental health hazard (e.g., a chemical compound). The assessment requires quantitative data on the human exposure in the specific situation. The end product is a quantitative statement about the proportion of affected people in a target population (WHO, 1988).

risk estimation: The quantification of dose-effect and dose-response relationships for a given environmental agent, showing the probability and nature of the health effects of exposure to the agent (WHO, 1988).

risk evaluation: The comparison of calculated risks of exposure to a given agent with the risks caused by other agents or societal factors and with the benefits associated with the agent (WHO, 1988).

risk management: The managerial, decision-making and control process to deal with those environmental agents for which risk evaluation has indicated that the risk is too high (WHO, 1988).

risk marker (synonym: *risk indicator*): An attribute that is associated with an increased probability of occurrence of a disease or other specified outcome and that can be used as an indicator of this increased risk. Not necessarily a causal factor (Last, 1988).

risk monitoring: The process of following up decisions and actions within risk management in order to check whether the aims of reduced exposure and risk are achieved (WHO, 1988).

safety (of a drug or other chemical substance for human health): The extent to which a chemical substance may be used in the amounts necessary for intended purposes with a minimum risk of adverse health effects (WHO, 1979).

safety factors (in food additives and contaminants): A factor applied to the no-observed-effect level to derive acceptable daily intake (ADI) (the no-observed-effect level is divided by the safety factor to calculate the ADI). The value of the safety factor depends on the nature of the toxic effect, the size and type of population to be protected,

and the quality of the toxicological information available (WHO, 1987).

sample: One or more items taken from a population and intended to provide information on the population, and possibly to serve as a basis for a decision on the population or on the process which had produced it (ISO, 1977).

sampling: The procedure used to constitute a sample (ISO, 1977).

sampling error: Part of the total estimation error of a parameter due to the random nature of the sample (ISO, 1977).

screening: The presumptive identification of unrecognized disease or defect by the application of tests, examinations, or other procedures which can be applied rapidly. A screening test is not intended to be diagnostic. Persons with positive or suspicious findings must be referred to their physicians for diagnosis and necessary treatment.

Screening is an initial examination only, and positive responders require a second, diagnostic examination. The initiative for screening usually comes from the investigator or the person or agency providing care rather than from a patient with a complaint. Screening is usually concerned with chronic illness and aims to detect disease not yet under medical care (from Last, 1988).

secondary pollutant: See *pollutant*.

sediment: Material that occurs on the bottom of a water-stream and is the result of sedimentation of suspended matter (WHO, 1979).

sedimentation: The effect of gravitational forces resulting in the separation of particles from the fluid in which they are suspended (ISO, 1979)

sensitivity (in chemical analysis): For a simple procedure, the slope of the analytical calibration curve, i.e., the differential of the measure (\bar{x}) with respect to concentration (c) (i.e., $d\bar{x}/dc$). The greater the value of this derivative, the greater the sensitivity. Sensitivity should not be confused with *limit of detection* (IUPAC, 1976).

sensitivity and specificity (of a screening test): *Sensitivity* is the proportion of truly diseased persons in the screened population who are identified as diseased by the screening test. Sensitivity is a measure of the probability of correctly diagnosing a case, or the probability that any given case will be identified by the test (synonym: *true positive rate*).

Specificity is the proportion of truly nondiseased persons who are so identified by the screening test. It is a measure of the probability

of correctly identifying a nondiseased person with a screening test (synonym: *true negative rate*). The relationships are shown in the following fourfold table, in which the letters *a*, *b*, *c*, and *d* represent the quantities specified below the table.

