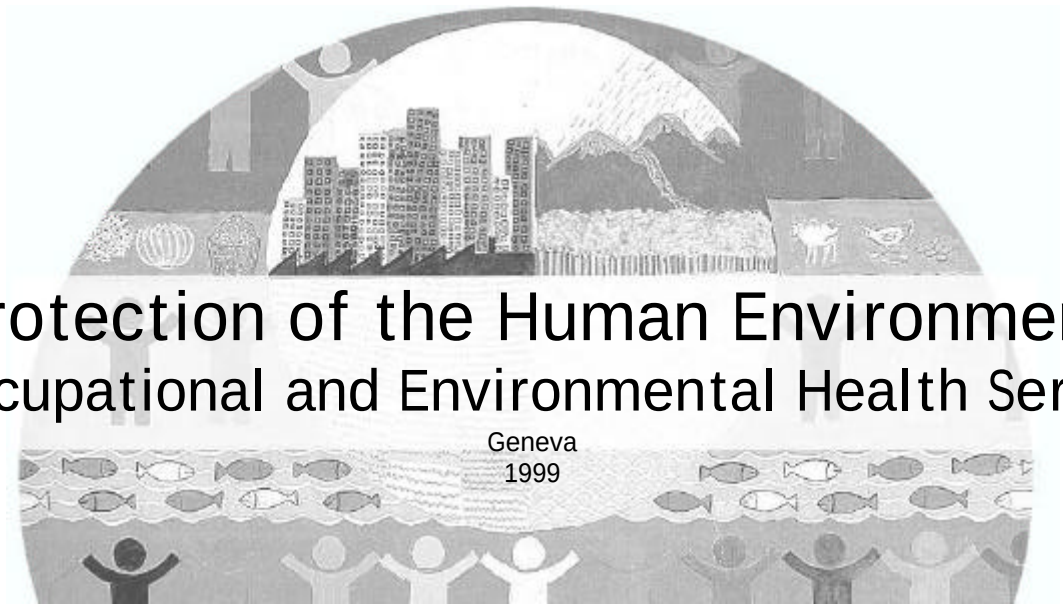
World Health Organization
Sustainable Development and Healthy Environments

WHO/SDE/OEH/99.10
Original: English
Dist.: Limited

ENVIRONMENTAL HEALTH INDICATORS: FRAMEWORK AND METHODOLOGIES



Protection of the Human Environment
Occupational and Environmental Health Series

Geneva
1999

The illustration of the cover page is extracted from Rescue Mission: Planet Earth, © Peace Child International 1994; used by permission.

8 World Health Organization 199

ENVIRONMENTAL HEALTH INDICATORS: FRAMEWORK AND METHODOLOGIES

Prepared by

David Briggs
Nene Centre for Research
University College Northampton

WORLD HEALTH ORGANIZATION

CONTENTS

1. INTRODUCTION

1.1 The role of indicators

There is an increasing need and demand for environmental health indicators, from agencies and practitioners to help support and monitor policy on environment and health at all levels - from the local to the international. Indicators are needed, for example:

- to help monitor trends in the state of the environment, in order to identify potential risks to health;
- to monitor trends in health, resulting from exposures to environmental risk factors, in order to guide policy;
- to compare areas or countries in terms of their environmental health status, so as to help target action where it is most needed or to help allocate resources;
- to monitor and assess the effects of policies or other interventions on environmental health;
- to help raise awareness about environmental health issues across different stake-holder groups (including policy-makers, health practitioners, industry, the public, the media);
- to help investigate potential links between environment and health (e.g. as part of epidemio-logical studies), as a basis for informing health interventions and policy.

1.2 What makes a good indicator?

The development of good environmental health indicators is nevertheless challenging. To be effective, indicators must satisfy a number of different criteria. In order to meet the needs of their users, who are often not experts in the subject matter or the idiosyncracies of the data, they must provide a relevant and meaningful summary of the conditions of interest. In order to satisfy the wider community - including those who might wish to challenge the message they give - they must be transparent, testable and scientifically sound. If they are to detect variation or change in the world they describe, they must be sensitive to real changes in the conditions they measure, yet robust enough not to be swamped by noise in - or minor differences in the source of - the data used. If they are actually to be developed and used, they must be cost-effective to compile and apply.

1.3 Implications for indicator design

These criteria have various implications which tend to condition and limit the types of indicator that can be developed, and the ways in which they may be constructed, presented and used. Many of these criteria are also to some extent mutually incompatible: that is one reason why indicators are difficult to design. The ultimate need for cost-effectiveness, for example, often means that indicators must be developed on the basis of data which already exist or which - if newly collected - can also be used for other purposes. Unfortunately, many of the data which do exist have been collected for specific purposes, and are therefore not ideal for other applications. The need for clarity and ease of understanding also implies that indicators must often condense large volumes of data into a brief overview, and reduce the complexities of the world to a simple and unambiguous message. The need for scientific validity, on the other hand, requires that this process of précis must not go too far. Indicators must simplify without distorting the underlying truth, or losing the vital connections and interdependencies which govern the real world. At the same time, if indicators are to be sensitive to change, they need to be based on accurate, high resolution and consistent data. Achieving this, whilst also maintaining simplicity, is itself a challenge. To do so whilst also ensuring that the indicators can make use of the limited, and often varied, data which are usually available is even more difficult. To achieve all this cost-effectively is difficult indeed.

The different uses to which indicators may be put - as illustrated by the list of potential applications, above - also creates challenges. Each use may imply the need for a slightly different indicator. An indicator devised to monitor trends over time, for example, should be based on data which are spatially representative, but not necessarily spatially intensive or complete. The same indicator, used to examine geographic patterns and identify ‘hotspots’, will need to be based on data which are spatially detailed and comprehensive: temporal variations will be less important. An indicator developed to raise public awareness about an environmental health issue will need to be interesting and acceptable to the community concerned (in the jargon of indicators it will need to have ‘resonance’). This may mean that some degree of complexity and rigour may need to be sacrificed to make the message bold and clear. In devising indicators for use as part of an epidemiological

investigation, however, emphasis will be placed first and foremost on its scientific validity and accuracy.

For all these reasons, developing multi-purpose indicators is extremely difficult. All indicators are to some extent use-specific and context-bound. Issues such as the geographic resolution of the source data and the level of spatial aggregation, the geographic coverage, the averaging times or periods to which the data relate, the detection limits and precision of the data, the way in which the indicator is constructed and presented, and the interpretations which are finally made, all depend upon the use to which the indicator is put.

Indicators also need to be dynamic. They must be updated and amended as the world changes: not only changes in the conditions they specifically describe, but also in the availability of data, in scientific knowledge, or in the levels of awareness and needs of their users. As new environmental health issues emerge - or even as potential issues begin to be seen - new indicators will need to be developed, while old ones may cease to be relevant and may be left to die.

Indicators, therefore, are neither fixed nor universal. What makes a good indicator at one place at one time will not necessarily be relevant at another. As a consequence, although it is possible to devise definitive indicator sets which serve specific needs (e.g. OECD 1998), the wider utility of these is inevitably limited. On the other hand, it is not appropriate simply to let a form of indicator anarchy - in which everyone develops their own indicators - prevail. This would merely result in a large duplication of effort, the proliferation of indicator sets, and a growing difficulty of comparing or combining indicators from different sources. It may also encourage the development of poorly-conceived and ill-designed indicators which may misinform rather than inform. Instead, the need is for guidelines which can help users develop and construct their own indicators, which satisfy their own needs, yet at the same time which meet high standards of design and validity.
That is the primary purpose of the 'Indicator Profiles' presented here. Their aim is:

- to rationalise the way in which environmental health indicators are formulated, constructed and applied;
- to provide clear guidelines on indicator design;
- to encourage clear and full documentation on the genealogy of indicators;
- to encourage awareness and consideration of the limitations inherent in the indicators; and
- to encourage good practice in indicator construction and interpretation.

To this end, the profiles describe a sample of environmental health indicators and show how they can be compiled and interpreted. The indicators are not intended to be comprehensive: they are a sample, selected to illustrate the range of indicators which might be developed in relation to a number of key environmental health issues, and to show some of the implications involved. Nor are the descriptions intended to be definitive: as argued above, indicators can and must be adapted and adjusted according to circumstance and need. The descriptions, however, provide a useful framework which should be relevant for many applications.

2. ORGANISATION OF THE INDICATOR PROFILES

2.1 Environmental health issues

The environmental health issues for which the indicator profiles have been developed are not to be defended in terms of their global importance or political priority. On the whole, the issues used *are* of widespread significance, but as noted above - and as the recent development of National Environmental Health Action Plans (Briggs *et al.* 1998) show - environmental health priorities vary markedly from one country to another. Major differences in priority occur, in particular, between the less developed and more developed areas of the world (WHO 1992, 1999). The issues illustrated here, however, are intended to represent a range of environmental health concerns: from 'traditional' risks such as poor sanitation, shelter and access to safe water, to 'modern' risks such as radiation and chemical safety of food. They have also been selected to show some of the links and interdependencies which exist between different environmental health issues, and thus between the indicators concerned. Indeed, one of the main messages to draw from the profiles is the need always to interpret indicators, and the issues to which they relate, holistically: to see them within the wider context.
In light of this, the issue-related indicators presented here are preceded by two introductory sets of indicators, relating to the socio-economic and policy contexts. The purpose of these is to provide a description of the wider realm within which the issues exist, and to provide background information which can be used to help interpret the issue-specific indicators.
It should also be mentioned that the definition of environmental health issues is, in itself, a complex task. The way any issue is defined and approached is likely to vary substantially depending on the perspective of those

involved. In defining issues, we are usually attempting to isolate a specific concern from a much wider range of processes and effects. A different person may place the focus of attention at a different point, and different links and factors will thus become relevant. There is no single set of environmental health issues, therefore; rather, each issue is an artefact of the person who defines it. Nor do issues really exist in isolation; instead they connect, overlap and intersect. These are further reasons why there are rarely if ever clearly defined and universally applicable indicator sets.

2.2 The DPSEEA framework

The indicators are arranged in terms of the now widely-used DPSEEA framework (Figure 1) (Corvalán *et al.* 1996). Within this framework, the driving forces component (D) refers to the factors which motivate and push the environmental processes involved. Of these, possibly the most important is population growth; others include technological development, economic development and policy intervention.

The driving forces within the DPSEEA model result in the generation of pressures (P) on the environment. These are normally expressed through human occupation or exploitation of the environment, and may be generated by all sectors of economic activity, including mining and quarrying, energy production, manufacturing, service industries, transport, tourism, agriculture and forestry. In each case, pressures arise at all stages in the supply chain - from initial resource extraction, through processing and distribution, to final consumption and waste release.

In response to these pressures, the *state* of the environment (S) is often modified. The changes involved may be complex and far-reaching, affecting almost all aspects of the environment and all environmental media. They are expressed, therefore, in terms of the frequency or magnitude of natural hazards, the availability and quality of natural resources, and the levels of environmental pollution. These changes in the state of the environment also operate at markedly different geographic scales. Many changes are intense and localised, and often concentrated close to the source of pressure (e.g. habitat loss, urban air pollution, contamination of local water supplies). Many others are more widespread, contributing to regional and global environmental change (e.g. desertification, marine pollution, climate change). Because of the complex interactions which characterise the environment, almost all these changes have far-reaching secondary effects.

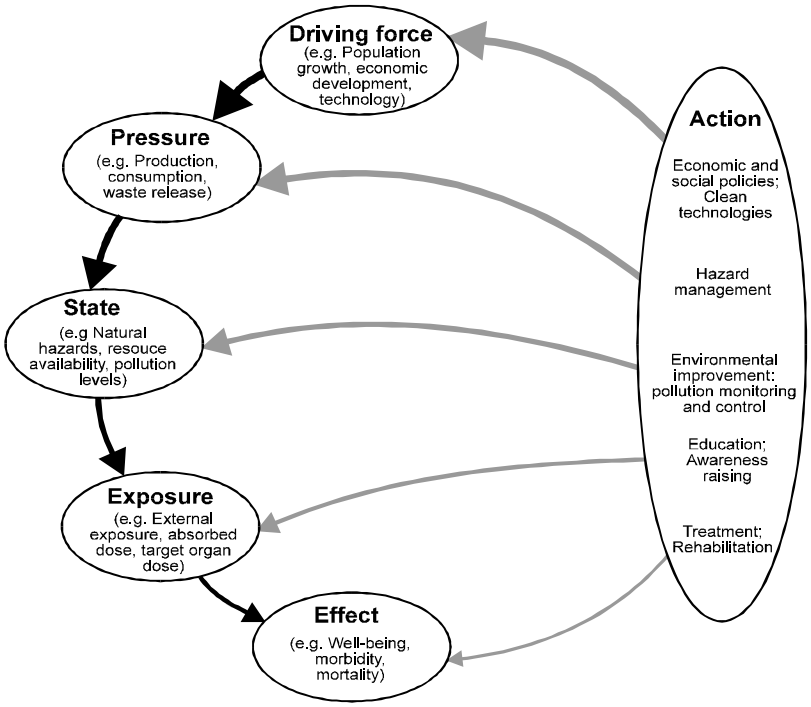


Figure 1. The DPSEEA framework

When people are exposed to these environmental hazards, then risks to health may occur. *Exposure* (E_1) thus refers to the intersection between people and the hazards inherent in the environment. The National Academy of Sciences (1991) defines exposure as 'an event that occurs when there is contact at a boundary between a human and the environment with a contaminant of a specific concentration for an interval of time'. In the case of environmental pollution, therefore, exposure can occur in a number of different ways — by inhalation, ingestion or dermal absorption — and may involve a wide range of different organs. *External exposure* refers to the quantity of the pollutant at the interface between the recipient and the environment. It is often measured either

using some form of personal monitor (e.g. passive sampling tubes for air pollution) or by modelling techniques (e.g. based upon knowledge of concentrations in the ambient environment). The amount of any given pollutant that is absorbed is often termed the *absorbed dose*, and may be dependent on the duration and intensity of the exposure. *Target organ dose* refers specifically to the amount that reaches the human organ where the relevant effects can occur (Sexton *et al.* 1995).

Exposure to environmental hazards, in turn, leads to a wide range of health *effects* (E_2). These may vary in type, intensity and magnitude depending upon the type of hazard to which people have been exposed, the level of exposure and the number of people involved. For convenience, a simple spectrum of effects can often be recognised. The earliest, and least intense, effects are sub-clinical, merely involving some reduction in function or some loss of wellbeing. More intense effects may take the form of illness or morbidity. Under the most extreme conditions, the result is death.

It must be said that the DPSEEA framework works well for risks associated with environmental pollution, where the chain from driving force to source activity and thence to health effect via emissions and exposure is evident. It can also be applied to the many psychological and perceptual health effects which may be generated by the fear, rather than the eventuality, of a hazard (e.g. stress or anxiety caused by fear of exposure to radiation from a nuclear power station, or of physical injury from war). It is less appropriate, however, in the case of physical risks, as presented by natural hazards (e.g. flooding) or technology (e.g. traffic accidents), where the concept of 'pressure' is less meaningful. Nor can it easily be applied in full to those environmental hazards, such as famine, which affect health more by omission than comission. Like other aspects of environmental health indicators, therefore, the DPSEEA framework should be seen as an aid, not a straight-jacket; it needs to be adapted and modified according to circumstance.

Partly as a reflection of this, it may be noted that the indicators presented here do not in most cases occupy every point in the DPSEEA chain for every issue. Because of the way they are conceived, different issues tend to focus on different parts of the DPSEEA framework. Some are more source-based (i.e. focusing on the driving forces and pressures which lead to exposure); many are exposure-based; others are effect- (i.e. health-) based. The indicators are thus presented either as 'chains' (i.e. a set of linked indicators from different parts in the DPSEEA framework) or as 'clusters' (i.e. a group of related indicators from one point in the framework). In almost all cases, however, the indicators are likely to be most meaningful and effective if interpreted together.

2.3 Structure of the profiles

The indicator profiles are designed to provide a range of information on the indicators. The profiles are divided into two sections:

- a general *Indicator Profile*, describing the environmental health issue which the indicator addresses, the rationale and role behind the indicator, linkage with other indicators (within the set described), alternatives methods of defining and constructing the indicator, related indicators (proposed or developed in other, international programmes), sources of further information, and relevant agencies involved in indicator development and use;
- an *Example Indicator*, giving a specific definition, relevant underlying concepts, data needs and sources, method of computation, units of measurement, potential scales of application and guidelines on interpretation.

Details of the information required in each section of the profile are given in Table 1. A full list of the indicators included in the profiles is given in Table 2.

The full set of indicator sheets is hosted on the Web, at address:
www.northampton.ac.uk/ncr/who/index.html

REFERENCES

Briggs, D.J., Stern, R.M. and Tinker, T. (eds.). 1998. *Environmental health for all. Risk assessment and risk communication in National Environmental Health Action Plans*. Dordrecht: Kluwer, 278 p.
Corvalán, C., Briggs, D. and Kjellstrom, T. 1996. Development of environmental health indicators. In: *Linkage methods for environment and health analysis. General guidelines.* (D. Briggs, C. Corvalán and M. Nurminen, eds.). Geneva: UNEP, USEPA and WHO, pp.19-53.
National Academy of Sciences.1991. *Human exposure assessment for airborne pollutants. Advances and opportunities.* National Academy of Sciences, National Academy Press, Washington, D.C., USA. 321 p.
OECD. 1998. *Towards sustainable development. Environmental indicators.* Paris: OECD.
Sexton K, Callahan MA, Bryan EF. 1995. Estimating exposure and dose to characterize health risks: the role of human tissue monitoring in exposure assessment. *Environmental Health Perspectives*, 103(S3), pp. 13-29.
WHO. 1992. *Our planet, our health.* Geneva: WHO.
WHO. 1999. *The global health report.* Geneva: WHO.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the input from WHO staff in the revision of the environmental health indicators' profiles and examples.

Table 1. Key to indicator profiles

Brief title of indicator	Position in DPSEEA chain
INDICATOR PROFILE	
Issue	Specification of the environmental health issue(s) to which the indicator relates
Rationale and role	Outline of the justification for the indicator and its potential use in relation to the issue(s) specified. Where appropriate, indicate the main user communities and the level of aggregation/geographic scale at which the indicator might be used.
Linkage with other indicators	Describe the relationship between this and other indicators relating to the issue(s) specified, listing all indicators, and their position in the DPSEEA chain.
Alternative methods and definitions	Outline possible alternatives to, or variations on, the indicator. In particular, suggest how the indicator can be improved (where suitable data exist), or adjusted/simplified to cope with inadequacies in the available data. If appropriate, suggest proxy indicators.
Related indicator sets	List similar or related indicators, proposed or developed as part of other indicator sets (e.g. UN Indicators for sustainable development, UNCHS Urban indicators programme, WHO Catalogue of health indicators)
Sources of further information	Give full details of references and other sources of information relevant to the indicator (e.g. Web addresses, databases). List, in particular, references to other indicator sets using similar indicators, examples of the use of the indicator, or materials which describe the context and rationale for its use.
Involved agencies	List agencies which have a leading role in relation to the indicator, including: data providers, indicator developers, indicator users. Include international, national and - where relevant - regional/local agencies.
EXAMPLE INDICATOR	
Definition of indicator	Detailed definition of the indicator
Underlying definitions and concepts	Definition of all terms and concepts involved in describing and constructing the indicator.
Specification of data needed	List data needed to construct indicator
Data sources, availability and quality	Outline potential sources of data, and comment on their quality and characteristics in terms of the indicator. Where appropriate indicate ways of obtaining data which are not readily available (e.g. through special surveys).
Computation	Specify the way in which the indicator is computed: i.e. how the data are analysed/processed to construct the indicator. Where relevant, express the computation process mathematically, and define the terms used.
Units of measurement	Specify the units of measurement used in presenting the indicator
Scale of application	Specify the potential scales of application or level of aggregation. Note that the scale specified refers to the area across which the indicator can be used; for geographic comparisons, the indicator might be developed at lower levels of aggregation. Definitions: local (within a city or community); regional (within a sub-national region); national (for a country); international (across several countries or globally).
Interpretation	Describe the ways in which the indicator may be interpreted in relation to the issue(s) specified. Show what inferences can be made from apparent trends or patterns in the indicator. Discuss, in particular, constraints on the interpretation of the indicator, due for example to limitations of the data or complexities in the relationships implied by the indicator.