Screening test results	True status		Total
	Diseased	Not diseased	
Positive	a	b	a + b
Negative	c	d	c + d
Total	a + c	b + d	a + b + c + d

- a. Diseased individuals detected by the test (true positives)
- b. Nondiseased individuals positive by the test (false positives)
- c. Diseased individuals not detectable by the test (false negatives)
- d. Nondiseased individuals negative by the test (true negatives)

$$\text{Sensitivity} = \frac{a}{a + c} \qquad \text{Specificity} = \frac{d}{b + d}$$

$$\text{Predictive value (positive test result)} = \frac{a}{a + b}$$

$$\text{Predictive value (negative test result)} = \frac{d}{c + d}$$

(Last, 1988).

sidestream smoke: The smoke that is given off from the cigarette (pipe, cigar) between puffs and is not directly inhaled by the smoker.

specificity (in chemical analysis): The degree to which a given analytical procedure detects a specified component but not other components that may be present in the sample (WHO, 1979).

standardization: A set of techniques used to remove as far as possible the effects of differences in age or other confounding variables, when comparing two or more populations. The common method uses weighted averaging of rates specific for age, sex, or some other potential confounding variable(s) according to some specified distribution of these variables. There are two main methods, as follows:

Direct method: The specific rates in a study population are averaged, using as weights the distribution of a specified standard population. The directly standardized rate represents what the crude rate would have been in the study population if that population had the

same distribution as the standard population with respect to the variable(s) for which the adjustment or standardization was carried out.

Indirect method: This is used to compare study populations for which the specific rates are either statistically unstable or unknown. The specific rates in the standard population are averaged, using as weights the distribution of the study population. The ratio of the crude rate for the study population to the weighted average so obtained is the standardized mortality (or morbidity) ratio, or SMR. The indirectly standardized rate itself is the product of the SMR and the crude rate for the standard population (Last, 1988).

standardized mortality (morbidity) ratio (SMR): The ratio of the number of events observed in the study group or population to the number of deaths expected if the study population had the same specific rates as the standard population, multiplied by 100 (Last, 1988).

stochastic effect: Effect for which the probability of occurrence depends on the absorbed dose. Hereditary effects and cancer induced by radiation are considered to be stochastic effects (ICRP, 1977). The term "stochastic" indicates that the occurrence of effects so named would be random. This means that, even for an individual, there is no threshold of dose below which the effect will not appear, but the chance of experiencing the effect increases with increasing dose (WHO, 1979).

stratification: The process of or result of separating a sample into several subsamples according to specified criteria such as age groups, socioeconomic status, etc. The effect of confounding variables may be controlled by stratifying the analysis of results. For example, lung cancer is known to be associated with smoking. To examine the possible association between urban atmospheric pollution and lung cancer, controlling for smoking, the population may be divided into strata according to smoking status. The association between air pollution and cancer can then be appraised separately within each stratum. Stratification is used not only to control for confounding effects but also as a way of detecting modifying effects. In this example, stratification makes it possible to examine the effect of smoking on the association between atmospheric pollution and lung cancer (Last, 1988).

stratified sampling: Of a population which can be divided into different subpopulations (called strata), sampling carried out in such a way that specific proportions of the sample are drawn from the different strata (ISO, 1977).

subacute toxicity test: An animal experiment serving to study the effects produced by the test material when administered in repeated doses (or continuously in food, drinking-water) over a period of up to about 90 days (WHO, 1979).

subjective environment (synonym: *perceived environment*): The environment as it is perceived by persons living in it, e.g., eye irritation caused by air pollution, or pleasure arising from good housing conditions (WHO, 1979).

surveillance: Ongoing scrutiny, generally using methods distinguished by their practicability, uniformity, and frequently their rapidity, rather than by complete accuracy. Its main purpose is to detect changes in trend or distribution in order to initiate investigative or control measures (Last, 1988).

synergism: See *potentiation*.

systems analysis: The analysis of an existing or proposed system in order to find optimal solutions for achieving the objectives of the system. The method owes much to the development of computer logic, and computerized methods of data control are used in the systems analysis when necessary (WHO, 1979).

target (biological): Any organism, organ, tissue, or cell that is subject to the action of a pollutant or other chemical, physical, or biological agent (WHO, 1979).

target (of environmental pollution): A human being or any organism, organ, tissue, cell, resource, or any constituent of the environment, living or not, that is subject to the activity of a pollutant or other chemical or physical activity or other agent (WHO, 1979).

target organ(s): Organ(s) in which the toxic injury manifests itself in terms of dysfunction or overt disease (WHO, 1979).

target population: (i) The collection of individuals, items, measurements, etc., about which we want to make inferences. The term is sometimes used to indicate the population from which a sample is drawn and sometimes to denote any "reference" population about which inferences are required; (ii) The group of persons for whom an intervention is planned (Last, 1988).

temporary acceptable daily intake: Used when data are sufficient to conclude that use of the substance is safe over the relatively short period of time required to generate and evaluate further safety data, but are insufficient to conclude that use of the substance is safe over a lifetime. A higher-than-normal safety factor is used when establishing a temporary ADI and an expiration date is established by which time appropriate data to resolve the safety issue should be available (WHO, 1987).

temporary maximum residue limit: A temporary maximum residue limit is a maximum residue limit established for a specified, limited period

when (i) only a temporary or conditional acceptable daily intake has been established for the pesticide concerned, or (ii) although an acceptable daily intake has been established, the residue data are inadequate for firm maximum residue recommendations (WHO, 1976).

teratogen. An agent which, when administered prenatally (to the maternal animal), induces permanent abnormalities in structure (WHO, 1987).

teratogenicity. The property (or potential) to produce structural malformations or defects in an embryo or fetus (WHO, 1987).

time-weighted average (TWA) exposure. The concentration in the exposure medium at each measured time interval multiplied by that time interval and divided by the total time of observation. For occupational exposure a working shift of eight hours is commonly used as the averaging time (WHO, 1979).

tolerance. An adaptive state characterized by diminished responses to the same dose of a chemical (WHO, 1979).

total diet study. A total diet study is a study designed to establish the pattern of pesticide residue intake by a person consuming a defined diet (WHO, 1979).

total diet studies. Studies undertaken to show the range and amount of various foodstuffs in the typical diet or to estimate the total amount of a specific substance (e.g., pesticide residue, vitamin, or food contaminant) in a typical diet (WHO, 1979).

toxicity. The toxicity of a substance is the capacity to cause injury to a living organism (WHO, 1978a). A highly toxic substance will cause damage to an organism if administered in very small amounts and a substance of low toxicity will not produce an effect unless the amount is very large. However, toxicity cannot be defined in quantitative terms without reference to the quantity of substance administered or absorbed, the way in which this quantity is administered (e.g., inhalation, ingestion, injection) and distributed in time (e.g., single or repeated doses), the type and severity of injury, and the time needed to produce the injury (WHO, 1979).

toxicokinetics. A term with the same meaning as *chemobiokinetics* for substances not used as drugs (WHO, 1979).

toxicometry. A combination of investigation methods and techniques for making a quantitative assessment of toxicity and hazards of poisons (UNEP/IRPTC, 1982).

trophic level: The amount of energy, in terms of food, that an organism needs. Organisms capable of utilizing inorganic chemicals, e.g., plants, or food of low energy content are said to be on a low trophic level whereas, for example, predator species needing food of high energy content are said to be on a high trophic level. The trophic level, thus, indicates the level of the organism in the food chain (WHO, 1979).

units of measurement: The base units of the SI system are: metre (m), kilogram (kg), second (s), ampere (A), kelvin (K), candela (cd), and mole (mol) (BIPM, 1979).

uptake (synonym: *absorption*): The entry of a chemical substance into the body, into a cell, or into the body fluids by passage through a membrane or by other means (WHO, 1979).

validity, measurement: An expression of the degree to which a measurement measures what it purports to measure.