Table 2. Summary list of environmental health indicators

ISSUE	THEME/TOPIC	INDICATOR	EXAMPLE DEFINITION	DPSEEA
Socio-demographic context	Poverty	Poverty	Human poverty index (compound index)	Driving force
	Population density	Population density	Population density	Driving force
	Population growth	Rate of population growth	Annual net rate of population growth	Driving force
	Age structure	Dependent population	Percentage of people aged less than 16 years or 65 years or more	Driving force
	Urbanisation	Rate of urbanisation	Annual net rate of change in the proportion of people living in urban areas	Driving force
	Infant mortality	Infant mortality rate	Annual death rate of infants under one year of age	Effect
	Life expectancy	Life expectancy	Number of years a newborn baby is expected to live, given the prevailing mortality rate	Effect
Air pollution	Outdoor air pollution	Ambient concentrations of air pollutants in urban areas	Mean annual concentrations of ozone, CO, particulates (PM_{10}, $PM_{2.5}$, SPM), SO_2, NO_2, O_3 and lead in the outdoor air in urban areas	State
	Indoor air pollution	Sources of indoor air pollution	Percentage of households using coal, wood or kerosene as the main source of heating and cooking fuel	Exposure
	Respiratory illness	Childhood morbidity due to acute respiratory illness	Incidence of morbidity due to acute respiratory infections in children under five years of age	Effect
	Respiratory illness	Childhood mortality due to acute respiratory illness	Annual mortality rate due to acute respiratory infections in children under five years of age	Effect
	Air quality management	Capability for air quality management	Capability to implement air quality management	Action
	Air quality management	Availability of lead-free gasoline	Consumption of lead-free gasoline as a percentage of total gasoline consumption	Action
Sanitation	Excreta disposal	Access to basic sanitation	Proportion of the population with access to adequate excreta disposal facilities	Exposure
	Diarrhoea	Diarrhoea morbidity in children	Incidence of diarrhoea morbidity in children under five years of age	Effect
	Diarrhoea	Diarrhoea mortality in children	Diarrhoea mortality rate in children under five years of age	Effect

ISSUE	THEME/TOPIC	INDICATOR	EXAMPLE DEFINITION	DPSEEA
Shelter	Informal settlements	Percentage of population living in informal settlements	Percentage of the population living in informal settlements	Exposure
	Unsafe housing	Percentage of population living in unsafe housing	Percentage of the population living in unsafe, unhealthy or hazardous housing	Exposure
	Home accidents	Accidents in the home	Incidence of accidents in the home	Effect
	Urban planning	Urban planning and building regulations	Scope and extent of building and planning regulations for housing	Action
Access to safe drinking water	Water quality/supply	Access to safe and reliable supplies of drinking water	Percentage of the population with access to an adequate amount of safe drinking water in the dwelling or within a convenient distance from the dwelling	Exposure/ Action
	Water quality/supply	Connections to piped water supply	Percentage of households receiving piped water to the home	Exposure/ Action
	Diarrhoea	Diarrhoea morbidity in children	Incidence of diarrhoea morbidity in children under five years of age	Effect
	Diarrhoea	Diarrhoea mortality in children	Diarrhoea mortality rate in children under five years of age	Effect
	Water-borne diseases	Outbreaks of water-borne diseases	Incidence of outbreaks of water-borne diseases	Effect
	Water quality monitoring	Intensity of water quality monitoring	Density of water quality monitoring network	Action
Vector-borne disease	Population at risk	Population at risk from vector-borne diseases	Number of people living in areas infected by disease vectors	Exposure
	Vector-borne disease mortality	Mortality due to vector-borne diseases	Mortality rate due to vector-borne diseases	Effect
	Vector control	Adequacy of vector control and manage-ment systems	Percentage of the at-risk population covered by effective vector control and management systems, by disease type	Action

ISSUE	THEME/TOPIC	INDICATOR	EXAMPLE DEFINITION	DPSEEA
Solid waste management	Waste collection	Municipal waste collection	Percentage of population served by regular waste collection services	Action
	Waste disposal	Municipal	Mass of solid waste disposed of by	Action

		waste disposal	municipal waste management services	
	Waste management	Hazardous waste policies	Effectiveness of hazardous waste policies and regulations	Action
Hazardous/ toxic substances	Blood lead	Blood-lead level in children	Percentage of children with blood lead levels > 10 ug/dl	Exposure
	Chemical poisonings	Mortality due to poisoning	Mortality rate due to poisoning	Effect
	Contaminated land	Contaminated land management	Scope and rigour of contaminated land management	Action
Food safety	Food-borne diseases	Food-borne illness	Outbreak rate of food-borne illness	Effect
	Diarrhoea	Diarrhoea morbidity in children	Incidence of diarrhoea morbidity in children under five years of age	Effect
	Diarrhoea	Diarrhoea mortality in children	Diarrhoea mortality rate in children under five years of age	Effect
	Monitoring of food safety	Monitoring of chemical hazards in food	Proportion of potentially hazardous chemicals monitored in food	Action
Radiation	Radiation exposure	Cumulative radiation dose	Percentage of the population receiving an effective radiation dose in excess of 5 mS/yr.	Exposure
	UV exposure	UV light index	UV light index	Exposure
Non-occu-pational health risks	Motor vehicle accidents	Mortality from motor vehicle accidents	Death rate due to road accidents	Effect
	Non-occupational injury	Injuries to children	Incidence of physical injury to children less than 5 years of age	Effect
	Poisoning	Incidence of poisonings of young children	Number of reported poisonings per year in children under 5 years of age	Effect
Occupational health risks	Occupational hazards	Exposure to unsafe work-places	Percentage of workers exposed to unsafe, unhealthy or hazardous working condi-tions	Exposure
	Occupational morbidity	Morbidity due to occupatio-nal health hazards	Incidence of occupational injury	Effect
	Occupational mortality	Mortality from occupational health hazards	Incidence of occupational mortality	Effect

Annex: ENVIRONMENTAL HEALTH INDICATORS: PROFILES AND EXAMPLES

POVERTY	**D**PSEEA
INDICATOR PROFILE	
Issue	Socio-demographic context
Rationale and role	Poverty is a major determinant of health. Lack of an adequate income tends to lead to poor levels of nutrition, poor housing conditions, impaired access to health and other services and low levels of education. Together these result in increased exposures to environmental risk factors, and an impoverished ability to mitigate their effects on health. Poverty is thus one of the most important **driving forces** in relation to environmental health, and one of the most vital points of intervention and control for environmental health policies. This indicator is thus designed to measure the level of poverty, and can be used: • to identify populations at risk because of their poverty, as a basis for targeting action at especially vulnerable or needy areas or groups; • to monitor trends in income and levels of poverty, in order to help plan environmental health strategies; • to compare and contrast cities, regions or countries in terms of the socio-economic context for human health; • to monitor and assess the effects of strategies aimed at reducing levels of poverty and disadvantage; • to help explore the effects of deprivation on health outcome, and to help control for socio-economic confounding in studies of relationships between environment and health.
Linkage with other indicators	This indicator is part of a chain of indicators describing the socio-economic context of environmental health: • Driving force: ***Poverty****; Population density; Rate of population growth; Dependent population; Rate of urbanisation* • Effect: *Infant mortality rate; Life expectancy* However, since poverty is such a pervasive determinant of health, it also has links with all other issues, including: • Air pollution • Access to basic sanitation • Access to adequate and safe food supply • Non-occupational health risks • Shelter • Access to safe drinking water • Vector-borne disease • Waste management • Sanitation
Alternative methods and definitions *Alternative*	A wide range of methods has been developed for assessing poverty at the local, national or international level. Examples include: • Income distribution: measures of the average income, or difference or range of incomes across the population. The UNCHS Household income distribution indicator (UNCHS 1993), for example, is calculated as the ratio of the average income of the highest income quintile to the average income of the lowest income quintile. • The poverty gap: a measure of the difference between the poverty line and the level of consumption of all individuals in the population – e.g. the Poverty gap index (DAC 1999,

methods and definitions *- continued*	UN 1996), or of the number of people living below the poverty line (e.g. UNCHS 1993). This method requires a definition of the poverty line, either in terms of income or level of consumption, which can be used as a reference against which to assess the poverty gap. • Poverty or deprivation indices: these typically assign an arithmetic score to individuals or areas based on a number of poverty or deprivation indicators (e.g. income, employment status, family situation, access to basic resources). Examples include the UNDP Human Poverty Index (UNDP 1999), the Jarman score (Jarman 1983), the Townsend Index (Townsend et al. 1988), the Carstairs score (Carstairs and Morris 1989).
Related indicator sets	UNDP *Human development report* • Human poverty index for developing countries (HPI-1) • Human poverty index for developed countries (HPI-2) UN *Indicators of sustainable development* • Head count index of poverty • Poverty gap index • Squared poverty gap index • Gini index of income inequality UNCHS and World Bank *Housing indicators programme* • Household income distribution • Households below poverty line • DAC Indicators of poverty reduction • Incidence of extreme poverty • Poverty gap ratio • Inequality Many indicators have also been developed at national level, often as a basis for allocating health resources or to e.g.: • the Carstairs score • the Jarman score • the Townsend index
Sources of further information	Carstairs, V. and Morris, R. *1989 Deprivation: explaining difference in mortality between Scotland and England and Wales*. British Medical Journal 299, 886-889. DAC 1999 http://www.oecd.org/dac/indicators/htm/list.htm Jarman, B. *1983 Identification of underprivileged areas*. British Medical Journal 286, 1705-1709 Townsend, P., Phillimore, P. and Beattie, A. 1988 *Health and deprivation: inequality and the north*. London: Croom Helm Ltd. UN *1996 Indicators of sustainable development. Framework and methodologies*. New York: UN. UNCHS (Habitat) and the World Bank 1993 *The Housing Indicators Programme*. Report and the Executive Director (Volume I). Nairobi: UNCHS. UNCHS (Habitat) 1995b *Monitoring human settlements*, Abridged Survey. Indicators Programme. Nairobi: UNCHS (Habitat). UNDP 1999 *Human development report*. New York: United Nations.
Involved agencies *Involved agencies* *- continued*	OECD (DAC) Overseas Development Institute United Nations – Centre for Human Settlements (Habitat) United Nations Development Programme (UNDP) WHO

	World Bank
EXAMPLE INDICATOR	
Definition of indicator	Human poverty index
Underlying definitions and concepts	The UNDP Human Poverty Index Poverty is a compound index, based on a number of component measures. Two indices have, in fact, been developed: HPI-1, an index for developing countries, and HPI-2, an index for developed countries. The index thus reflects the circumstances that: • poverty is multi-dimensional and cannot be adequately assessed on the basis of any single condition or factor; • poverty is a relative concept, and thus that different factors and different expectations need to be taken into account in different countries. • HPI-1 (the index for developing countries) is based on five component measures of deprivation, each of which needs to be defined: • longevity: the percentage of the population with a life expectancy less than 40 years; • illiteracy: the percentage of the population aged 15 years or over who are unable, with understanding, both to read and write a short, simple statement on their everyday life; • people without access to safe water: the percentage of people without access to safe and reliable supplies of drinking water either in the home or at a reasonable distance from the home; • people without access to health services: the percentage of people without local access to a basic health services; • underweight children: the percentage of children at age 5 years who are at least two standard deviations below the median weight for the age of the reference population. • HPI-2 (the index for developed countries) is based on four component measures of deprivation, each of which needs to be defined: • longevity: the percentage of the population with a life expectancy of less than 60 years; • illiteracy: defined as for HPI-1 • standard of living: the percentage of the population living below the poverty line (defined as 50% of the median disposable personal income) • exclusion: percentage of the work force in long-term unemployment (12 months or more). • poverty: a level of consumption which is below that defined by the poverty line; • poverty line: a basis level of consumption (including food, shelter and other essentials) considered to be the minimum required for a healthy standard of living. This is normally defined in terms of the level of income necessary to provide these basic needs. • total population: total resident population at the time of survey.
Specification of data needed *Specification of data needed* *-continued*	For HPI-1, the following data are required: • number of people with a life expectancy less than 40 years • number of people aged 15 years or over who are functionally illiterate • number of people without access to safe drinking water • number of people without access to health services • median weight and standard deviation of children aged 5 • number of children aged 5 with a weight at least 2 standard deviations below the median weight at age 5 • total resident population • total number of people 15 years or over • total number of children aged 5 years

	• For HPI-2, the following data are required: • number of people with a life expectancy less than 60 years • number of people aged 15 years or over who are functionally illiterate • total number of people aged 15 years or more • median disposable income • number of people with disposable income less than 50% of the median • number of people in the work force • number of people in long-term unemployment (12 months or more)
Data sources, availability and quality	Data on life expectancy (for both HPI-1 and HPI-2) are available in most countries from life tables, based on age- and gender-specific death rates. The level of aggregation of these statistics may vary, however, and in some countries statistics are only available for relatively large regions. Where life tables do not exist, calculations of life expectancy may be made from data on the numbers of births and deaths and age-stratified population statistics. Data on literacy rates (for both HPI-1 and HPI-2) may be available from national censuses, or can be obtained through household or special surveys. National estimates are available for most countries (e.g. UNDP 1999), but these may be based on surveys or censuses carried out at different dates so may not be strictly comparable. UNESCO also conduct surveys at intervals. Data on the availability of, and access to, safe drinking water (for HPI-1) may be obtained both from censuses and from relevant administrative authorities (e.g. water companies, public works departments). Data on access to informal supplies will usually need to be obtained via household surveys. Data on access to health services (for HPI-1) may be available from national census sources or from the health authorities concerned. Alternatively, information may need to be collected via household or sample surveys. Data on the number of underweight children (for HPI-1) may be available from routine monitoring undertaken be health services; where routine data are not available, special surveys may need to be undertaken. Data on disposable income (for HPI-2) are obtainable primarily through results of household surveys. The quality of these data depends primarily on the date, size and representativeness of the surveys. Data on unemployment status (and on the total labour force) are routinely collected in many countries as part of national censuses and routine household or labour force surveys. Data may also be available from relevant administrative authorities (e.g. ministries of labour or employment) and social service and taxation records. Data are generally reliable for formal employment, but are likely to be highly unreliable for casual and unregistered employment. Population data (including data on age structure) are available from national censuses and are usually reliable.
Computation	The two indexes are computed arithmetically, as follows: HPI-1 = $[0.3 (P_1^3 + P_2^3 + P_3^3)]^{0.3}$ where: P_1 = percentage of people not expected to survive to 40 years P_2 = illiteracy rate
Computation - continued	$P_3 = (P_{31} + P_{32} + P_{33}) / 3$ where: P_{31} = percentage of people without access to safe water P_{32} = percentage of people without access to health services P_{33} = percentage of underweight children HPI-2 = $[0.25 (P_2^3 + P_4^3 + P_5^3 + P_6^3)]^{0.3}$

	where: P_2 = illiteracy rate (as above) P_4 = percentage of people not expected to survive to 60 years P_5 = percentage of people with disposable income < 50% of the median P_6 = percentage of people in long term unemployment
Units of measurement	Percentage
Scale of application	Local to international
Interpretation	In general terms, an increase in the index value may be taken as an indication of increased poverty and an associated increase in the vulnerability of the population to health problems, and reduced quality of life. Care is nevertheless necessary, especially in comparing countries or regions which differ markedly in terms of their culture, economy and way of life. Marked rural/urban differences may also occur, which may be masked where data are aggregated to large areas. The data needed to construct the indicator may also suffer from inaccuracies, inconsistencies and gaps, which might not be apparent in the reported statistics. As with all composite indicators, in which several measures are combined, it is important to recognise that the final index may hide differences in the component variables: thus areas or countries with markedly different profiles of poverty may end up with a similar index value.

POPULATION DENSITY	**D**PSEEA
INDICATOR PROFILE	
Issue	Socio-demographic context
Rationale and role	Population density varies greatly across the world, and high levels of population density are not of themselves indicative of either a poor living environment or inadequate health conditions. In less developed countries, however, high levels of population density are often associated with rapid urbanisation and severe pressures on local services (e.g. water supply, sanitation) and the health system. In the long term, high population densities may also be unsustainable because of the pressures they exert on the surrounding environment. Changes in population density thus act as **a driving force**, affecting many other aspects of the environment and human health. The indicator thus provides a useful measure of the socio-economic context for environmental health. As such, it can be used: • to monitor changes in population densities, and to provide an early warning of the pressures these might exert on the environment, local services and the health system; • to identify areas of excessively high and unsustainable population density, where special efforts might be needed to improve or protect health; • to help interpret patterns in other environmental health indicators or health outcomes (e.g. variations in infant mortality, life expectancy or nutritional status).
Linkage with other indicators	This indicator is part of a chain of indicators describing the socio-economic context of environmental health: • Driving force: *Poverty;* ***Population density****; Rate of population growth; Dependent population; Rate of urbanisation* • Effect: *Infant mortality rate; Life expectancy* However, since population density is a generic driving force which affects many other aspects of environmental health, it also has links to most other issues, including: • Air pollution • Access to basic sanitation • Access to adequate and safe food supply • Non-occupational health risks • Shelter • Access to safe drinking water • Vector-borne disease • Waste management • Sanitation
Alternative methods and definitions	The population density is defined as the total population divided by surface area. For some purposes, it may be appropriate to compute this indicator for specific subsections of the population or to stratify it by age or other socio-economic factors. In regions or countries containing large areas of water surface, it may be more appropriate to define the population in terms of the **land** area.
Related indicator sets	UN *Indicators of sustainable development* • Population density

Sources of further	UN *1996 Indicators of sustainable development. Framework and methodologies.* New York: UN.

information	UNCHS (Habitat) and the World Bank 1993 *The Housing Indicators Programme*. Report and the Executive Director (Volume I). Nairobi: UNCHS. UNCHS (Habitat) 1995b *Monitoring human settlements, Abridged Survey*. Indicators Programme. Nairobi: UNCHS (Habitat).
Involved agencies	United Nations – Centre for Human Settlements (Habitat) WHO
EXAMPLE INDICATOR	
Definition of indicator	Population density
Underlying definitions and concepts	Population: the resident population (including those living in both formal and informal settlements)
Specification of data needed	Total population Land area
Data sources, availability and quality	Data on population numbers are usually available via national censuses and are generally reliable. Data on land area of the administrative area of interest can be derived either from basic statistical sources, or by measurement from maps.
Computation	The indicator is computed as: P / A where P is the total population and A is the land area (km^2)
Units of measurement	Number per square kilometre
Scale of application	Local to international
Interpretation	This indicator needs to be interpreted with caution, for population density is not a direct measure of environmental health. The relationship between population density and environmental quality or health status may vary depending on other factors, such as the level of economic development, the resource base and carrying capacity of the area, and the quality of the support services. Where these conditions are inadequate, an increase in population density may be taken as an indication of increased pressures on the environment and increased risks to health. In the longer term, the indicator can also provide a general measure of potential sustainability.

RATE OF POPULATION GROWTH	DPSEE**A**
INDICATOR PROFILE	
Issue	Socio-demographic context
Rationale and role	Population growth represents one of the major **driving forces** acting on environmental health. Rapid or persistent population growth can result in severe environmental damage and increased pressures on local infrastructure and services. As a result, risks to health may increase: for example, through inadequate nutrition, poor sanitation, insufficient access to safe drinking water, poor housing conditions and increased exposure to vector-borne diseases. This indicator thus provides a useful measure of potential pressures on the environment and human health. It can be used, for example: • to provide an early warning of developing pressures on the environment or service facilities; • to identify areas of high population growth, as a basis for informing resource allocations; • to help interpret patterns or trends in other environmental health indicators (e.g. infant mortality, life expectancy, levels of sanitation).
Linkage with other indicators	This indicator is part of a chain of indicators describing the socio-economic context of environmental health: • Driving force*: Poverty; Population density; **Rate of population growth;** Dependent population; Rate of urbanisation* • Effect: *Infant mortality rate; Life expectancy* However, since population growth is a generic driving force which affects many other aspects of environmental health, it also has links to most other issues, including: • Air pollution • Access to basic sanitation • Access to adequate and safe food supply • Non-occupational health risks • Shelter • Access to safe drinking water • Vector-borne disease • Waste management • Sanitation
Alternative methods and definitions	Population growth can be defined as the rate of change in the resident population between two time periods. For some purposes, it may be appropriate to compute this indicator for specific subsections of the population or to stratify it by age or other socio-economic factors
Related indicator sets	UN *Indicators of sustainable development* • Population growth rate UNCHS and World Bank *Housing indicators programme* • Population growth rate
Sources of further information	UN *1996 Indicators of sustainable development. Framework and methodologies.* New York: UN.
Sources of further	UNCHS (Habitat) and the World Bank 1993 *The Housing Indicators Programme*. Report and the Executive Director (Volume I). Nairobi: UNCHS. UNCHS (Habitat) 1995b *Monitoring human settlements, Abridged Survey*. Indicators

information -continued	Programme. Nairobi: UNCHS (Habitat).
Involved agencies	United Nations – Centre for Human Settlements (Habitat) WHO
EXAMPLE INDICATOR	
Definition of indicator	Annual net rate of population growth
Underlying definitions and concepts	Population growth: the rate of change in the resident population per unit of time. Note that population growth may thus be positive (increase in population) or negative (decrease in population).
Specification of data needed	Total resident population for two years
Data sources, availability and quality	Data on population numbers are usually available via national censuses and are generally reliable.
Computation	The indicator is computed as: $100 * [(P_{t1} - P_{t0})/ P_{t0}] / n$ where P_{t1} is the total population at time 1; P_{t0} is the total population at time 0; and n is the number of years (t1-t0).
Units of measurement	Percentage per year
Scale of application	Local to international
Interpretation	In general terms, rapid growth in population may be seen as evidence of growing pressures on the environment and the health-related services, and potential increased risks to health. The relationships implied by this interpretation are, however, complex and may not always be valid. The effects of population growth may vary, for example, depending on the resource base of the area concerned, the lifestyle of the population, the level of economic development, the level of trade with other areas, the degree of development of its infrastructure and services, and the strength and adequacy of environmental and health planning. Marked geographic differences in population growth rate may also occur (e.g. between rural and urban areas, or between inner-city and suburban areas), which may be masked when the data are aggregated to large areas. The indicator thus needs to be interpreted with caution.

DEPENDENT POPULATION	DPSEEA
INDICATOR PROFILE	
Issue	Socio-demographic context
Rationale and role	Population age structure has important implications for environmental health, in both the long and the short term. A high proportion of young children, for example, implies the potential for rapid population growth in the future as these children reach their fertile age. A high proportion of dependents (either young children or the elderly) places a higher burden of support on those who are economically active, and may also imply the need for improved support services. The young and the elderly are also those who are often most vulnerable to environmental health risks. This indicator is intended to provide a measure of the total dependent population. It is thus a **driving force** indicator, which can be used: • to monitor trends in the population structure, and provide an early warning of potential implications for population change and pressures on economic development and health services; • to identify areas with especially high dependent or vulnerable populations, which might need particular support and help; • to help plan the long-term development of environment and health services and resource allocation.
Linkage with other indicators	This indicator is part of a chain of indicators describing the socio-economic context of environmental health: • Driving force*: Poverty; Population density; Rate of population growth; **Dependent population**; Rate of urbanisation* • Effect: *Infant mortality rate; Life expectancy* Because the young and elderly are those who are most at risk from environment-related illness, however, the indicator also has links to many other issues, including: • Air pollution • Sanitation • Hazardous/toxic substances • Access to adequate and safe food supply • Non-occupational health risks • Shelter • Access to safe drinking water • Vector-borne diseases
Alternative methods and definitions	This indicator might usefully be defined in a number of different ways. For most purposes, the dependent population may be seen to comprise two main groups – children and the elderly – though it may also be appropriate to include those who are dependent for other reasons (e.g. disability). The indicator might thus be computed either for these groups collectively, or for each group separately: the latter may be more appropriate in many cases, since the implications for population growth and long-term health needs clearly differ between different age and dependency groups.
Related indicator sets	UNCHS and World Bank *Housing indicators programme* • Population by sex

Sources of	UN *1996 Indicators of sustainable development. Framework and methodologies.* New York:

further information	UN. UNCHS (Habitat) and the World Bank 1993 *The Housing Indicators Programme*. Report and the Executive Director (Volume I). Nairobi: UNCHS. UNCHS (Habitat) 1995b *Monitoring human settlements, Abridged Survey*. Indicators Programme. Nairobi: UNCHS (Habitat).
Involved agencies	United Nations – Centre for Human Settlements (Habitat) WHO
EXAMPLE INDICATOR	
Definition of indicator	Percentage of people aged less than 16 years, or 65 years or more
Underlying definitions and concepts	Dependent population: those who can be considered economically inactive because of their age - in this case, those under 16 years of age or over 65 years of age.
Specification of data needed	Number of people aged 15 years or less Number of people aged 65 or over Total population
Data sources, availability and quality	Data on population numbers by age are usually available through national censuses and may be considered reliable. Where suitable census data are not available (e.g. for inter-censal years), estimates may be derived through analysis of vital statistics.
Computation	The indicator can be computed as: $100* [P_{0-15} + P_{65+}) / P_{tot}]$ where P_{0-15} is the number of people aged 15 years or under; P_{65+} is the number of people aged 65 or over; and P_{tot} is the total population.
Units of measurement	Percentage
Scale of application	Local to international
Interpretation	This indicator provides useful, contextual information on the demographic character of the population, and its implications for population growth and the demand for health support. In general terms, an increase in the percentage of the dependent population may be seen as an indication of an increased proportion of highly vulnerable people, and a potential increased demand on health services. Nevertheless, the indicator must be interpreted with caution, especially where the two age groups are combined into a single measure of dependent population since the young and elderly differ substantially in their environmental health needs.

RATE OF URBANISATION	**D**PSEEA
INDICATOR PROFILE	
Issue	Socio-demographic context
Rationale and role	The world's population is becoming increasingly urbanised. Natural rates of population growth are high in many urban areas, and in many countries there is a strong trend of net migration into towns, as a result of both the 'pull' of apparent economic opportunity in towns and the 'push' of famine and insufficient employment in rural areas. Urbanisation, however, poses severe challenges to both the environment and health. Without adequate planning and control, rapid urbanisation may lead to: the development of informal settlements; development in inappropriate (e.g. contaminated, flood-prone or unstable) areas; poorly serviced and designed residential areas; excessive pressures on the available services; and resultant problems of sanitation, air pollution, inadequate access to safe drinking water, over-crowding and social problems. Urbanisation is thus an important **driving force** for environmental health. This indicator provides a measure of the rate of urbanisation. Its can be used to: • monitor trends in urbanisation, as a basis for identifying future policy needs; • compare cities or countries in terms of their rate of urbanisation and to identify areas of especially rapid growth; • assess and monitor the effectiveness of interventions aimed at controlling urban development; • help interpret other environmental health indicators (e.g. infant mortality, life expectancy, access to safe drinking water, sanitation).
Linkage with other indicators	This indicator is part of a chain of indicators describing the socio-economic context of environmental health: • Driving force: *Poverty; Population density; Rate of population growth; Dependent population;* ***Rate of urbanisation*** • Effect: *Infant mortality rate; Life expectancy* However, since urban population growth is a generic driving force which affects many other aspects of environmental health, it also has links to most other issues, including: • Air pollution • Access to basic sanitation • Access to adequate and safe food supply • Non-occupational health risks • Shelter • Access to safe drinking water • Vector-borne disease • Waste management • Sanitation
Alternative methods and definitions	The rate of urbanisation can be defined as the rate of change in the proportion (or total number) of people living in urban areas, within a defined interval of time. The indicator might be based on different definitions of urban areas, as appropriate for the area under consideration. The indicator might also usefully be stratified by age, gender or other socio-economic variables. Where the purpose is to examine the causes of urban growth, it might be appropriate to compute the indicator separately for the natural growth rate and the net migration rate.

Related indicator sets	UN *Indicators of sustainable development* • Rate of growth of urban population • Percent of population in urban areas UNCHS and World Bank *Housing indicators programme* • City population
Sources of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN. UNCHS (Habitat) and the World Bank 1993 *The Housing Indicators Programme*. Report and the Executive Director (Volume I). Nairobi: UNCHS. UNCHS (Habitat) 1995a *Monitoring the shelter sector. Housing Indicators review.* Nairobi: UNCHS. UNCHS (Habitat) 1995b *Monitoring human settlements, Abridged Survey*. Indicators Programme. Nairobi: UNCHS (Habitat).
Involved agencies	United Nations – Centre for Human Settlements (Habitat) The World Bank WHO
EXAMPLE INDICATOR	
Definition of indicator	Annual net rate of change in the proportion of people living in urban areas
Underlying definitions and concepts	Urban areas: areas of continuous built-up land, with a population of greater than 20,000 inhabitants. Urban population: the number of people resident in urban areas.
Specification of data needed	Urban population in two years
Data sources, availability and quality	Data on urban population numbers may be available from national censuses, in which case they are usually relatively reliable. In many cases, however, the census districts used for population enumeration do not coincide with the morphological boundaries of urban areas. Over- and under-bounding may thus occur: in the former case, the reported populations may include people living outside the urban area (e.g. in the countryside or in outlying towns and villages); in the latter case, the reported population will omit some people who live within the urban area. Problems may also arise with the accuracy of the data because illegal or unregistered inhabitants may not be counted, and marked seasonal variations may occur due to short-term migration (e.g. of seasonal labour). Where direct measures of the urban population are not available from the census, estimates may be made by spatial analysis of census statistics (e.g. using GIS). The reliability of these estimates will depend on the accuracy of the models used: the most accurate estimates usually require the use of land cover (e.g. air photography or satellite) data to define the urban boundaries and disaggregate the population totals. Where these methods are not possible or appropriate, data may need to be obtained through household surveys.
Computation	The indicator can be computed as: $100 * \{[(P_{urb} / P_{tot})_{t1} - (P_{urb} / P_{tot})_{t0}] / (P_{urb} / P_{tot})_{t0}\} / n$ where P_{urb} is the number of people living in urban areas; P_{tot} is the total population, t1 and t0 are years, and n is the number of years (t1-t0).

Units of	Percentage per year

measurement	
Scale of application	Mainly regional to international
Interpretation	In general terms, rapid urban population growth may be seen as evidence of growing pressures on the environment and the health-related services, and potential increased risks to health. The relationships implied by this interpretation are, however, complex and may not always be valid. The effects of urban population growth may vary, for example, depending on the resource base of the city and its hinterland, the lifestyle of the population, the level of economic development, the level of trade with other areas, the degree of development of its infrastructure and services, and the strength and adequacy of environmental and health planning. Problems of data quality (e.g. due to effects of under- and over-bounding, incomplete counting of illegal residents, or because of seasonal variations in population) may also limit the accuracy of the indicator. The indicator thus needs to be interpreted with caution.

INFANT MORTALITY RATE	DPSEEA
INDICATOR PROFILE	
Issue	Socio-demographic context
Rationale and role	Young children are in many ways the most vulnerable group to adverse effects of environmental health. They are sensitive not only to conditions in their immediate environment after birth, but also to the pre- and post-natal health of their mother, and the quality of the health support services. Information on infant mortality thus provides both a specific indication of the health status of young children, and a more general indicator of the overall quality of health conditions and the effectiveness of health facilities. The indicator may be used: • to assess the health status of young children and risks of early mortality; • to monitor trends in infant mortality, either as an indication of changing health status or to help prioritise policy; • to map variations in infant mortality, as a basis for identifying areas of particular need and to target intervention; • to monitor or assess the effectiveness of policy or health service interventions; • as a basis for drawing inferences about the quality of the post-natal environment and level of health support; • to help investigate links between environmental conditions and health.
Linkage with other indicators	This indicator is part of a chain of indicators, describing the general socio-demographic status and context of the population: • Driving force*: Poverty; Population density; Rate of population growth; Dependent population; Rate of urbanisation* • Effect: ***Infant mortality rate****; Life expectancy* However, since infant mortality may occur for a wide range of reasons, it also has much wider significance, e.g. in relation to: • Air pollution • Sanitation • Access to adequate and safe food supply • Shelter • Access to safe drinking water • Vector-borne diseases • Environmental health management
Alternative methods and definitions	Infant mortality is usually expressed as the death rate of infants under one year of age, per 1000 live births, over a given period of time. If complete data on infant deaths and births are unavailable, the infant mortality rate can be calculated through indirect or modelling methods based on special questions asked in censuses or demographic surveys. (For information on these estimates, see DESIPA 1983, 1988). Where available, the indicator can usefully be disaggregated according to cause of death, and by gender and geographic area.
Related indicator sets *Related indicator*	UN *Indicators of sustainable development* • Infant mortality rate WHO *Catalogue of health indicators*

sets *- continued*	• Infant mortality rate UNDP *Human development report* • Infant mortality rate
Sources of further information	DESIPA 1983 *Manual X: indirect techniques for demographic estimation*. New York: Population Division. UN. DESIPA 1988 *The United Nations software package for mortality measurement.* New York: Population Division, UN. DESIPA 1993 *Demographic yearbook.* Statistical Division. New York: UN. Hill, K. 1991 *Approaches to the measurement of childhood infant mortality: A comparative review.* Population Index 57(3), 368-382. UN *1996 Indicators of sustainable development. Framework and methodologies.* New York: UN. UNDP 1999 *Human development report*. New York: United Nations. WHO 1981 *Development of indicators for monitoring health for all by the year 2000,* p.29. Geneva, WHO. WHO *1994 Ninth general programme of work covering the period 1996-2001.* Geneva: WHO. WHO 1994 *Global Health for All data base*. Geneva: WHO. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO programmes.* Geneva: WHO (under revision). WHO and UNICEF 1992 *Measurement of overall and cause specific mortality in infants and children.* Report of a joint WHO/UNICEF consultation, 15-17 December 1992. Unpublished document WHO/ESM/UNISEF/CONS/92.5
Involved agencies	UN – Department of Economics and Social Information and Policy Analysis, Population Division and Statistics Division WHO – Programme for the Promotion of Environmental Health UNICEF
EXAMPLE INDICATOR	
Definition of indicator	Mortality rate for children under 1 year of age
Underlying definitions and concepts	This indicator is based on the following definitions: **Infant mortality:** number of deaths under one year of age within a specified period. **Number of live births:** number of live births in the same period.
Specification of data needed	Number of infant deaths. Number of live births.
Data sources, availability and quality *Data sources, availability and quality*	Routine data on the number of infant deaths and live births are available from a number of sources, including vital registrations, sample registration systems, surveillance systems and censuses and demographic surveys (such as the demographic and health surveys of world fertility surveys). Information needed for this indicator is also collated by the UN on a regular basis. These data are generally of sound quality. In some developing countries, however, registration procedures may be incomplete or inconsistent, especially in remote rural areas. For this reason, rates based on civil registrations or hospital data may be biased towards the more affluent, urban sectors of the population. Definitions of live births may also vary between countries. Where data on infant deaths are lacking, special surveys may be conducted including retrospective questions about the survival of children. Surveys using maternal histories, in which women are asked to give the date of birth and the age of death (if applicable) of each live-born child are used in many household surveys, but care must be taken to avoid age-misreporting and to be sure there is a complete report of infant deaths. The preceding birth

- continued	technique, used in antenatal clinics, maternity clinics, and at the time of immunisation, can be useful as a basis for estimating the probability of dying by age two years, for children of health service users at the local level.
Computation	The indicator is computed as: 1000 * (D / B) where D is the number of deaths under one year of age in the survey period, and B is the number of live-births in the same period of time.
Units of measurement	Number of deaths per thousand live born.
Scale of application	Local to international
Interpretation	This indicator can be interpreted directly as a measure of the adequacy of the health environment (including not only the physical environment but also the social and health service context) for newborn children. An increase in infant mortality may be taken to imply a deterioration in that environment; a reduction in infant mortality implies an improvement in the health environment for young children. The range of factors affecting infant mortality is, however, large so specific risk factors - or the effects of specific interventions - cannot necessarily be inferred. Problems also exist with the quality of the data in some cases, especially in remote rural areas in developing countries. This can lead to significant bias in the data, towards urban and more affluent sectors of the population.

LIFE EXPECTANCY	DPSEEA
INDICATOR PROFILE	
Issue	Socio-demographic context
Rationale and role	Life expectancy is a widely used and generic measure of the health status of the population. Whilst non-specific, it does provide a useful indicator or the overall **effect** of environmental and other risk factors on health, and a basis for monitoring both trends in health and for comparing different areas or countries in terms of their health status.
Linkage with other indicators	This indicator is part of a chain of indicators, describing the general socio-demographic status and context of the population: • Driving force: *Poverty; Population density; Rate of population growth; Dependent population; Rate of urbanisation* • Effect: *Infant mortality rate**; Life expectancy*** However, since life expectancy is affected by a wide range of factors, it also has much wider significance, e.g. in relation to: • Air pollution • Sanitation • Access to adequate and safe food supply • Shelter • Access to safe drinking water • Vector-borne diseases • Non-occupational health risks • Occupational environment
Alternative methods and definitions	Life expectancy is usually defined as the number of years that a person may be expected to live, given the prevailing mortality conditions. It is most commonly defined either at birth or at age 5 years, and is usefully defined by gender. One commonly used alternative to this indicator is the age-standardised total death rate. This shows the death rate (numbers per 100,000 people) in each age group.
Related indicator sets	UN *Indicators of sustainable development* • Life expectancy UNCHS and The World *Bank Housing indicators programme* • Life expectancy at birth UNDP *Human development report* • Life expectancy at birth
Sources of further information	UN 1996 *Indicators of sustainable development.* Framework and methodologies. New York: UN. UNCHS (Habitat) and the World Bank 1993 *The Housing Indicators Programme*. Report and the Executive Director (Volume I). Nairobi: UNCHS. UNCHS (Habitat) 1995b *Monitoring human settlements, Abridged Survey*. Indicators Programme. Nairobi: UNCHS (Habitat). UNDP 1999 *Human development report.* New York: United Nations. WHO 1994 *Implementation of the Global Strategy for Health for All by the year 2000. Second evaluation. Eighth report on the world health situation.* Geneva: WHO Regional Office for Europe, Volume 5, European Region.
Involved agencies	UN

	WHO
EXAMPLE INDICATOR	
Definition of indicator	Life expectancy at birth
Underlying definitions and concepts	**Life expectancy at birth:** number of years a newborn child is expected to live, given prevailing mortality conditions
Specification of data needed	Age- and gender-specific death rates
Data sources, availability and quality	Data on life expectancy at birth are available for most countries from UN statistics. Detailed data are also available for some countries from life tables, based on age- and gender-specific death rates. The level of aggregation of these statistics may vary, however, and in some countries statistics are only available for relatively large regions. Where life tables do not exist, calculations of life expectancy may be made from data on the numbers of births and deaths and age-stratified population statistics.
Computation	The indicator is usually derived directly from life tables as the average expected lifespan of newborn children at the time of survey.
Units of measurement	Years
Scale of application	Local to international
Interpretation	Life expectancy at birth provides a simple, composite indicator of the health status of the population. Since it is non-specific, however, it cannot directly be interpreted as a measure of *environmental* health, and changes in life expectancy cannot necessarily be assumed to reflect changes in environmental conditions. In most cases, therefore, the indicator needs to be interpreted in association with other, more specific indicators. Uncertainties are also attached to estimates of life expectancy, since they are based on the assumption of *prevailing* mortality conditions. Changes in these conditions may render past estimates of life expectancy invalid.