Several varieties are distinguished, including *construct validity*, *content validity*, and *criterion validity* (concurrent and predictive validity).

construct validity: The extent to which the measurement corresponds to theoretical concepts (constructs) concerning the phenomenon under study. For example, if on theoretical grounds, the phenomenon should change with age, a measurement with construct validity would reflect such a change.

content validity: The extent to which the measurement incorporates the domain of the phenomenon under study. For example, a measurement of functional health status should embrace activities of daily living, occupational, family, and social functioning, etc.

criterion validity: The extent to which the measurement correlates with an external criterion of the phenomenon under study. Two aspects of criterion validity can be distinguished.

- (1) *Concurrent validity.* The measurement and the criterion refer to the same point in time. An example would be a visual inspection of a wound for evidence of infection validated against bacteriological examination of a specimen taken at the same time.
- (2) *Predictive validity.* The measurement's validity is expressed in terms of its ability to predict the criterion. An example would be an academic aptitude test that was validated against subsequent academic performance (Last, 1988).

validity, study. The degree to which the inference drawn from a study, especially generalizations extending beyond the study sample, are warranted when account is taken of the study methods, the representatives of the study sample, and the nature of the population from which it is drawn. Two varieties of study validity are distinguished:

- (1) *Internal validity:* The index and comparison groups are selected and compared in such a manner that the observed differences between them on the dependent variables under study may, apart from sampling error, be attributed only to the hypothesized effect under investigation.
- (2) *External validity (generalizability):* A study is externally valid or generalizable if it can produce unbiased inferences regarding a target population (beyond the subjects in the study). This aspect of validity is only meaningful with regard to a specified external target population. For example, the results of a study conducted using only white male subjects might or might not be generalizable to all human males (the target population consisting of all human males). It is not generalizable to females (the target population consisting of all people). The evaluation of generalizability usually involves much more subject-matter judgment than internal validity (Last, 1988).

REFERENCES

- BIPM (1977) *Le système international d'unités (SI)* Sèvres, Bureau international des Poids et Mesures.
- BISHOP, C.A. (1957) EJC policy statement on air pollution and its control. *Chem. eng. Process*, 53(11): 146-170.
- DUSTMAN, E.H. & STICKEL, L.F. (1969) The occurrence and significance of pesticide residue in wild animals. *Ann. N.Y. Acad. Sci.*, 160: 162-170.
- FINNEY, D.G. (1971) *Probit Analysis*, 3rd ed., London, Cambridge University Press.
- HAGAN, J.M. (1959) Acute toxicity. *Q. J. Assoc. Food Drug Off.*, 22: 17-25.
- IAEA (1978) *Particle size analysis in estimating the significance of airborne contamination*, Vienna, International Atomic Energy Agency (Technical Report Series No. 179).
- IARC (1977) *IARC monograph programme on the evaluation of the carcinogenic risk of chemicals to humans*, Lyon, International Agency for Research on Cancer (Technical Report No. 77/002).
- ICRP (1965) *Principles of environmental monitoring related to the handling of radioactive materials. Report of Committee IV of the International Commission on Radiological Protection*, Oxford, Pergamon Press.
- ICRP (1977) *Radiation protection. Recommendations of the International Commission on Radiological Protection*, Oxford, Pergamon Press (Annals of the ICRP, Publication No. 26).
- ICRU (1980) *Radiation quantities and units*, Washington, DC, International Commission on Radiation Units and Measurements (ICRU Report No. 33).
- ILO (1977) *Code of practice on occupational exposure to airborne substances harmful to health*, Geneva, International Labour Office (MELE/1977/V).
- ISO (1972) *Nuclear energy glossary*, Geneva, International Organization for Standardization (ISO, 921).
- ISO (1975) *Vibration and shock - Vocabulary*, Geneva, International Organization for Standardization (ISO, 2041).

- ISO (1977) *Statistics - Vocabulary and symbols*, Geneva, International Organization for Standardization (ISO, 3534).
- ISO (1979) *Cleaning equipment for air or other gases - Vocabulary*, Geneva, International Organization for Standardization (ISO, 3649).
- ISO (1980) *Air quality: General Aspects - Vocabulary*, Geneva, International Organization for Standardization (ISO, 3649).
- ISO (1981) *Terms and definitions used in connection with reference materials*, Geneva, International Organization for Standardization (ISO Guide 30).
- IUPAC (1972) Manual of symbols and terminology for physicochemical quantities and units. Appendix: Definitions, terminology and symbols in colloid and surface chemistry. *Pure appl. Chem.*, 31: 577-638.
- IUPAC (1976) Nomenclature, symbols, units and their usage in spectrochemical analysis: II. Data interpretation. *Pure appl. Chem.*, 45: 99-103.
- KJELLSTROM, T., ELINDER, C.G., & FRIBERG, L. (1984) Conceptual problems in establishing the critical concentration of cadmium in human kidney cortex. *Environ. Res.*, 33: 284-295.
- LAST, J.M. (1988) *A dictionary of epidemiology: A handbook sponsored by the International Epidemiological Association*, 2nd ed., New York, Oxford, Toronto, Oxford Medical Publications, Oxford University Press.
- TASK GROUP ON METAL ACCUMULATION (1973) Accumulation of toxic metals with special reference to their absorption, excretion and biological half-time. *Environ. Physiol. Biochem.*, 3: 65-107.
- TASK GROUP ON METAL TOXICITY (1976) In: Nordberg, G.F., ed. *Effect and dose-response relationships of toxic metals*, Amsterdam, Elsevier Science Publishers, pp. 1-111.
- UN (1972) *Report of the United Nations Conference on the Human Environment*, Stockholm, 5-16 June, 1972. New York, United Nations (A/CONF.48/14/Rev.1).
- UNEP/IRPTC (1982) *English-Russian glossary of selected terms in preventive toxicology: Interim document*, Moscow, Centre of International Projects, GKNT, 68 pp.
- VETTORAZZI, G., ed. (1980) *Handbook of international food regulatory toxicology - Vol. 1: Evaluations*, New York, Spectrum Publications Inc.

- WAGNER, H.J., ed. (1986) *Principles of nuclear medicine*. Philadelphia, W.B. Saunders.
- WHO (1966) Expert Committee on Health Statistics. Prevalence and incidence. *Bull. World Health Organ.*, 35: 783-784.
- WHO (1972) WHO Technical Report Series, No. 485 (Report of a WHO Scientific Group on Human Development and Public Health), 40 pp.
- WHO (1974) WHO Technical Report Series, No. 546 (Report of a WHO Scientific Group on Assessment of Carcinogenicity and Mutagenicity of Chemicals), 19 pp.
- WHO (1976) WHO Technical Report Series, No. 592 (Report of the 1975 Joint Meeting of the FAO Working Party of Experts on Pesticide Residues and the WHO Expert Committee on Pesticide Residues), 45 pp.
- WHO (1978a) *Environmental Health Criteria 6: Principles and methods for evaluating the toxicity of chemicals. Part I*. Geneva, World Health Organization, 272 pp.
- WHO (1978b) *Primary health care. Report of the International WHO/UNICEF Conference on Primary Health Care, Alma Ata, USSR, 6-12 September 1978*. Geneva, World Health Organization.
- WHO (1979) *Agreed terms on health effects evaluation and risk and hazard assessment of environmental agents. Internal Report of a Working Group*. Geneva, World Health Organization (EHE/EHC/79.19).
- WHO (1980) *Glossary on air pollution*. Copenhagen, World Health Organization, Regional Office for Europe (WHO Regional Publications, European Series No. 9).
- WHO (1987) *Environmental Health Criteria 70: Principles for the safety assessment of food additives and contaminants in food*. Geneva, World Health Organization, 174 pp.
- WHO (1988) *Basic terminology for risk and health impact assessment and management. Internal Report of Working Group, 24-25 March, 1988*. Geneva, World Health Organization (Annex 3).