AMBIENT CONCENTRATIONS OF AIR POLLUTANTS IN URBAN AREAS	DPSEEA
INDICATOR PROFILE	
Issue	Air pollution
Rationale and role	This indicator provides a measure of the **state** of the environment in terms of air quality and is an indirect measure of population **exposure** to air pollution in urban areas. The purpose of this indicator is to measure overall air quality and the potential exposure of people to air pollutants of health concern. The indicator may be used: • to monitor trends in air pollution as a basis for prioritising policy actions; • to map levels of air pollution in order to identify hotspots or areas in need of special action; • to help assess the number of people exposed to excess levels of air pollution; • to monitor levels of compliance with air quality standards; • to assess the effects of air quality policies; • to help investigate associations between air pollution and health effects.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of air pollution on health. • State: ***Ambient concentrations of air pollutants in urban areas*** • Exposure*: Sources of indoor air pollution* • Effect: *Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness* • Action: *Capability for air quality management; Availability of lead-free gasoline*
Alternative methods and definitions	This indicator may be designed and constructed in a number of ways. Where monitored data are available, it might usefully be expressed in terms of mean annual or percentile concentrations of air pollutants with known health effects - e.g. ozone, CO, particulates (PM_{10}, $PM_{2.5}$, SPM), black smoke, SO_2, NO_2, O_3, VOCs, benzene and lead - in the outdoor air in urban areas. Alternatively, the indicator might be expressed in terms of the number of days on which air quality guidelines or standards are exceeded (though in this case comparisons need to be made with care because of possible changes or differences in the guideline values). Where monitoring data are unavailable, estimates of pollution levels may be made using air pollution models. Dispersion models are, however, depend on the availability of emissions data; where these are not available, surveys may be conducted using rapid source inventory techniques (Economopolous 1993). Because of potential errors in the models or the input data, results from dispersion models should ideally be validated against monitored data.
Related indicator sets	UN *Indicators of sustainable development* • Ambient concentrations of pollutants in urban areas
Sources of further information	Economopolous, A.P. 1993 *Assessment of sources of air, water and land pollution.* A guide to rapid source inventory techniques and their use in formulating environmental control strategies, (2 vols). Geneva: WHO. UN 1996 *Indicators of Sustainable Development: framework and methodologies.* Report for the UN Commission on Sustainable Development. New York: UN Department for Policy Coordination and Sustainable Development. WHO 1987 *Air Quality Guidelines for Europe.* WHO Regional Publications, European Series No. 23. Geneva: WHO. (updated 1998: see http://www.who.int). WHO 1991 *Global Strategy for Health for all by the year 2000.* Geneva: WHO. WHO 1994 *Ninth General Programme of Work covering the period 1996-2001*. Geneva: WHO.
Sources of further	WHO 1998 Healthy Cities Air Management Information System, AMIS 2.0. CDRom. Geneva:

information -continued	WHO.
Involved agencies	WHO-Programme for the Promotion of Environmental Health National air quality monitoring networks WHO European Centre for Environment and Health European Environment Agency and Air Quality Topic Centre
EXAMPLE INDICATOR	
Definition of indicator	Mean annual and percentile concentrations of ozone, CO, particulates (PM_{10}, $PM_{2.5}$, SPM), SO_2, NO_2, O_3 and lead in the outdoor air in urban areas.
Underlying definitions and concepts	This indicator is based on the assumption that outdoor levels of air pollution in urban areas represent a significant source of exposure and health risk. Underlying definitions are: • Mean annual concentration: mean concentration of the pollutant of concern, averaged over all hours of the year. • Percentile concentration: concentration of pollutant of concern exceeded in 100-X% of hours, where X is the percentile as defined by the relevant standards.
Specification of data needed	Mean annual and percentile concentrations for CO, PM_{10}, $PM_{2.5}$, SPM, SO_2, NO_2, O_3 and lead. Site location, site type (e.g. kerbside, intermediate, background), monitoring method (e.g. passive sampler, continuous monitor) and sampling frequency.
Data sources, availability and quality	Data on ambient air pollution concentrations can be obtained from national or local monitoring networks, using either continuous (fixed-site) monitors or passive samplers. In addition, a growing volume of data can be obtained from the WHO Healthy Cities Air Management Information System (AMIS).
Computation	The indicator can be presented as: • the mean annual concentration • the relevant (e.g. 98th) percentile concentration or otherwise as appropriate (e.g. number of days/hours in excess of air pollution standard).
Units of measurement	$\mu g/m^3$, ppm or ppb, as appropriate; or percentage of days when standards/guideline values are exceeded
Scale of application	Mainly local to regional; application at broader scales is limited by the spatial non-representativeness of monitoring stations.

Interpretation	This indicator can be used to interpret both spatial patterns and temporal trends in air pollution levels. In general terms, an increase in pollutant concentrations may be taken to suggest an increase in exposures and raised health risk; a reduction in pollution levels implies a decrease in exposures and a reduction in health risk. Interpretation is often aided by reference to the relevant air quality guidelines or standards (e.g. by assessing the number of days or hours during which the standards are exceeded). Several factors nevertheless need to be taken into account in interpretation. One of the most important is the siting of the monitors. As a measure of exposure, data is generally most relevant where monitoring sites are located in residential or densely populated areas.

	Allowance also needs to be made for the detection limits, accuracy and comparability of the measurement methods. In particular, care needs to be taken when comparing data from different monitoring networks, due to the possibility of differences in sampling or measurement techniques. When used as a basis for assessing exposure, it is also important to recognise that actual exposures depend fundamentally upon indoor concentrations and time activity patterns of individuals. As with all exposure measures, relationships with health are also subject to considerable confounding, which should be strictly controlled for in epidemiological studies.

SOURCES OF INDOOR AIR POLLUTION	DPSEEA
INDICATOR PROFILE	
Issue	Air pollution
Rationale and role	Indoor exposures to air pollution are an important factor in respiratory illness and mortality. Much of this exposure relates to the use of fuels such as wood, kerosene, coal or dung for cooking and heating. The indicator thus provides a measure of the potential **exposure** to air pollution from indoor sources. It can be used: • to show time trends in levels of potential exposure • to provide an early indication of the effects of changes in domestic energy supplies on indoor exposures to air pollution • to show geographic variations in levels of potential exposure • to compare areas or countries in terms of potential exposures • to monitor the effects of intervention strategies aimed at reducing sources of indoor exposures due to cooking and heating fuels
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of air pollution on health. • State: *Ambient concentrations of air pollutants in urban areas* • Exposure: ***Sources of indoor air pollution*** • Effect: *Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness* • Action: *Capability for air quality management; Availability of lead-free gasoline*
Alternative methods and definitions	This indicator can be computed as the number or proportion of households (or population) which rely on fuels such as coal, wood, dung and kerosene (or other high emission and poorly ventilated systems) for heating and cooking. Relevant data are often available from household surverys. Alternatively, the indicator could be defined as the percentage of households connected to electricity and gas supplies. Data on this may be available from censuses or from the utility companies. Another possible alternative would be to base the indicator on the percentage of total energy consumption provided by electricity or gas.
Related indicator sets	None
Sources of further information	WHO 1994 *Implementation of the Global Strategy for Health for All by the year 2000*. Second evaluation. Eighth report on the world health situation. Geneva: WHO Regional Office for Europe, Volume 5, European Region. WHO 1998 Healthy Cities Air Management Information System, AMIS 2.0. CDRom. Geneva: WHO.
Involved agencies	National energy supply companies National ministries of energy WHO
EXAMPLE INDICATOR	
Definition of indicator	Proportion of households using coal, wood, dung or kerosene as the main source of heating and cooking fuel

Underlying	This indicator is based on the assumption that use of kerosene, wood, coal or dung for heating

definitions and concepts	and cooking tends to increase levels of exposure to indoor air pollution. Underlying definitions are: • **Household:** a single dwelling unit (e.g. a house or apartment) intended for permanent residence. • **Use of coal, wood, dung or kerosene as the main source of heating and cooking fuel:** the reliance on coal (or lignite), wood, dung or kerosene as the primary cooking a and heating fuel in the home.
Specification of data needed	Number of households using coal, wood, dung or kerosene as the main source of heating and cooking fuel Total number of households
Data sources, availability and quality	Data on number of households using coal, wood, dung or kerosene as the main source of cooking and heating fuel may be available from census statistics or household surveys, and in these cases are liable to be broadly reliable. In many cases, however, data will need to be collected as part of special surveys. Data on the total number of households should be available through national census statistics, though care is needed in relation to the definition of a 'household' (e.g. how collective dwellings are classified).
Computation	The indicator can be computed as: (C / H) * 100 where C is the number of households using coal, wood, dung or kerosene as the main source of cooking/heating fuel; H is the total number of households. The indicator should normally be calculated for a specified census date.
Units of measurement	Percentage
Scale of application	Mainly local to regional; problems of data consistency limit its application at broader scales.
Interpretation	This indicator provides a general measure of differences or trends in exposure to air pollutants from indoor heating and cooking sources: a reduction in the percentage of homes relying on coal, wood, dung or kerosene may be taken to imply a reduced level of exposure. In applying and interpreting the indicator, however, it should be noted that: • it takes no account of use of other sources of indoor pollution (e.g. smoking, furnishings, solvents) • the indicator takes no account of the many other factors (e.g. lifestyle and ventilation behaviour) likely to affect exposures • relationships with health outcome may be heavily confounded by other factors, including exposures to outdoor and occupational pollution, housing conditions and socio-economic factors.

CHILDHOOD MORBIDITY DUE TO ACUTE RESPIRATORY ILLNESS	DPSEEA
INDICATOR PROFILE	
Issue	Air pollution
Rationale and role	The incidence of acute respiratory illness in young children has shown a marked increase in recent decades, in almost all countries of the world. Many possible risk factors have been identified which might account for this trend; one of the most important is exposure to air pollution both in the home and outdoors. This indicator is intended to provide a measure of the **effect** of these exposures to air pollution in children. As such, it can be used: • to monitor trends in acute respiratory illness in children, in order to help prioritise policy action; • to map the distribution of the disease, in order to identify areas in need of special action; • to help identify specific at-risk groups in order to target intervention; • to analyse relationships between air pollution (and other risk factors) and respiratory health; • to assess the effectiveness of intervention strategies (such as air pollution control, traffic management, awareness raising campaigns).
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of air pollution on health. • State: *Ambient concentrations of air pollutants in urban areas* • Exposure: *Sources of indoor air pollution* • Effect: ***Childhood morbidity due to acute respiratory illness****; Childhood mortality due to acute respiratory illness* • Action: Capability for air quality management; Availability of lead-free gasoline
Alternative methods and definitions	This indicator can be defined as the incidence of morbidity due to acute respiratory illness in children under five years of age. Since acute respiratory illness tend to be more common in boys than girls, it can usefully be standardised by gender. Where the aim is to investigate relationships with potential causative factors, stratification on the basis of other variables (e.g. ethnicity) may also be appropriate. Variations on this indicator are possible, depending on the availability of morbidity data. In some countries, sales of respiratory medication (e.g. inhalers) can be used as a proxy, though this is non-specific to this age group; registrations at asthma clinics may also provide a proxy. The indicator could also be compiled and presented for other, more specific categories of acute respiratory infection, e.g.: • **Acute lower respiratory infection** (ALRI): an acute infection of the larynx, trachea, bronchi, bronchioles or lung. • **Acute upper respiratory infection** (AURI): an acute infection of the nose, pharynx (throat) or middle ear. Similar indicators might also be developed for other age groups considered to be at-risk (e.g. the elderly).
Related indicator sets	WHO *Catalogue of health indicators* Care-seeking for children with acute respiratory infections
Sources of further information *Sources of*	WHO 1992 *The measurement of overall and cause specific mortality in infants and children.* Report of joint WHO/UNICEF Consultation, 15-17 December 1992. WHO 1994 *Ninth general programme of work covering the period 1996-2001*. Geneva: WHO. WHO 1994 *The management of acute respiratory infections in children. Practical guidelines for outpatient care.* Geneva: for the Control of Diarrhoea and Acute Respiratory Diseases,

further information *- continued*	WHO. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO programmes.* Geneva: WHO. WHO 1997 *Health and environment in sustainable development. Five years after the Earth Summit.* Geneva: WHO.
Involved agencies	WHO – Department of Child and Adolescent Health and Development (CAH) UNICEF
EXAMPLE INDICATOR	
Definition of indicator	Incidence of morbidity due to acute respiratory infections in children under five years of age
Underlying definitions and concepts	This indicator is based on the following definitions: • **Acute respiratory infection** (ARI): an acute infection of the ear, nose, throat, epiglottis, larynx, trachea, bronchi, bronchioles or lung. • **Total population of children under five years of age**: number of live children less than five years of age at the midpoint of the year (or other survey period).
Specification of data needed	Number of cases of acute respiratory infection (ARI) in children under five years of age. Total number of children under five years of age.
Data sources, availability and quality	Data on the number of cases of acute respiratory infection amongst young children may be obtainable from a number of different sources, including hospital admissions, GP records and special surveys. None of these sources is comprehensive and wholly free of bias, and GP data are difficult to acquire. For most purposes, therefore, the best available data are likely to come either from hospital admissions records or by specially designed surveys. The former includes only the more severe cases, and will omit cases which are not referred to hospital (e.g. which are treated at home or by the GP). Special surveys are inevitably based on relatively small samples, and may also suffer from bias or inconsistency in reporting. Data on the total number of children under five years of age are available from national census statistics, and should be reliable, especially for census years. Inter-censal estimates may be made using vital registration data or demographic models, but may contain some uncertainties due to effects of migration. These are likely to be significant only at the small area scale.
Computation	The indicator can be computed as: $1000 * (R_c / P_c)$ where R_c is the total number of cases of acute respiratory infection in children under five years of age in the survey period (e.g. the last calendar year), and P_c is the total number of children under five years of age at the mid-point of that survey period.
Units of measurement	Number per thousand children under five years of age.
Scale of application	Mainly local to regional; problems of data consistency limit application at broader scales.

Interpretation	This indicator is intended to provide a measure of changes or differences in the incidence of acute respiratory infections, as a result of exposure to air pollution. In this context, an increase in the morbidity rate may be taken to infer an increase in exposures; a reduction in morbidity may imply a decrease in levels or frequency of exposure. In practice, however, such interpretations are problematic. Exposure to air pollution is only

	one of many possible causes of acute respiratory infection; other risk factors include exposures to house dust mite, damp and mould in the home, food additives and pollen. Factors such as family history, sibling order and genetic predisposition are also important. Associations between the incidence of acute respiratory infection and air pollution are thus complex and highly confounded. Data on morbidity are also limited and often inconsistent, making comparisons between different countries or interpretations of trends potentially difficult. Many cases go unreported. Differences in the structure of the health service (e.g. the extent of provision of asthma clinics) and in diagnosis also affect the reported rates. Attempts to combine statistics from different sources pose difficulties because of differences in classification and possible double-counting of individual cases. As with all morbidity measures, therefore, this indicator needs to be interpreted with care.

CHILDHOOD MORTALITY DUE TO ACUTE RESPIRATORY ILLNESS	DPSEEA
INDICATOR PROFILE	
Issue	Air pollution
Rationale and role	Acute respiratory illness is the single largest cause of mortality in children under 5 years of age. This indicator measures the **health effect** of acute respiratory mortality in the high risk group of under-five year olds. As an indicator for environmental health it provides an indication of potential health effects associated with the important issues of air pollution (especially indoor and vehicle pollution) and other environmental issues such as crowding and socio-economic status. Death due to acute respiratory illness is most commonly associated with infection or obstruction of the lower respiratory tract (i.e. the larynx, trachea, bronchi, bronchioles or lung). By providing a measurement of mortality in the sensitive group of under-five year olds, this indicator also provides an indirect indication of potential health effects in older age groups. As a measurement of cause-specific mortality, this indicator can serve several purposes: • to establish the relative public health importance of acute respiratory illness as a cause of death; • to monitor trends over time and provide an early warning of the need for intervention; • to map variations in acute respiratory illness, as a basis for identifying areas requiring special interventions; • to monitor the effectiveness of policies and other interventions aimed at reducing acute respiratory mortality; • to help investigate associations between air pollution or other risk factors and mortality due to acute respiratory illness. • to provide an indication of the potential for other diseases associated with the same environmental health issues. An important example in developing countries is diseases such as chronic respiratory disease in women who as a result of exposure to domestic indoor air pollution from coal and biomass burning.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of air pollution on health. • State: *Ambient concentrations of air pollutants in urban areas* • Exposure: *Sources of indoor air pollution* • Effect: *Childhood morbidity due to acute respiratory illness;* ***Childhood mortality due to acute respiratory illness*** • Action: *Capability for air quality management; Availability of lead-free gasoline*
Alternative methods and definitions	This indicator can be defined as the annual mortality rate due to acute respiratory illness in children under five years of age. Since acute respiratory infections tend to be more common in boys than girls, it can usefully be standardised by gender. Where the aim is to investigate relationships with potential causative factors, stratification on the basis of other variables (e.g. ethnicity) may also be appropriate. The indicator could also be compiled and presented for other, more specific categories of acute respiratory illness, e.g.: • **Acute lower respiratory infection** (ALRI): an acute infection of the larynx, trachea, bronchi, bronchioles or lung. • **Acute upper respiratory infection** (AURI): an acute infection of the nose, pharynx (throat) or middle ear. In this way, the indicator could be applied to monitor or investigate disease-specific mortality:
Alternative	In developing countries, this might focus on the problem of pneumonia associated with

methods and definitions *- continued*	biomass/coal-burning and indoor air pollution. (Typically this will comprise a high proportion of deaths due to acute respiratory illness in these countries.) In developed countries the growing problem of asthma associated with vehicle air pollution may prompt use of asthma-specific indicators. Similar indicators might also be developed for other age groups considered to be at-risk (e.g. the elderly).
Related indicator sets	WHO *Catalogue of health indicators* • Under-five deaths due to acute respiratory infections
Sources of further information	WHO 1992 *The measurement of overall and cause specific mortality in infants and children.* Report of joint WHO/UNICEF Consultation, 15-17 December 1992. WHO 1994 *Ninth general programme of work covering the period 1996-2001*. Geneva: WHO. WHO 1994 *The management of acute respiratory infections in children. Practical guidelines for outpatient care.* Geneva: for the Control of Diarrhoea and Acute Respiratory Diseases, WHO. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO programmes.* Geneva: WHO. WHO 1997 *Health and environment in sustainable development. Five years after the Earth Summit.* Geneva: WHO.
Involved agencies	WHO – Department of Child and Adolescent Health and Development (CAH) UNICEF

EXAMPLE INDICATOR

Definition of indicator	Annual mortality rate due to acute respiratory infections in children under five years of age
Underlying definitions and concepts	The indicator is based on the following definitions: • **Acute respiratory infection** (ARI): an acute infection of the ear, nose, throat, epiglottis, larynx, trachea, bronchi, bronchioles or lung. • **Total population of children under five years of age**: number of live children less than five years of age at the midpoint of the year (or other survey period).
Specification of data needed	Annual number of deaths of children under five years of age due to acute respiratory infections (ARI). Total number of children aged under five years at the mid-point in the survey year.
Data sources, availability and quality	Data on childhood deaths due to ARI, especially in developing countries, are rare. In some countries, data may be available from demographic surveillance systems or from household surveys and, in some cases, from vital registration or sample registration systems. In a number of countries, the demographic surveillance surveys have included a verbal autopsy module aimed at collecting information on the cause of death in children.
Computation	This indicator can be computed as: $1000 * (M_c / P_c)$ where M_c is the number of deaths due to ARI in children under five years of age, and P_c is the total number of children under five years of age.
Units of measurement	Number of deaths per thousand children below age five each year.

Scale of application	Local to international, though at broader scales problems of data consistency and differences in the causes of infection cause difficulties for interpretation.
Interpretatio	This indicator may be interpreted to show trends or patterns in mortality due to ARI as a result of exposure to air pollution. An increase in mortality rates might imply higher exposures and

n	worsening air pollution conditions; a reduction in mortality might imply a decrease in exposures and an improvement in air quality. For many reasons, however, such interpretations need to be made with care. Crucially, the association between ARI mortality and air pollution is not simple. Many other factors may cause ARI, including exposures to dust mite and other allergens in the home; factors such as family history of atopy and sibling order are also important. In developing countries, HIV and malaria are extremely important factors in either causing lower respiratory infection, or presenting as LRI. These may thus have a substantial effect on observed death rates. Mortality is also highly dependent upon the effectiveness of the health care system and availability of treatment; indeed, in many developed countries, mortality rates for acute respiratory illness have remained broadly stable over recent decades, despite a large increase in morbidity.

CAPABILITY FOR AIR QUALITY MANAGEMENT	DPSEE**A**

INDICATOR PROFILE

Issue	Air pollution
Rationale and role	Many of the risks to human health from air pollution can be addressed and resolved through air quality management. Strategies for air quality management may vary substantially, depending on the specific sources and types of pollution involved and the social, political and environmental context. In general terms, however, management is aimed at controlling emissions at source in order to reduce pollution levels and prevent pollution episodes. Important elements of an air quality management strategy may thus include: air quality standards (for both short- and long-term concentrations); monitoring systems; emission limits and controls; and specific land use, transport, energy and industrial policies aimed at reducing air pollution. This indicator is thus an **action** indicator, designed to assess the capability to implement policies and strategies for air quality management. Its main purposes are thus: • to allow comparisons between areas or countries in terms of their air quality management capability (e.g. to help identify and disseminate good practice or to identify areas where improvements are needed); • to monitor and assess the implementation of air quality management strategies.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of air pollution on health. • State: *Ambient concentrations of air pollutants in urban areas* • Exposure: *Sources of indoor air pollution* • Effect: *Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness* • Action: ***Capability for air quality management****; Availability of lead-free gasoline*
Alternative methods and definitions	Developing indicators which adequately assess management capability is invariably difficult. In this case, a valuable and widely applicable approach has been developed by MARC (1996). This is a compound indicator, incorporating scores for four separate components of management capability, assessed in terms of 14 sets of variables: • Air quality measurement capacity: measured in terms of the capacity to measure chronic health effects, acute health effects, trends in pollutant concentrations, the spatial distribution of pollutants, kerbside concentrations and data quality; • Data assessment and availability: measured in terms of the capacity to analyse data and data dissemination; • Emissions estimates: measured in terms of source emissions estimates, pollutant emissions estimates, accuracy of the emissions estimates, and availability of the emissions estimates; • Air quality management capability tools: measured in terms of the capacity to assess air quality acceptability and to use air quality information. This approach is comprehensive and provides a good, encompassing measure of the capability for air quality management at the city or local level. It may, however, need to be customised to specific circumstances – e.g. according to the geographic scale and administrative context, where the focus of attention is on ambient concentrations rather than emissions, or where interest focuses on one specific source of pollution (e.g. transport). It is also possible to calculate and report the different components or variables (or combinations of them) separately, if appropriate.

Related	GEMS/AIR:

indicator sets	Management capabilities assessment index
Sources of further information	MARC 1996 *Air quality management and assessment capabilities in 20 major cities.* GEMS/AIR London: Monitoring and Assessment Research Centre.
Involved agencies	National air quality monitoring agencies National environment ministries UNEP WHO
EXAMPLE INDICATOR	
Definition of indicator	Capability to implement air quality management
Underlying definitions and concepts	This indicator is a based on the Management Capabilities Assessment Index, developed by MARC (1996) on behalf of UNEP and WHO. In this example, the original index has been simplified and adapted by selecting and redefining a smaller subset of variables, which might be considered most relevant to its application at the regional or national level. The scores have also been modified from the original index (they thus total to 60 rather than 100). Key definitions are: • **Air quality management capability**: the existence, implementation and enforcement of instruments, and measures aimed at controlling or reducing air pollution in the ambient environment. • **Air quality standards**: legally specified limits for specific air pollutants, which should not be exceeded over the specified averaging time. • **Emissions controls**: legally specified limits for emissions from specific sources, which should not be exceeded under the specified operating conditions.
Specification of data needed	Evidence of: • capability for monitoring and reporting on air quality • capability for measurement/estimation and reporting of emissions • existence of, and capability to enforce, air quality standards • existence and enforcement of emission controls • integration of air quality issues into planning procedures
Data sources, availability and quality	Information on the existence of these instruments and measures
Computation	The index is computed as: $\Sigma (C_i)$ where Ci is the score for component i. The full list of components (i) are as follows: **1. A network of continuous monitoring sites covering residential areas for:** • NO_2 • SO_2 • PM
Computation -continued	• CO • Lead

Computation -continued	• O_3 *Score 1 for each pollutant [max = 6]* **2. Open access to air quality information through:** • annual published reports • newspapers • the Internet *Score 1 for each pollutant [max = 3]* **3. Publication of air quality warnings during pollution episodes** *Score 3 if present [max = 3]* **4. Requirement to measure and report emissions from:** • Major combustion sources • Large industrial sources • Other point emission sources *Score 1 for each source [max = 3]* **5. Detailed emission inventories covering emissions from:** • Industrial sources • Transport sources • Domestic sources • Other sources **for:** • NO_2 • SO_2 • PM • CO • Metals (e.g. lead) • VOCs *Score 0.25 for each source and 1 for each pollutant; score calculated as sum of (source score * pollutant score) [max = 6]* **6. Short-term (e.g. maximum daily) standards for** • NO_2 • SO_2 • PM • O_3 • CO *Score 1 for each pollutant [max = 5]* **7. Long-term (e.g. mean annual) standards for:** • NO_2 • SO_2 • PM • Lead *Score 1 for each pollutant [max = 5]* **8. Regulations to enforce compliance with air quality standards**

	Score 3 if present [max = 3] **9. Arrangements to review and update air quality standards on a regular basis** *Score 3 if present [max = 2]* **10. Emission controls for:** • New road vehicles • Domestic dwellings • Industrial premises *Score 2 for each source [max=6]* **11. Availability of unleaded gasoline** *Score 3 if present [max = 3]* **12. Requirement for testing of road vehicles, including testing of emissions, at a frequency of at least every five years for:** • Public service vehicles • Heavy goods vehicles • Cars *Score 2 for each group [max = 6]* **13. Formal requirements for local air quality management strategies** *Score 3 if present [max = 3]* **14. Requirements for air quality issues to be addressed as part of:** • industrial development • major road developments *Score 3 for each type of development [max = 6]*
Units of measurement	Ordinal score (0-60)
Scale of application	Mainly national to international
Interpretation	This indicator provides a general measure of the capability for air quality management: an increase in the score may thus be taken as a broad indication of increased capability, a reduction the reverse. Like all compound indicators, however, this one needs to be interpreted with care, for the final score is the sum of many different components: areas with the same indicator score, therefore, do not necessarily have the same capability profile for air quality management. It is consequently important to examine the components of the indicator in drawing conclusions from the measure.

AVAILABILITY OF LEAD-FREE GASOLINE	DPSEE**A**
INDICATOR PROFILE	
Issue	Air pollution
Rationale and role	Vehicle fuel represents a major source of exposure to lead, traditionally accounting for 80-90% of the total lead concentration in the atmosphere. Other important sources are lead smelting, battery manufacture and refuse incineration. Chronic exposure to lead in the atmosphere is known to have a wide range of health effects, including raised blood pressure, disorders of the nervous system, and haematological effects. In children, exposures are known to be associated with behavioural and learning difficulties. The provision of unleaded petrol is one of the most effective and widely used methods of reducing lead emissions and thereby reducing human exposures. This indicator provides a measure of the a**ction**, and as such can be used to: • Monitor progress towards policy targets and goals on reducing lead in petrol. • Compare regions or countries in terms of their policies on lead pollution and exposure reduction. • Identify potential at-risk populations because of their raised exposure to lead in the atmosphere. • Analyse the effects of reductions in the use of leaded fuel in the environment and human health. This indicator can also be used as a proxy measure of potential **exposure** to lead, especially in broad-scale studies.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of air pollution on health. • State: *Ambient concentrations of air pollutants in urban areas* • Exposure: *Sources of indoor air pollution* • Effect: *Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness* • Action: *Capability for air quality management;* ***Availability of lead-free gasoline***
Alternative methods and definitions	This indicator can be defined as the percentage (by volume) of total gasoline consumption provided by unleaded fuel. Alternative versions of the indicator might also be computed, for example by using either population or surface area as the denominator (e.g. unleaded gasoline consumption per head of population or per square km). This would have the advantage of allowing for differences in the total volume of fuel consumed. Use of population as a denominator provides an indicator of the **rate** of consumption, and thus tends to highlight regions with high per capita usage of unleaded gasoline. Use of area as the denominator provides an indicator of the **intensity** of consumption, and thus tends to highlight regions which potentially have high levels of emission and higher atmospheric concentrations of lead.
Related indicator sets	*GEMS/AIR* Management Capabilities Assessment Index: Unleaded petrol available in the city
Sources of further information	WHO 1992 *Human exposure to lead.* Report on the Human Exposure Assessment Location (HEAL) Programme Meeting held in Bangkok, Thailand 16-19 November 1992. Geneva: WHO. WHO 1994 *Ninth general programme of work covering the period 1996-2001*. Geneva: WHO. WHO 1995 *Inorganic lead.* Environmental Health Criteria Series, Number 165. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization. Geneva: WHO. http://www.who.int/dsa/cat97/zehc1.htm
Involved agencies	WHO Petroleum companies

EXAMPLE INDICATOR	
Definition of indicator	Consumption of lead-free gasoline as a percentage of total gasoline consumption
Underlying definitions and concepts	This indicator is based on the assumption that leaded fuel represents one of the main sources of exposure to lead in the atmosphere, and thus a significant health risk. Underlying definitions are: • **Unleaded gasoline consumption:** total sales (volume) of gasoline not containing lead. • **Total gasoline consumption:** total sales of all gasoline (by volume).
Specification of data needed	Volume of unleaded gasoline sold Total volume of gasoline sold
Data sources, availability and quality	Data on the amounts of gasoline sold are usually available from national statistics, and are typically derived either from trade data, taxation data or the sales data of the petroleum companies. These data are reasonably reliable at the national level; at the regional/local level, however, they may be difficult to acquire (for reasons of commercial confidentiality) and may be less accurate.
Computation	The indicator can be computed as: (U / T) * 100 where U is the total volume of unleaded gasoline sold, and T is the total volume of all gasoline sold.
Units of measurement	Percentage
Scale of application	Regional to international
Interpretation	This indicator is relatively simple to interpret, in that sales of unleaded gasoline are influenced largely by policy action. In particular, differential taxation of fuels on the basis of their lead content is effective in controlling consumption. Nevertheless other factors affect consumption of unleaded fuels, including vehicle design and performance (both of which may be determined by manufacturers beyond the area of interest). Therefore, changes in sales of unleaded fuels should not, necessarily, be seen as evidence of the direct effects of policy action. When used as an indicator of exposure, it is also important to recognise that many other sources of exposure may occur, including industrial activity and coal combustion, both of which might be important locally. Recycling of lead in dust also means that relatively long delays may occur between reductions in use of leaded fuels and changes in atmospheric concentrations or human exposures.

ACCESS TO BASIC SANITATION	DPS**E**EA
INDICATOR PROFILE	
Issue	Sanitation
Rationale and role	Access to adequate excreta disposal facilities is an important requirement if adverse health effects of poor sanitation are to be avoided. This indicator thus provides a measure both of the potential **exposure** of the population to infectious agents associated with poor sanitation, and of the **action** taken to improve domestic sanitation. The indicator can be used: • to assess and compare general levels of access to sanitation facilities, as a basis for priority setting; • as one of a group of indicators to assess levels of in social inequality and deprivation; • to assess and identify areas with poor sanitation, where specific policy action may be required; • to help investigate associations between sanitary conditions and specific health effects; • to help target and plan efforts to improve domestic sanitation and to monitor progress of such measures.
Linkage with other indicators	This indicator is part of a chain of indicators, collectively describing the effects on health of access to basic sanitation, water quality and access, and food safety: • Exposure: ***Access to basic sanitation*** • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children*
Alternative methods and definitions	The indicator can be defined as the percentage of the population (or of households) with (or alternatively without) access to adequate excreta disposal facilities. To apply this definition, a clear and appropriate definition is needed of what constitutes 'adequate excreta disposal facilities'. This needs to specify both the type of facility and its accessibility (e.g. whether in the home or outside). Definitions are likely to vary according to local circumstances (e.g. between developed and developing countries). Where data are available, the indicator could be further refined according to the type of facilities (e.g. connection to public sewerage system, cess-pit, pit latrines, facilities in house or outside).
Related indicator sets	UN *Indicators of sustainable development* • Basic sanitation: percent of population with adequate excreta disposal facilities WHO *Catalogue of health indicators* • Access to sanitary means of excreta disposal
Sources of further information	UN *1996 Indicators of sustainable development. Framework and methodologies.* Report for the UN Commission on Sustainable Development. New York, USA, UN Department for Policy Coordination and Sustainable Development. WHO 1981 *Development of indicators for monitoring health for all by the year 2000*. P. 29. Geneva: WHO. WHO 1982 *National and global monitoring of water supply and sanitation.* VWS series of Cooperative Action for the decade, No.2. WHO 1990 *Water supply and sanitation sector monitoring report (WSSMR).* WHO/UNICEF Joint Monitoring Programme. WHO *1994 Ninth general programme of work covering the period 1996-2001*. Geneva: WHO. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO Programmes.* Geneva: WHO.
Involved agencies	WHO-Programme for the Promotion Environmental Health.

EXAMPLE INDICATOR	
Definition of indicator	Percentage of the population with access to adequate excreta disposal facilities.
Underlying definitions and concepts	This indicator is based on the assumption that poor sanitary facilities increase the risks of infectious diseases such as diarrhoea and cholera. Underlying definitions are: • **Adequate excreta disposal facilities**: a facility which provides for the controlled disposal of human excreta in ways which avoid direct human exposure to faeces, or contamination of food and local water supplies by raw faeces. Suitable facilities might range from simple but effective pit latrines, to flush toilets with sewerage. All facilities, to be effective, must be correctly constructed and properly maintained. • **Access to adequate excreta disposal facilities**: people with excreta disposal facilities either in their dwelling or located within a convenient distance (<50 metres) from the user's dwelling. This thus includes the urban and rural populations served by connections to public sewers; household systems (pit privies, pour-flush latrines, septic tank, etc); communal toilets; and simple but adequate excreta disposal such as pit privies, pour-flush latrines, covered by latrines, etc • **Total population**: total resident population.
Specification of data needed	The number of people with access to adequate excreta-disposal facilities. Total population.
Data sources, availability and quality	Data on excreta disposal facilities may be available from relevant administrative authorities (e.g. public works, sanitary works or housing departments). In some countries, data are also available via national censuses. Where such sources do not exist or are inadequate, special surveys will be necessary. Data on total population are available from national censuses and should be reliable.
Computation	The indicator can be computed as: $100 * (P_e / P_t)$ where P_e is the number of people living in dwellings with access to adequate excreta disposal facilities, and P_t is the total population.
Units of measurement	Percentage
Scale of application	Local to international
Interpretation	The indicator can be interpreted directly to show the adequacy of domestic sanitary conditions, and thus the risks to health from exposures to infectious agents. A high percentage of people or households with access to adequate excreta disposal facilities should indicate a lower risk of exposure and adverse health effects; a low percentage would imply higher risks of exposure and infection. If compared to national targets, the indicator can similarly be interpreted to show progress towards achieving these goals. Nevertheless, some care is needed in interpreting the indicator, in particular because the availability of a facility does not always translate into their proper utilisation and improved hygiene. Data may also be of uncertain quality.

DIARRHOEA MORBIDITY IN CHILDREN	DPSEEA
INDICATOR PROFILE	
Issue	Sanitation Access to safe drinking water Food safety
Rationale and role	This indicator measures the **health effects** of diarrhoea in the high risk group of under five-year olds. It is an indication of the magnitude of the problem of diarrhoea and the potential health effects from exposure to the environmental problems of poor quality of sanitation, water and food. As a measurement of cause-specific morbidity this indicator can serve several purposes: • to establish the magnitude of the problem of childhood diarrhoea and its relative public health importance; • to evaluate trends over time, especially as a method of evaluating the probable impact of intervention, management and control programmes; • to select place and programme interventions; • to provide an indication of the potential for health effects associated with the same environmental health issues.
Linkage with other indicators	This indicator is part of a number of chains of indicators, collectively describing the effects on health of access to basic sanitation, water quality and access, and food safety. 1) Sanitation • Exposure: *Access to basic sanitation* • Effect: *Diarrhoea mortality in children****; Diarrhoea morbidity in children*** 2) Access to safe drinking water • Exposure: *Connections to piped water supply; Access to safe and reliable supplies of drinking water* • Effect: ***Diarrhoea morbidity in children****; Diarrhoea mortality in children; Outbreaks of water-borne diseases* • Action: *Intensity of drinking water quality monitoring* 3) Food safety • Effect: *Food-borne illness;* ***Diarrhoea morbidity in children****; Diarrhoea mortality in children* • Action*: Monitoring of chemical hazards in food*
Alternative methods and definitions	This indicator can be defined as the incidence of diarrhoea in children under five years of age. Where appropriate it could be applied to other age groups (e.g. 0-1 year old). Alternatively, the indicator can be assessed on the basis of the number of hospital admissions for acute gastro-intestinal infections. This, however, would tend to underestimate the incidence of illness because only the most serious cases would be included. Bias might also occur in the indicator, because of social and geographic differences in access to hospital.
Related indicator sets	WHO *Catalogue of health indicators* • Annual incidence of diarrhoea in children under 5 years of age
Sources of further information *Sources of further*	WHO 1992 *Readings on diarrhoea: student manual.* Division for the Control of Diarrhoea and Acute Respiratory Disease, Geneva: WHO. WHO 1994 *Ninth general programme of work covering the period 1996-2001*. Geneva: WHO. WHO 1994 *Household survey manual: diarrhoea and acute respiratory infections*. WHO/CDR/94.8. Geneva: WHO.

information - continued	WHO 1996 *Catalogue of health indicators: A selection of health indicators recommended by WHO Programmes.* Geneva: WHO. WHO 1997 *Health and environment in sustainable development – five years after the Earth Summit.* Geneva: WHO.
Involved agencies	WHO – Department of Child and Adolescent Health and Development (CAH) WHO – Programme for Promotion of Environmental Health UNICEF
EXAMPLE INDICATOR	
Definition of indicator	Incidence of diarrhoea morbidity in children under five years of age.
Underlying definitions and concepts	**Diarrhoea**: three or more watery stools in a 24-hour period, a loose stool being one that would take the shape of the container (WHO 1996), or local definition of diarrhoea. **Episode of Diarrhoea:** An episode of diarrhoea begins with a 24-hour period with three or more loose or watery stools. An episode of diarrhoea is considered to have ended after 48 hours without three or more loose watery stools within a 24-hour period. **Incidence of diarrhoea morbidity:** total number of episodes of diarrhoea during a 1-year period amongst the children surveyed. **Total population of children under five years of age:** number of children less than five years of age in the survey, at the time of survey.
Specification of data needed	Data on number of episodes of diarrhoea among children under five. Population data for total number of children under five years of age. Disaggregating data such as socio-economic status, geographic area and age/sex of children.
Data sources, availability and quality	Morbidity data for diarrhoea disease does not tend to be collected on a routine basis, and usually depends on special surveys. Methods for data collection by surveys are recommended by the WHO Division for the Control of Diarrhoea and Acute Respiratory Disease (CDD/ARI) household survey manual (see Sources of further information). The CDD/ARI Household Survey is designed to collect qualitative as well as quantitative information on diarrhoea episodes occurring in the past two weeks. The manual includes instructions on how to convert the results to an annual incidence taking into account seasonal variations.
Computation	The indicator can be computed as: I_c / P_c where I_c is the incidence of diarrhoea in children under five years of age in the survey, and P_c is the total number of children under five years of age in the survey.
Units of measurement	Number of cases per child per year.
Scale of application	Local to national; application at broader scales is limited by problems of data consistency and completeness.

Interpretation	This indicator is a powerful measure of health status of children, especially under conditions of inadequate water or food hygiene and basic sanitation. Action to improve these conditions can generally help to reduce morbidity rates. Like other infectious diseases, however, marked short-term variations in morbidity may occur, making identification of long-term trends difficult, especially on the basis of short-term or irregular surveys. Data on the incidence of diarrhoea are also subject to large margins of error due to inconsistencies in reporting and in definitions, and problems of ensuring adequate sampling in surveys.

	Interpretation of the indicator can be assisted by disaggregating the data by age and gender of the child, economic status of the parents and geographic area.

DIARRHOEA MORTALITY IN CHILDREN	DPSEEA
INDICATOR PROFILE	
Issue	Sanitation Access to safe drinking water Food safety and supply
Rationale and role	Diarrhoea and related gastrointestinal illnesses continue to be one of the most important causes of illness and death, worldwide especially amongst vulnerable groups such as young children. Much of this illness is due to exposures to contaminated water or food, as a result, for example, of poor water quality, limited access to water, poor food hygiene and safety, or poor sanitation in the home. Major pathogens include Salmonella, Shigella, *Campylobacter*, *E. coli* and rotavirus. This indicator provides a measure of the extent and severity of these effects. It can thus be used: • to monitor general trends in the burden of disease amongst children; • to infer changes in the quality of drinking and bathing water, food and basic sanitation; • to map patterns of disease, as a basis for identifying at-risk areas or groups, and target policy action; • to assess and monitor the effectiveness of intervention programmes; • to analyse relationships between environmental exposures and health.
Linkage with other indicators	This indicator is part of a number of chains of indicators, collectively describing the effects on health of access to basic sanitation, water quality and access, and food safety. 1) Sanitation • Exposure: *Access to basic sanitation* • Effect: ***Diarrhoea mortality in children;*** *Diarrhoea morbidity in children* 2) Access to safe drinking water • Exposure: *Connections to piped water supply; Access to safe and reliable supplies of drinking water* • Effect: *Diarrhoea morbidity in children;* ***Diarrhoea mortality in children****; Outbreaks of water-borne diseases* • Action*: Intensity of drinking water quality monitoring* 3) Food safety • Effect: Food-borne illness; Diarrhoea morbidity in children; **Diarrhoea mortality in children** • Action: Monitoring of chemical hazards in food
Alternative methods and definitions	This indicator can be defined as the mortality rate due to diarrhoea in children under five years of age. It could alternatively be assessed using a broader category of illnesses (e.g. diseases of the digestive system - ICD codes 520-579). While this would broaden the potential range of exposures of relevance, it would tend to reduce inconsistencies due to diagnosis. It could also be applied to other age groups (e.g. < 1 year) where appropriate. Stratification by gender may be useful in some cases.
Related indicator sets	WHO *Catalogue of health indicators* • Deaths due to diarrhoea among infants and children under 5 years of age

Sources of	WHO 1992 *Readings on diarrhoea: student manual.* Division for the Control of Diarrhoea and

further information	Acute Respiratory Disease, Geneva: WHO. WHO 1994 *Ninth general programme of work covering the period 1996-2001*. Geneva: WHO. WHO 1994 *Household survey manual: diarrhoea and acute respiratory infections*. WHO/CDR/94.8. Geneva: WHO. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO Programmes.* Geneva: WHO. WHO 1997 *Health and environment in sustainable development – five years after the Earth Summit.* Geneva: WHO.
Involved agencies	WHO – Department of Child and Adolescent Health and Development (CAH) WHO – Programme for Promotion of Environmental Health UNICEF
EXAMPLE INDICATOR	
Definition of indicator	Diarrhoea mortality rate in children under five years of age
Underlying definitions and concepts	**Death due to diarrhoea in children under five years of age**: death in which diarrhoea is defined as a primary cause of a child of less than five years of age at the time of death. **Total population of children under five years of age**: number of live children less than five years of age at the midpoint of the survey year (or other survey period).
Specification of data needed	Total number of deaths due to diarrhoea in children under five years of age. Total population of children under five years of age.
Data sources, availability and quality	Data on death due to diarrhoea in children under five years of age should be available through national or regional/local death statistics. Differences in both diagnosis and reporting practice may be significant in these data, especially where diarrhoea is part of a complex of symptoms (e.g. associated with malnutrition). Where statistical data are not available from routine sources, special surveys will be necessary. Data on the total population of children under five years of age should usually be available via national censuses. Inter-census estimates can be made using vital registration data, or demographic models. Care is needed in applying a consistent and appropriate census date, especially where marked seasonal patterns in birth may occur.
Computation	The indicator can be computed as: $1000 * (M_c / P_c)$ where M_c is the total number of deaths amongst children under five years of age and P_c is the total population of children under five years of age.
Units of measurement	Number per thousand children under five years of age.
Scale of application	Local to international, though at broader scales extreme care is needed in interpretation because of problems of data consistency and completeness.
Interpretation	This indicator is a powerful measure of health status of children, especially under conditions of inadequate water or food hygiene and basic sanitation. Action to improve these conditions can generally help to reduce mortality rates. Like other infectious diseases, however, marked short-term variations in mortality may occur, making identification of long-term trends difficult. Death of young children due to diarrhoea may also be a result of several different, and often inter-related, exposures: attributing changes in mortality to any one of these without consideration of the others might be misleading. Rates of mortality are also fundamentally affected by the effectiveness of, and access to, the health service and levels of awareness amongst parents.

POPULATION IN INFORMAL SETTLEMENTS	DPS**E**EA
INDICATOR PROFILE	
Issue	Shelter
Rationale and role	Rapid urbanisation and inadequate capability to cope with the housing needs of people in urban areas have contributed to the development of informal settlements. Living in these settlements often poses significant health risks: sanitation and drinking water quality are often poor, with the result that inhabitants are exposed to a wide range of pathogens; cooking facilities are often basic, with the consequence that high levels of exposure to indoor pollution may occur; and access to health and other services may be limited. This indicator thus provides a measure of exposure to inadequate housing conditions. Its can be used to: • compare areas or countries in terms of their extent of informal settlements and the adequacy of their housing; • monitor trends in the extent of informal settlements (e.g. in response to urbanisation or population change); • identify areas characterised by poor housing conditions, in order to target action; • help investigate associations between housing conditions and health; • assess and monitor the effectiveness of interventions aimed at improving housing conditions.
Linkage with other indicators	This indicator is one of a chain of indicators describing the health risks associated with inadequate shelter. Others are: • Exposure: ***Population in informal settlements;*** *Population living in unsafe housing* • Effect: *Accidents in the home* • Action: *Urban planning and building regulations* However, the characteristics of, and health risks associated with, living in informal settlements extend more widely than this, and other relevant indicators include: • Exposure*: Access to basic sanitation; Connections to piped water; Access to safe and reliable supplies of drinking water* • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children; Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness*
Alternative methods and definitions	This indicator can be defined as the percentage of the population living in informal settlements. It is often restricted to informal settlements within the urban environment, and as such may omit contiguous peri-urban settlements. An urban focus makes the indicator less comprehensive, but data are likely to be more readily available and of better quality than for rural settlements. The indicator might also be presented as the total number of people living in informal settlements. Where suitable data on population are not available, the indicator might alternatively be measured as the area (e.g. km^2) of informal settlements. This may be estimated from aerial photographs. It is liable to understate the scale of the problem, however, since it makes no allowance for population density, which is often higher in informal settlements than in formal settlements. Many other measures of marginal human settlements have also been formulated, which could be used for similar indicators, including: unplanned settlements, squatter settlements, marginal settlements, unconventional dwellings, non-permanent structures, inadequate housing, slums, housing in compliance etc.
Alternative	*Unconventional dwellings* are commonly defined by the number of housing units occupied by

methods and definitions *- continued*	households, but considered inappropriate to human habitation. *Housing in compliance* is used as a Human Settlements Indicator by the UN Habitat Programme and is defined as the percentage of the total housing stock in urban areas which is in compliance with current regulations (authorised housing). Housing may also be categorised by its type or permanence (e.g. permanent, semi-permanent, non-permanent), although definitions of these categories vary widely from country to country.
Related indicator sets	UN *Indicators of sustainable development* Area and population of urban formal and informal settlements
Sources of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN. UNCHS (Habitat) and the World Bank 1993 *The housing indicators programme. Report and the Executive Director (Volume I).* Nairobi: UNCHS. UNCHS (Habitat) 1995 *Monitoring the shelter sector. Housing Indicators review.* Nairobi: UNCHS. UNCHS (Habitat) 1995 *Monitoring human settlements, abridged survey*. Indicators Programme. Nairobi: UNCHS (Habitat). UNCHS Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/database/
Involved agencies	United Nations – Centre for Human Settlements (Habitat) The World Bank WHO – Healthy Cities Project
EXAMPLE INDICATOR	
Definition of indicator	Percentage of the population living in informal settlements.
Underlying definitions and concepts	This indicator depends on the ability to define and measure the number of people living in informal settlements. It covers both urban and rural settlements. Underlying definitions are: • **Informal settlements**: various definitions have previously been proposed, but that suggested by the UN Habitat Programme is probably the most appropriate. This defines informal settlements as: i) residential areas where a group of housing units has been constructed on land to which the occupant have no legal claim, or which they occupy illegally; ii) unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorised housing). • **Unauthorised housing**: excludes units where land titles, leases or occupancy permits have been granted (UN 1996). • **Total population**: total resident population, It should be noted that informal settlements do NOT cover the ***homeless***.
Specification of data needed	Number of people living in informal settlements. Total population.
Data sources, availability and quality	Data on the number of people living in informal settlements are often limited, since inhabitants are often only inadequately covered by formal censuses: census data may therefore not provide a clear separation of those living in informal settlements. Where suitable census data do not exist, special surveys may be necessary. Data on total population should be available from national censuses and are generally reliable (except for those living in informal settlements).
Computation	The indicator is computed as: $100 * (P_i / P_t)$

	where P_i is the population living in informal settlements and P_t is the total population.
Units of measurement	Percentage
Scale of application	Local to international
Interpretation	This indicator provides a relatively straightforward measure of the quality of housing. A large percentage of people living in informal settlements can be taken to imply relatively poor housing conditions; a low percentage implies better housing conditions. Nevertheless, the relationship between the number of people living in informal settlements and environmental health is not always simple. In particular, those living in formal settlements are not necessarily better provided for (e.g. the homeless or people living in crowded or unsafe housing). Problems of data accuracy also mean that the indicator should be interpreted with care, especially where comparisons are being made between different surveys.

POPULATION LIVING IN UNSAFE HOUSING	DPS**E**EA
INDICATOR PROFILE	
Issue	Shelter
Rationale and role	The adequacy of housing is an important determinant of health status, in a number of ways. *Inter alia*, housing quality affects levels of exposure to indoor pollutants, food and water hygiene, levels of sanitation, exposures to physical hazards and injury, and general quality of life. Housing may be unsafe, therefore, for a variety of reasons, including: dangerous construction, inadequate ventilation, inadequate heating, dangerous or inadequately maintained services, inadequate size for the number of residents (i.e. overcrowding) or location in a hazardous area (e.g. areas prone to flooding or earthquakes, or on contaminated land). Living in inadequate housing is therefore likely to result in increased risks of a variety of health effects, including respiratory illness, gastro-intestinal infections and infant mortality. This indicator provides a general measure of the adequacy of the housing stock, and the level of exposures to these hazards which might thus occur. Potential uses include: • monitoring the general adequacy of the housing stock, and access to this stock by the population; • monitoring the magnitude and implications of major demographic or social changes in the population (e.g. as a result of rapid urbanisation or migration); • assessment of changes in the general level of health risk associated with poor housing; • mapping risks associated with poor housing, in order to identify areas of special need; • assessing the effectiveness of national or regional strategies aimed at improving the housing stock; • analysing relationships between quality of housing and health effects.
Linkage with other indicators	This indicator is part of a chain of indicators which collectively describe the risks associated with inadequacy of shelter: • Exposure*: Population in informal settlements;* ***Population living in unsafe housing*** • Effect: *Accidents in the home* • Action: *Urban planning and building regulations* However, the characteristics of, and health risks associated with, unsafe, unhealthy or hazardous housing extend more widely than this, and other relevant indicators include: • Exposure: *Access to basic sanitation; Connections to piped water; Access to safe and reliable supplies of drinking water* • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children; Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness; Outbreaks of water-borne diseases*
Alternative methods and definitions	Although potentially valuable, this indicator is difficult to define and measure in a clear and systematic manner. The most appropriate measure would be the percentage (or number) of people living in unsafe, unhealthy or hazardous housing. Defining the terms 'unsafe', 'unhealthy' and 'hazardous', however, poses severe difficulties, as does obtaining data on houses which meet these criteria. A somewhat weaker alternative to this indicator can be obtained by assessing the percentage of the total housing stock which is considered unsafe, unhealthy or hazardous. Information can be obtained from housing condition surveys. This is liable to underestimate the number of people affected because of the tendency for overcrowding in poorer quality housing. A further alternative is to use census derived-data (e.g. on overcrowding or the availability of basic amenities in the home), where these exist, as a measure of inadequate housing. These terms are usually defined nationally by the census.
Alternative methods and	Where the main concern is about natural hazards, such as flooding, earthquakes, avalanches or radon exposures, estimates of the exposed population may be made using GIS techniques to

definitions *- continued*	map hazardous areas and overlay these with population data.
Related indicator sets	UNCHS (Habitat) *Urban Indicators Programme*: • Permanent structures (percentage of housing units located in structures expected to be maintain their stability for 20 years or longer under local conditions with normal maintenance) • Housing in compliance (percentage of the total housing stock in compliance with current regulations) • Housing destroyed (percentage of the housing stock destroyed by natural or man-made disasters over the past ten years)
Sources of further information	WHO 1994 *Implementation of the Global Strategy for Health for All by the year 2000. Second evaluation. Eighth report on the world health situation.* Geneva: WHO Regional Office for Europe, Volume 5, European Region. WHO 1997 *Health and environment in sustainable development. Five years after the Earth Summit.* Geneva: WHO. UNCHS Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/database/
Involved agencies	UN - Centre for Human Settlements (Habitat) WHO Healthy Cities Programme National, regional and local housing agencies
EXAMPLE INDICATOR	
Definition of indicator	Percentage of the population living in unsafe, unhealthy or hazardous housing.
Underlying definitions and concepts	This indicator requires the ability to identify, and measure the extent of, unsafe, unhealthy or hazardous housing. This poses significant difficulties, for these are all to a large extent both environmentally and culturally dependent, and thus are liable to vary from one area (or one time) to another. Possible definitions of unsafe, unhealthy or hazardous housing include housing which is: • physically unsound and likely to be dangerous to its occupants, because of its poor construction, or inadequately maintained services (e.g. electricity); or • is located in a physically hazardous area (e.g. an area of flood or earthquake risk) or is sited on contaminated land (e.g. by chemical wastes, radioactivity); or • provides serious risks of exposures to indoor pollution (e.g. air pollutants) or pathogens (e.g. moulds, ticks, fleas); or • provides inadequate shelter (e.g. due to poor insulation, inadequate roofing) and basic amenities (e.g. cooking facilities, heating). In addition, a definition is required of the total population: i.e. the total resident population at the time of census or survey.
Specification of data needed	Number of people living in unsafe, unhealthy or hazardous housing Total resident population
Data sources, availability and quality *Data sources, availability and quality* *- continued*	Data on the quality of the housing stock, and the number of people living in unsafe, unhealthy or hazardous housing is rarely available from routine sources. In some countries, an approximation to this may be available from census statistics (e.g. housing lacking basic amenities). Generally, however, data will need to be obtained by special surveys. In all cases, these data are liable to considerable margins of error and inconsistency due to difficulties of definition, inconsistent reporting and difficulties of ensuring representative sampling. Data on the total resident population should be available from national censuses and should be reliable.

Computation	The indicator can be computed as: 100 * (U / P) where U is the number of people living in unsafe, unhealthy or hazardous housing and P is the total population.
Units of measurement	Percentage
Scale of application	Mainly local
Interpretation	This is an important indicator, which has wide-ranging significance for policy. In providing a measure of the adequacy of the housing stock, it also acts as an indicator of health risks associated with poor sanitation, exposures to indoor air pollution, and access to safe water. It can therefore help to interpret a range of other issues and indicators. Like all general-purpose indicators, however, it needs to be interpreted carefully. The characteristics which render housing unsafe, unhealthy or hazardous may clearly vary; without information on these specific characteristics it can be misleading to infer either the existence of particular health risks or effects or the need for specific actions. Definitional issues are also likely to pose major difficulties for comparisons between different areas, or between different surveys, unless standard protocols have been used. A clear understanding of the data is therefore essential before interpretations are made.

ACCIDENTS IN THE HOME	DPSE**E**A
INDICATOR PROFILE	
Issue	Shelter
Rationale and role	Accidents in the home are one of the main causes of injury and death. Though accidents can occur in any home, the risk of accidents tends to be increased by poor building design and inadequate safety requirements for housing. This indicator thus provides a measure of the **effect** of inadequate housing. It can be used: • to monitor the incidence of accidents in the home; • to identify areas or types of housing with unacceptably high rates of accident or injury, as a basis for targeting action; • to help develop and design safer houses; • to help establish more effective planning and building regulations; • to assess the effectiveness of policy interventions, aimed at reducing accidents in the home - e.g. new building regulations or awareness raising campaigns.
Linkage with other indicators	This indicator is part of a chain of indicators which collectively describe the risks associated with inadequacy of shelter: • Exposure: *Population in informal settlements; Population living in unsafe housing* • Effect: ***Accidents in the home*** • Action: *Urban planning and building regulations*
Alternative methods and definitions	This indicator can be defined as the incidence of injury by accidents in the home. Because the young and elderly are the most vulnerable to accidents in the home, it may be appropriate to stratify the indicator by age (and perhaps gender) or to restrict it to specific age groups.
Related indicator sets	None
Sources of further information	
Involved agencies	WHO
EXAMPLE INDICATOR	
Definition of indicator	Incidence of injury by accidents in the home
Underlying definitions and concepts	**Accidents in the home**: an accident, taking place in the home, which leads to physical injury sufficient to require medical treatment. Common accidents include falling down stairs, electrocution, burning, scalding and accidents with kitchen utensils and equipment. For the purpose of this indicator, poisonings should be excluded, if possible. **Total population**: total resident population
Specification of data needed	Number of reported accidents in the home Total population

Data sources, availability and quality	Comprehensive data on physical injuries by accidents in the home are likely to be difficult to acquire, due to lack of referral or reporting. Many injuries may not be considered sufficient to be referred to the medical services; many others, though reported, may not be clearly classified as a result of an accident in the home. Probably the most useful source of data are hospital

	admissions statistics, though these tend to cover the more severe, acute injuries. Other potential sources include data from GPs and household surveys. Data on the total population should be available from national census statistics, and should be reliable.
Computation	The indicator can be computed as: 1000 * (A / P) where A is the total number of reported cases of injury by accidents in the home, and P is the total population.
Units of measurement	Number per thousand head of population
Scale of application	Local to international, though problems of data consistency and completeness limit application at broader scales.
Interpretation	This is a potentially useful indicator, which gives a general measure of injuries due to accidents in the home. Problems of data availability and quality, however, mean that care is needed in making comparisons between different areas or countries, or over long periods of time. Data are likely to be affected, for example, by ease of access to the medical services, and by differences in reporting procedures.

URBAN PLANNING AND BUILDING REGULATIONS	DPSEE**A**
INDICATOR PROFILE	
Issue	Shelter
Rationale and role	The application of strict building and planning regulations for housing is one of the main ways by which health risks of inadequate housing can be mitigated. Such regulations can control development on unsuitable sites (e.g. contaminated, unstable or flood-prone land), and set minimum standards for residential accommodation (e.g. in terms of space, quality of construction and safety). This indicator is thus an **action** indicator, aimed at assessing the level of commitment made to ensuring safe housing. It is relevant mainly at the international level, e.g. to: • compare countries in terms of their level of planning and building regulations; • monitor national trends towards the establishment of adequate planning and building control; • help interpret inter-country variations in the quality of housing and levels of morbidity of mortality relating to inadequate housing.
Linkage with other indicators	This indicator is part of a chain of indicators which collectively describe the risks associated with inadequacy of shelter: • Exposure: *Population in informal settlements; Population living in unsafe housing* • Effect: *Accidents in the home* • Action***: Urban planning and building regulations***
Alternative methods and definitions	Like most indicators relating to the effectiveness or adequacy of policy and management, this indicator is not easy to define and apply in a stringent and systematic way. Possibly the best that can normally be achieved is to assess the existence and rigour of building and planning regulations for residential housing (see example below). It needs to be recognised, however, that the existence of such regulations does not necessarily mean that they are being effectively applied. Alternatively, the indicator could be assessed in terms of the proportion of the housing stock covered by formal building regulations. More complex indicators could be developed, by defining in more detail the elements of building regulations and planning consents, and if appropriate by separating the regulations relating to public and private housing development.
Related indicator sets	None
Sources of further information	UNCHS (Habitat) and the World Bank 1993 *The housing indicators programme. Report and the Executive Director (Volume I).* Nairobi: UNCHS. UNCHS (Habitat) 1995 *Monitoring the shelter sector. Housing Indicators review.* Nairobi: UNCHS. UNCHS (Habitat) 1995 *Monitoring human settlements, abridged survey*. Indicators Programme. Nairobi: UNCHS. UNCHS (Habitat) 1998 *People, settlements, environment and development*. Nairobi: UNCHS UNCHS Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/
Involved agencies	UN - Centre for Human Settlements (Habitat) WHO
EXAMPLE INDICATOR	
Definition of indicator	Scope and extent of building regulations for housing
Underlying definitions	This indicator is based on the assumption that urban planning and building regulations can help to reduce health risks by controlling residential development on unsuitable sites and by

and concepts	providing adequate standards for housing construction and design. Underlying definitions are: • **land use planning**: formal procedures for controlling where, and under what conditions, land is developed for housing and other purposes. These procedures usually require formal consent before development and construction can occur. Land may also be zoned, with specific areas designated for housing purposes. • **building regulations**: legally defined standards and norms for building which must be met by the developer. Building regulations may cover issues such as the amount of space per occupant, construction materials and methods and safety standards.
Specification of data needed	Evidence of the existence, implementation and enforcement of land use planning and building regulations for housing.
Data sources, availability and quality	Evidence can normally best be obtained by scrutinising relevant legislation.
Computation	The indicator is computed by scoring 1 for each of the following components: • Formal planning consent required for all residential development • Strict land zoning in existence which defines areas suitable/permissible for housing • Building regulations exist which define minimum space requirements and living conditions (e.g. lighting, insulation) for houses • Building regulations exist which control building methods and materials for houses • Building regulations exist which define safety standards for houses
Units of measurement	Ordinal score (0-5)
Scale of application	Mainly national to international
Interpretation	This indicator provides a general measure of the rigour and scope of building and planning regulations for housing, and thus of the level of commitment to ensuring safe and adequate housing. The simple scoring system, however, means that it should be interpreted with caution, not least because the existence of the various regulations and planning instruments does not necessarily mean that they are effectively implemented and enforced.

ACCESS TO SAFE AND RELIABLE SUPPLIES OF DRINKING WATER	DPS**E**EA

INDICATOR PROFILE	
Issue	Access to safe drinking water
Rationale and role	Contaminated drinking water is a major cause of illness and mortality, as a result of exposures both to infectious agents (e.g. *E. coli*, cryptosperidium) and to chemical pollutants (e.g. lead, disinfection products). Inadequate access to water in the home is also a major source of economic disadvantage (by requiring large commitment of human resources to fetching and carrying water). This indicator provides a measure both of **exposure**, in terms of access to safe drinking water, and the effectiveness of **action** to improve access. It can be used: • to monitor the degree of access to safe drinking water, as a basis for prioritising policy; • to identify areas with poor access, where specific interventions are needed; • to indicate the potential health risks from use of poor quality drinking water, or inadequate water supplies; • to investigate relationships between access to safe water and health outcomes; • to monitor progress towards environmental health objectives in terms of access to safe water.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of water quality and access to water resources on health. • Exposure*: Connections to piped water supply;* ***Access to safe and reliable supplies of drinking water*** • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children; Outbreaks of water-borne diseases* • Action: *Intensity of drinking water quality monitoring*
Alternative methods and definitions	For general application, this indicator can be expressed as the percentage of people with access to safe and reliable supplies of drinking water. Defining the terms inherent in this indicator (i.e. 'safe', 'reliable' and 'access'), however, poses significant difficulties. Safe water implies that the water meets accepted drinking water quality standards, and poses no significant risk to health (e.g. from water-borne diseases). The safety of drinking water thus needs to be determined on the basis either of water quality monitoring, or evidence of effective treatment. A reliable supply implies a supply which is continuous, or guaranteed at all times of need (though short-term disruptions may occur to supplies in any system because of technical difficulties). Adequate access implies that the supply is available either in the home or, at worst, in close proximity. Each of these concepts and definitions may need to be varied, depending on local circumstances and expectation: e.g. between rural and urban areas, or between more and less developed countries. In developed countries, for example, the expectation is likely to be of a supply direct to the home. In developing countries, it may be considered acceptable to collect water from a local source. In the latter case, the distance to the source must be defined. A distance of 1000 metres is proposed by the WHO/UNICEF Global water supply and sanitation assessment 2000. However, shorter distances may be more appropriate in many cases.
Related indicator sets	UN **Indicators of sustainable development** • Access to safe drinking water WHO *Catalogue of health indicators* • Access to safe drinking water UNCHS (Habitat) *Urban indicators programme* • Household connect levels • Access to potable water

Sources of	UN *1996 Indicators of sustainable development. Framework and methodologies.* New York:

further information	UN. WHO 1981 *Development of indicators for monitoring health for all by the year 2000*. p.29. Geneva: WHO. WHO 1982 *National and global monitoring of water supply and sanitation.* CWS series of Cooperative Action for the decade, No.2. WHO 1994 *Ninth general programme of work covering the period 1996-2001*. Geneva: WHO. WHO 1994 *Implementation of the Global Strategy for Health for All by the year 2000. Second evaluation. Eighth report on the world health situation*. Geneva: WHO Regional Office for Europe, Volume 5, European Region. WHO *1996 Catalogue of health indicators: a selection of health indicators recommended by WHO programmes.* Geneva: WHO. WHO/UNICEF 1996 *Water supply and sanitation sector monitoring report 1996.* WHO/UNICEF Joint Monitoring Programme. WHO/UNICEF 1999 *Global water supply and sanitation assessment 2000. Water supply and sanitation sector questionnaire, 1999.* (Draft report). UNCHS Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/database/
Involved agencies	WHO-Programme for the Promotion Environmental Health UNICEF UN - Centre for Human Settlements (Habitat) Water Supply and Sanitation Collaborative Council National water companies and water authorities
EXAMPLE INDICATOR	
Definition of indicator	Percentage of the population with access to an adequate amount of safe drinking water in the dwelling or within a convenient distance from the dwelling.
Underlying definitions and concepts	The indicator is based on the following definitions: • **Access to safe water**: access to a safe and adequate supply of water either in the dwelling or within a convenient distance from the dwelling. • **Safe water**: water which either naturally, or as a result of treatment, is free from harmful or distasteful contaminants. • **Convenient distance**: May be defined as 15 minutes walking distance each way, or <1000 metres. This definition might vary from rural to urban areas. • **Adequate supply of water**: a continuous supply of water, sufficient to meet the needs of the user for drinking and hygiene. The minimum volume required may be defined as 20 litres per person per day. • **Continuous supply**: a supply which operates, without interruption, 24 hours per day. • **Total population**: total resident population.
Specification of data needed	Number of people with access to adequate supplies of safe drinking water. Total population.

Data sources, availability and quality	Data on the availability of, and access to, piped or public water supplies or water supplies provided under a formal licensing scheme (e.g. licensed abstractions from wells) may be obtained both from censuses and from relevant administrative authorities (e.g. water companies, public works departments). Data on access to informal supplies will usually need to be obtained via household surveys.

	Data on total population are available from national censuses and should be reliable.
Computation	The indicator can be computed as: $100 * (P_a / P_t)$ where P_a is the number of people with access to adequate and safe water supplies, and P_t is the total population.
Units of measurement	Percentage
Scale of application	Mainly local to national; application at broader scales is limited by problems of data availability and consistency.
Interpretation	This indicator provides a measure of the access to adequate and safe drinking water, and thus to potential health effects of dependence on inadequate or unsafe supplies. In general, an increase in the percentage of the population with access to safe drinking water may be taken as an indication of reduced exposure and health risk. Nevertheless, in interpreting the indicator, it is important to recognise that data on the quality, accessibility and adequacy of water supplies are often poor, especially in relation to non-piped water supplies.

CONNECTIONS TO PIPED WATER SUPPLY	DPS**EE**A
INDICATOR PROFILE	
Issue	Access to safe drinking water
Rationale and role	Contaminated drinking water is a major cause of illness and mortality, as a result of exposures both to infectious agents (e.g. *E. coli*, cryptosperidium) and to chemical pollutants (e.g. lead, disinfection products). Inadequate access to water in the home is also a major source of economic disadvantage (by requiring large commitment of human resources to fetching and carrying water). Provision of piped water thus provides one of the main ways of improving, both the quality of, and access to, drinking water, and as such has major health benefits. This indicator has two functions. It is an indicator of potential **exposure** to safe and adequate drinking water, and as such can be used to show trends or spatial variations in levels of potential exposure. In addition, where specific efforts are being made to improve access to safe water by installing a water supply system, it can serve as a useful **action** indicator showing the effectiveness of the policy.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of water quality and access to water resources on health. • Exposure: ***Connections to piped water supply****; Access to safe and reliable supplies of drinking water* • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children; Outbreaks of water-borne diseases* • Action*: Intensity of drinking water quality monitoring*
Alternative methods and definitions	This indicator could be expressed as the percentage of the population with (or alternatively without) access to piped water in the home. It could also be based on the number of households (rather than total population) if appropriate (e.g. when data on the number of people living in households connected to the water supply system are not available).
Related indicator sets	UNCHS (Habitat*) Urban indicators programme* • Household connection levels • Access to potable water
Sources of further information	WHO 1982 *National and global monitoring of water supply and sanitation*. CWS series of Cooperative Action for the decade, No.2. WHO 1994 *Implementation of the Global Strategy for Health for All by the year 2000. Second evaluation. Eighth report on the world health situation*. Geneva: WHO Regional Office for Europe, Volume 5, European Region. WHO/UNICEF 1996 *Water supply and sanitation sector monitoring report, 1996.* WHO/UNICEF Joint Monitoring Programme. WHO/UNICEF 1999 *Global water supply and sanitation assessment 2000. Water supply and sanitation sector questionnaire, 1999.* (Draft report). UNCHS Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/database/
Involved agencies	WHO-Programme for the Promotion Environmental Health UN - Centre for Human Settlements (Habitat) UNICEF Water Supply and Sanitation Collaborative Council National water companies and water authorities
EXAMPLE INDICATOR	

Definition of indicator	Percentage of the population receiving piped water to the home
Underlying definitions and concepts	This indicator is based on the assumption that access to piped water supplies can substantially reduce exposures to contaminated drinking water. Underlying definitions are: • **Piped water supply to the home:** existence of a permanent piped water system, providing treated water direct to the home • **Total population:** total resident population
Specification of data needed	Number of people living in households connected to the piped water supply Total population
Data sources, availability and quality	Data on number of people living in households receiving piped water to the home may be available from national water agencies or government statistics, and are liable to be broadly reliable. Alternatively, data may be obtained from household surveys. Data on the total population should be available through national census statistics and should be reliable
Computation	The indicator can be computed as: $(P_w / P_t) * 100$ where P_W is the number of people living in households receiving piped water to the home, and P_t is the total populations. The indicator should usually be calculated for a specified census date.
Units of measurement	Percentage
Scale of application	Local to international
Interpretation	This indicator provides a measure of the potential exposures to contaminated drinking water. In general, an increase in the proportion of households receiving piped water to the home may be taken as an indication of reduced exposure and health risk. Nevertheless, in interpreting the indicator, it is important to recognise that: • No allowance is made for differences in the quality of the supply; intermittent or poorly treated supplies may still pose significant health risks. Unreliable supplies, in particular, may encourage unsafe water storage in the home and exacerbate risks of water-borne disease. • For some forms of contamination (e.g. lead) old or poorly maintained water supply systems may be an important exposure source

OUTBREAKS OF WATER-BORNE DISEASES	DPSE**E**A
INDICATOR PROFILE	
Issue	Access to safe drinking water
Rationale and role	Water-borne continue to be a major cause of ill health and death across much of the developing world. This indicator is intended to provide a measure of this human disease burden. It can be used: • to monitor changes in the number of reported outbreaks; • to help assess the effectiveness of intervention programmes (e.g. aimed at improving drinking water quality); • to identify areas with high rates of disease, where specific actions need to be taken; • to raise awareness about the problem, and encourage action at the local or national level.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of water quality and access to water resources on health. • Exposure: *Connections to piped water supply; Access to safe and reliable supplies of drinking water* • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children;* ***Outbreaks of water-borne diseases*** • Action: *Intensity of drinking water quality monitoring*
Alternative methods and definitions	Various measures are available, on which to base an indicator of waterborne diseases. One of the most useful and widely used is the number of **outbreaks** of waterborne diseases in any survey period; this recognises the circumstance that most occurrences of waterborne disease occur as linked cases, relating to a single water source or pathway of exposure. Alternatively, indicators can be developed on the basis of the number of cases of waterborne disease. Although this gives a better measure of the total disease burden, it is less useful for management purposes, since intervention is usually aimed not at treating individual cases, but at preventing or controlling outbreaks at source. Either of these measures might also be applied to specific health endpoints; one example, is the set of indicators relating to dranunculiasis (Guinea-worm) developed by the WHO as Indicators for Monitoring the Health of the General Population (WHO 1996).
Related indicator sets	WHO *Catalogue of health indicators* • monthly incidence of Guinea-worm cases • annual incidence of Guinea-worm cases • villages with new cases of Guinea-worm
Sources of further information	WHO 1992 *Our planet, our health.* Geneva: WHO. WHO 1996 *Catalogue of health indicators.* Geneva: WHO. WHO Collaborating Center for Research, Training and Control of Dracunculiasis (no date) *Guidelines for surveillance in Dracunculiasis eradication programs*. Atlanta, USA: CDC.
Involved agencies	WHO
EXAMPLE INDICATOR	
Definition of indicator	Incidence of outbreaks of water-borne diseases

Underlying	• **Water-borne disease:** a disease which arises from the contamination of water by human

definitions and concepts	or animal faeces or urine infected by pathogenic viruses or bacteria, and which is directly transmitted when the water is drunk or used in the preparation of food. Water-borne diseases may be separated from several other categories of disease, including: • water-washed diseases - i.e. those resulting from inadequate personal hygiene because of scarcity or inaccessibility of water (e.g many waterborne diseases as well as typhus) • water-based diseases - those arising from parasites which use an intermediate host that lives in or near water (e.g. dracunculiasis) • water-related diseases - diseases borne by insect vectors which have habitats in or near water (e.g. malaria), and • water-dispersed diseases - infections whose agents proliferate in fresh water and enter the human body through the respiratory tract (e.g. Legionella) • **Outbreak:** an occurrence of two or more linked cases of the same illness, or an increase in the number of observed cases over the expected number. • **Total population:** total resident population during the survey period.
Specification of data needed	Number of outbreaks of water-borne diseases within a specified area within a specified period (e.g. a year) Total population
Data sources, availability and quality	Data on the number of outbreaks of water-borne diseases can be derived from a variety of sources, including: • routine passive case reporting by health care workers • community-based surveillance programmes • special surveys • analysis of hospital admission or GP statistics and records All of these are likely to lead to significant under-estimation of the number of outbreaks, due to incomplete referral and reporting. Serious inconsistencies in the estimates also occur between different areas or reporting periods because of variations in referral rates, in diagnosis and in reporting methods and accuracy. Data on the total resident population can usually be obtained from national censuses and should be reliable.
Computation	The indicator is computed as: 1000* (N / P) where N is the number of reported outbreaks and P is the total population.
Units of measurement	Number of outbreaks per thousand head of population
Scale of application	Local to international, though at broader scales interpretation is limited by problems of data consistency and completeness.
Interpretation	At a simple level, this indicator can be interpreted to show patterns or trends in the incidence of outbreaks of waterborne diseases. Considerable care is needed, however, because of the inherent inconsistencies and inaccuracies in the available data. Information relating to the incidence of outbreaks should also not be used to infer the absolute numbers of cases, since outbreaks may vary greatly in terms of the numbers of people affected.

INTENSITY OF DRINKING WATER QUALITY MONITORING	DPSEE**A**
INDICATOR PROFILE	
Issue	Access to safe drinking water
Rationale and role	Water quality monitoring provides a valuable tool in support of policy and management aimed at controlling water pollution and reducing risks to health. This indicator provides a measure of the extent to which action has been taken to monitor water pollution and drinking water quality in support of these goals. As such it can be used to: • show trends in level of policy concern and commitment to problems of water pollution • show geographic variations in monitoring activities, and identify areas needing additional monitoring effort • monitor the effectiveness of strategies aimed at improving information on the level of water pollution • provide some measure of reliability to national or regional statistics on water pollution and estimates of populations at risk
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the effects of water quality and access to water resources on health. • Exposure: *Connections to piped water supply; Access to safe and reliable supplies of drinking water* • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children; Outbreaks of water-borne diseases* • Action: ***Intensity of drinking water quality monitoring***
Alternative methods and definitions	A number of factors need to be considered in developing indicators of the capacity (i.e. intensity or extent) of water quality monitoring. These include: • the points in the supply chain at which monitoring is undertaken (e.g. at point of abstraction, after treatment, at point of supply) • the number and range of water quality parameters (determinants) measured • the number of measurements made • the number of stations/locations at which monitoring is carried out As a result, indicators of water quality monitoring can be designed and constructed in a wide variety of ways. Possibly the most relevant is in terms of the intensity of monitoring – i.e. the number of measurements (analyses times determinants) made per head of population or per unit of water abstracted or consumed – at point of supply. The advantage of this measure is that it relates most closely to levels of potential exposure, and also provides an indication of the overall effectiveness of water quality control at the end of the supply chain. Alternatively, the indicator might be assessed separately for each point in the supply chain. A further (but less sensitive) indicator is the total expenditure on water quality monitoring. Whichever of these indicators is used, it is important to appreciate that they measure only the capacity for water quality *monitoring*; they do not indicate the quality of the water itself, or the extent to which water quality complies with existing standards.
Related indicator sets	UN *Indicators on sustainable development* • Density of hydrological networks
Sources of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies*. New York: UN. WHO 1994 *Implementation of the Global Strategy for Health for All by the year 2000. Second evaluation. Eighth report on the world health situation*. Geneva: WHO Regional Office for Europe, Volume 5, European Region.
Sources of further	WHO/UNICEF 1996 *Water supply and sanitation sector monitoring report, 1996*. WHO/UNICEF Joint Monitoring Programme.

information - continued	WHO 1997 *Guidelines for drinking-water quality. Volume 3: Surveillance and control of community water supplies.* Second edition. Geneva: WHO. WHO/UNICEF 1999 *Global water supply* and sanitation assessment 2000. Water supply and sanitation sector questionnaire, 1999. (Draft report).
Involved agencies	WHO-Programme for the Promotion of Environmental Health UNICEF Water Supply and Sanitation Collaborative Council National water companies and water authorities National drinking water regulators
EXAMPLE INDICATOR	
Definition of indicator	Number of valid measurements of drinking water quality per head of population per year
Underlying definitions and concepts	The indicator depends upon the following assumptions: • The monitoring of water quality by official agencies implies the provision of relevant data, and its use for policy and management purposes by the agencies concerned • Measurements by different methods and on different determinants are broadly equivalent in terms of the quality and utility of the data they provide • Measurement is undertaken more-or-less uniformly across the population The indicator is based on the following definitions: • **Water quality measurement:** a single measurement of a single determinant of health concern, made by an official monitoring agency • **Determinant:** an officially recognised measure of water quality (e.g. concentration of NO_3-N; number of faecal coliforms) • **Total population:** total resident population.
Specification of data needed	Number of valid measurements made in previous year Total population
Data sources, availability and quality	Accurate information on the number of monitoring stations and pollutants monitored should be available from the relevant monitoring agencies. Data on total population should be available from national census sources, and should be of high quality.
Computation	The indicator can be computed as: $1000 * (\Sigma M_i / P)$ where M_I = number of valid measurements of pollutant I; P = total resident population. The indicator should normally be computed for a specified census date (e.g. the last day of the year).
Units of measurement	Number of measurements per thousand head of population.
Scale of application	Regional to international

Interpretation	This indicator provides a useful measure of the attention given to monitoring of drinking water quality, and as such shows how seriously issues of water pollution are being taken. In interpreting the indicator, however, it is important to bear in mind that monitoring may be terminated (and thus monitoring effort reduced) once pollution falls to a negligible level, and may be increased when pollution is worse. It is also important to remember that the indicator

	does not measure the quality of the water concerned, or its level of compliance with drinking water quality standards. For many purposes, therefore, the indicator needs to be considered in association with other indicators of drinking water quality (e.g. the proportion of analyses which meet drinking water quality standards).

POPULATION AT RISK FROM VECTOR-BORNE DISEASES	DPS**E**EA
INDICATOR PROFILE	
Issue	Vector-borne disease
Rationale and role	Vector-borne diseases are a major cause of both morbidity and mortality, especially in the developing world. This indicator is intended to evaluate the number of people at-risk from vector-borne diseases, by virtue of living in areas infected with the disease vectors. It can thus be used: • to assess the numbers of people at risk; • to identify areas of particular risk, where special action is required; • to assess and compare the effectiveness of control programmes (e.g. habitat removal or management, pest control measures).
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the risks of vector-borne diseases: • Exposure: ***Population at risk from vector-borne diseases*** • Effect: *Mortality due to vector-borne diseases* • Action: *Adequacy of vector control and management systems*
Alternative methods and definitions	The accurate determination of the number of people at risk from vector-borne diseases is, in practice, complex. For a real risk to occur, three preconditions need to exist: a parasite, a suitable vector and a susceptible host population. These also need to come into contact (and to do so at relevant points in the lifecycle of the parasite). Rarely are detailed data available on these factors at an appropriate spatial and temporal scale. A simple indicator can, however, be constructed in terms of the number of people living in areas endemic for vector-borne diseases. This provides a general indication of the *potential* for exposure. Where appropriate, this indicator should be separately defined for each disease and/or vector species. Where reliable data on population are not available, this indicator might alternatively be defined in terms of the endemic area. This, however, will clearly make no distinction between densely and sparsely populated regions. Another alternative for this indicator is the Entomological Inoculation Rate (EIR). This is widely used in relation to malaria, for example, to indicate the transmission intensity.
Related indicator sets	WHO *Catalogue of health indicators* • Incidence rate of severe malaria
Sources of further information	WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide*. AFRO/CTD/MAL/ 94.3. Brazzaville: WHO Regional Office for Africa. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO Programmes.* Geneva: WHO.
Involved agencies	UNDP UNICEF WHO World Bank
EXAMPLE INDICATOR	
Definition of indicator	Number of people living in areas endemic for vector-borne diseases

Underlying	• **Vector-borne disease:** a disease which is transmitted by a biological agent (often an

definitions and concepts	insect). Common vector-borne diseases include malaria, yellow fever, dengue fever, river blindness (onchocerciasis), filiariasis, schistosomiasis, Japanese encephalitis and sleeping sickness. Many of the most important vector-borne diseases are water-related, in that the insect vectors concerned breed or pass part of their lifecycle in or close to water. Vector-borne diseases have thus been exacerbated in many cases by inappropriate water-engineering (e.g. irrigation) or poor management of water resources and wastes (e.g. poor sanitation). Some vector-borne diseases are also animal-related (e.g. Lyme's disease), in that the insect vectors are associated with specific animal hosts. In these cases, land use and land cover are important factors in their distribution and prevalence. • **At-risk population:** the population at risk from vector-borne disease, by virtue of living in, or visiting, an endemic area**.**
Specification of data needed	At-risk population
Data sources, availability and quality	Reliable data on the at-risk population are difficult to obtain, but estimates can be made by analysis of national census data and information on the extent of the vector-borne diseases of interest. GIS techniques might usefully be applied in order to estimate the number of people living in the endemic area (e.g. by overlaying boundaries of the infected area on population data). Where data on the extent of the endemic area are not directly available, estimates may be made on the basis of the distribution of potential vector habitats (e.g. using remotely sensed data). In this case, the endemic area may be defined by buffering around each potential habitat at an appropriate distance (depending on the parasite and vector concerned).
Computation	The indicator can be computed as the number of people living within endemic areas, or living within a specified distance of potential vector habitats. Separate estimates should be made for each type of vector-borne disease and vector species.
Units of measurement	Number of people
Scale of application	Local to international, though at broader scales interpretation is limited by problems of data consistency and completeness.
Interpretation	This indicator provides a general measure of the population at risk from vector-borne diseases: an increase in the numbers of people living in endemic areas may be taken to imply an increased risk, a reduction the reverse. Nevertheless, in interpreting the indicator it is important to take account both of the potential uncertainties in the data, and the possible complexities in the relationship between place of residence and risk. Data on the extent of the endemic area, for example, may be unreliable both because of omission (i.e. exclusion of unknown endemic areas) and commission (inclusion of non-endemic areas). These errors are likely to increase as the scale of mapping becomes smaller (i.e. less detailed). The actual risk across the population living within an endemic area is also likely to vary substantially, depending on local conditions (below the resolution of the available data), age, disposable income and lifestyle. There are, for example, important micro-epidemiological differences in malaria, so that even at the community level the disease may be clustered in certain families. It is also important to remember that people are not static, but move both within and through the area. Thus the at-risk population may change over time, and includes visitors to, or past residents of, the endemic area.

MORTALITY DUE TO VECTOR-BORNE DISEASES	DPSEEA
INDICATOR PROFILE	
Issue	Vector-borne diseases
Rationale and role	Vector-borne diseases are a major cause of both morbidity and mortality, especially in the developing world. This indicator is devised to provide a measure of the effect of exposure to disease vectors. It can be used to: • monitor changes in mortality rates due to vector-borne diseases, in order to identify trends and plan control strategies; • assess the effectiveness of vector-control or health care strategies; • identify areas with especially high rates of mortality, which may need special interventions; • analyse relationships between environmental conditions likely to affect exposures (e.g. land use, climate change) and health outcome.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the risks of vector-borne diseases: • Exposure: *Population at risk from vector-borne diseases* • Effect: ***Mortality due to vector-borne diseases*** • Action: *Adequacy of vector control and management systems*
Alternative methods and definitions	Where appropriate data are available, the most appropriate way of defining this indicator is in terms of the mortality rate due to vector-borne diseases, by type of disease. Since children are often the most vulnerable to vector-borne diseases, this indicator could usefully be stratified by age (including 0-4 year old and 5-15 year old age groups). Pregnant women are also an important susceptible group, so the indicator might also be separately computed for these. The indicator can be simplified by presenting only the aggregate death rate for all vector-borne diseases. This, however, may mask important environmental and policy-related differences (e.g. by masking changes in diseases associated with specific vectors, habitats or land use systems).
Related indicator sets	WHO *Catalogue of health indicators* • Incidence rate of severe malaria
Sources of further information	WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide*. AFRO/CTD/MAL/ 94.3. Brazzaville: WHO Regional Office for Africa. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO Programmes.* Geneva: WHO.
Involved agencies	UNDP UNICEF WHO World Bank
EXAMPLE INDICATOR	
Definition of indicator	Mortality rate due to vector-borne diseases, by type

Underlying	• **Vector-borne disease:** a disease which is transmitted by a biological agent (often an

definitions and concepts	insect). Common vector-borne diseases include malaria, yellow fever, dengue fever, river blindness (onchocerciasis), filiariasis, schistosomiasis, Japanese encephalitis and sleeping sickness. Many of the most important vector-borne diseases are water-related, in that the insect vectors concerned breed or pass part of their lifecycle in or close to water. Vector-borne diseases have thus been exacerbated in many cases by inappropriate water-engineering (e.g. irrigation) or poor management of water resources and wastes (e.g. poor sanitation). Some vector-borne diseases are also animal-related (e.g. Lyme's disease), in that the insect vectors are associated with specific animal hosts. In these cases, land use and land cover are important factors in their distribution and prevalence. • **Total population:** total resident population.
Specification of data needed	Number of deaths due to vector-borne diseases Total population
Data sources, availability and quality	Data on the number of deaths due to vector-borne diseases can generally be obtained from routine health service sources, either nationally or locally. For some forms of vector-borne disease, mortality statistics are also collated as part of national or international surveillance programmes. Where routine data do not exist, special surveys may be necessary. In all cases, data may be subject to some uncertainties, due to incomplete or inconsistent reporting as a result both of the complex disease syndromes and limitations in the reporting services. Data on total population are usually available through national censuses, and should be reliable.
Computation	The indicator can be computed as: $1000 * (V_d / P)$ where V_d is the number of deaths due to vector-borne disease d within the survey period, and P is the total population.
Units of measurement	Number of deaths per thousand head of population
Scale of application	Local to international, though at broader scales interpretation is limited by problems of data consistency and completeness.
Interpretation	In general terms, this indicator provides a direct measure of the health effects of vector-borne diseases: an increase in the mortality rate may be interpreted as evidence of an increase in the health impacts, a reduction the reverse. As a mortality indicator, however, it provides information only on the most severe effects of these diseases; it does not show the much larger burden of morbidity which exists. Mortality rates are also highly dependent on the quality of the health care service, and on factors such as remoteness and access to health care. Differences in mortality rate need to be interpreted in this context. Some problems of data consistency and accuracy may occur, especially in remote or less developed areas where routine reporting is limited. Many vector-borne diseases also show natural periodicity (related, for example, to seasonal or inter-annual fluctuations in the vector population). Short-term trends therefore need to be interpreted with caution, and care is needed in inferring effects of intervention strategies over short periods.

ADEQUACY OF VECTOR CONTROL AND MANAGEMENT SYSTEMS	DPSEE**A**

INDICATOR PROFILE	
Issue	Vector-borne disease
Rationale and role	Control of vector-borne diseases requires a varied and integrated approach. Prevention depends upon the implementation of appropriate development and land use strategies, which can reduce the extent of habitats for the disease vectors, or at least separate effectively them from human populations. Vector control programmes are needed to reduce or eliminate vector species (e.g. through use of insecticides). Treatment requires the existence of effective surveillance systems and treatment programmes, supported by adequate drug supplies. Programmes are needed to monitor drug and insecticide resistance. Education is also needed to help those concerned reduce their risks of exposure, recognise the symptoms of infection and follow the prescribed treatments effectively. This indicator is intended to evaluate the effectiveness of the available prevention, control and treatment systems. It can thus be used: • to assess and compare prevention, control and treatment systems in different countries or areas (e.g. to identify good practice or areas where more effective intervention is required); • to monitor the dissemination of good practice, or progress towards agreed goals and standards for prevention, control and treatment.
Linkage with other indicators	This indicator represents one in a chain of indicators which together describe the risks of vector-borne diseases: • Exposure: *Population at risk from vector-borne diseases* • Effect: *Mortality due to vector-borne diseases* • Action: ***Adequacy of vector control and remediation systems***
Alternative methods and definitions	This indicator can be defined and assessed in various ways. Possibly the most feasible and informative in many situations is to determine the percentage of the at-risk population covered by effective and integrated vector prevention, control and treatment systems, by disease type. This requires the ability to define and recognise the existence and extent of effective programmes. As alternatives, the indicator might be separately defined for different types of programme (e.g. prevention, control, treatment), or by disaggregating these programmes into their constituent activities. Where treatment, rather than control, is the main focus of interest, an indicator might be developed to assess the number of treatment centres specifically equipped to deal with the vector-borne diseases of interest per thousand people at risk. In this case, treatment centres might be defined in terms of the availability of trained staff and continuous and adequate supplies of drugs. Alternatively, an indicator could be defined in terms of the proportion of the at-risk population inoculated against infection. Where avoidance and control are the focus of attention, an indicator might be developed in terms of either: a) the number of people living in endemic areas (a measure both of exposure and of the effectiveness of actions taken; or b) the area of endemic land which has been cleared of the disease vector.
Related indicator sets	WHO *Catalogue of health indicators* • Availability of anti-malaria drugs in health facilities

Sources of further information	WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide*. AFRO/CTD/MAL/ 94.3. Brazzaville: WHO Regional Office for Africa. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by*

	WHO Programmes. Geneva: WHO.
Involved agencies	UNDP UNICEF WHO World Bank
EXAMPLE INDICATOR	
Definition of indicator	Percentage of the at-risk population covered by effective vector control and management systems, by disease type
Underlying definitions and concepts	• **Vector-borne disease**: a disease which is transmitted by a biological agent (often an insect). Common vector-borne diseases include malaria, yellow fever, dengue fever, river blindness (onchocerciasis), filiariasis, schistosomiasis, Japanese encephalitis and sleeping sickness. Many of the most important vector-borne diseases are water-related, in that the insect vectors concerned breed or pass part of their lifecycle in or close to water. Vector-borne diseases have thus been exacerbated in many cases by inappropriate water-engineering (e.g. irrigation) or poor management of water resources and wastes (e.g. poor sanitation). Some vector-borne diseases are also animal-related (e.g. Lyme's disease), in that the insect vectors are associated with specific animal hosts. In these cases, land use and land cover are important factors in their distribution and prevalence. • **Vector control programme**: a specific programme aimed at controlling the disease vectors, for example by use of pesticides, by introduction of biological controls (e.g. natural predators), habitat removal or by habitat management. • **Development controls**: specific controls on developments aimed at avoiding the construction of potential habitats for vectors. These might include the need for impact assessment as part of the development process, or the enforcement of specific design standards for developments. • **Vector-borne disease surveillance programme**: a system or programme for the routine monitoring and reporting of vector-borne diseases, operating over a sufficient geographic area, and at a sufficient frequency, to identify local/regional and short-term variations in disease incidence and prevalence. • **Education programme**: a programme of education and awareness raising, aimed at improving public understanding of the risks of vector-borne diseases, and the avoidance/treatment strategies which individuals should adopt. • **Treatment programme**: a specific programme of health care, aimed at early and effective treatment of the disease. This should include the availability of trained personnel with sufficient and continuous supplies of relevant drugs, with easy access to those at risk. • **Integrated vector control and management programme**: a programme which is explicitly designed and implemented to control, manage and monitor vector-borne diseases at all relevant points of control, in a co-ordinated and integrated manner. Such programmes typically include actions to manage or remove habitats of the vector species, to control the vector species directly (e.g. by pesticides or biological controls), to educate and inform those most at risk, to provide early treatment to those at risk or affected, and to monitor the disease vectors (including their resistance to insecticides, drugs etc) and the effectiveness of the control programmes. • **At-risk population**: the population at risk from vector-borne disease, by virtue of living in an infected area. • **Population covered by vector-borne disease control and treatment systems:** number of people living in areas where each of the above types of programme is in place and operational
Specification of data needed	At-risk population Number of people covered by integrated vector-borne control systems, by type of disease
Data sources, availability	Reliable data on the at-risk population are difficult to obtain, but estimates can be made by analysis of national census data and information on the extent of the vector-borne diseases of

and quality	interest. Where data on the extent of the endemic area are not directly available, estimates may be made on the basis of the distribution of potential vector habitats (e.g. using remotely sensed data). GIS techniques might usefully be applied in order to estimate the number of people living in the endemic area. Information on the extent and scope of management and control systems can best be obtained by examining relevant legislation and through direct contact with the health or other officials concerned. Where relevant data are not available, questionnaire surveys of relevant officials may be used.
Computation	The indicator can be computed as: $100 * (N_{pd} / R_d)$ where N_{pd} is the number of people covered by programme p for vector-borne disease d; and R_d is the number of people at risk of vector-borne disease d.
Units of measurement	Percentage
Scale of application	Regional to international
Interpretation	This indicator provides a general measure of the adequacy and effectiveness of the actions taken to control and treat vector-borne diseases. In general, an increase in the percentage of at-risk people covered by these programmes, the more effective the actions. As with all action-based indicators, however, it is important to make a distinction between the existence of strategies or programmes and their impact on the ground. For this reason, the indicator is best interpreted in association with indicators of effect (e.g. the mortality rate due to vector-borne diseases) or exposure (e.g. the number of people at risk).

MUNICIPAL WASTE COLLECTION	DPSEE**A**
INDICATOR PROFILE	
Issue	Waste management
Rationale and role	The development of an effective service for domestic waste collection is one of the primary ways of improving living conditions in urban areas, of reducing pollution of surface water and groundwater, and of reducing exposures (especially of children) to hazardous substances and pathogens in waste materials. While this indicator is thus primarily an **action** indicator, it also provides a measure of potential exposure to materials likely to affect health. It can be used: • to assess and compare the extent and effectiveness of measures to collect and remove wastes and progress towards waste management objectives; • to identify areas with poor waste collection facilities, where special action is required; • as a measure of potential exposures to unhealthy living conditions or hazardous/unsafe substances and pathogens in waste materials; • to help investigate relationships between exposures to waste and health effects.
Linkage with other indicators	This is part of a group of indicators assessing the action taken in terms of waste management: • ***Municipal waste collection;*** *Municipal waste disposal; Hazardous waste policies* However, as an indicator of potential exposure, it also has links to a number of indicators, including: • Exposure: *Population in informal settlements; Population living in unsafe housing* • Effect*: Diarrhoea morbidity in children; Diarrhoea mortality in children*
Alternative methods and definitions	This indicator can be defined as the percentage of households served by regular waste collection services. Alternatively it could be expressed as the proportion of population served by regular municipal waste removal services, where data on the number of persons per household are available. This has a significant advantage, in that waste collection services often preferentially serve more affluent areas, with lower occupation densities; higher density housing may thus be under-represented.
Related indicator sets	UN *Indicators of sustainable development* • Municipal waste disposal • Waste recycling and reuse • Household waste disposal per capita
Sources of further information	IMO 1995 *Global waste survey.* International Maritime Organization, Final Report. ISWA 1996 *Solid waste management for economically developing countries.* Copenhagen: International Solid Waste Association. ISWA 1997/98,1995/*96 International directory of solid waste management.* The ISWA year books. UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN. UNEP & IETC 1996 *International source book on environmentally sound technologies for municipal solid waste management,* Technical Publication Series (6): Osaka/Shiga, Japan. WHO 1984 *Management of solid waste in developing countries.* WHO Regional Office for South-East Asia. Series #1. WHO 1995 *Solid waste management in some countries of the Eastern Mediterranean Region,* CEHA Document, No. Special studies, SS-4, Amman: CEHA. WHO 1995 *Waste collection.* Copenhagen: WHO regional office for Europe.
Sources of	WHO 1995 *Solid waste and health.* Copenhagen: WHO regional office for Europe.

further information *- continued*	WHO 1996 *Municipal solid waste management in Latin America and the Caribbean*. Washington, DC: Pan American Health Organization - WHO Regional Office for the Americas.
Involved agencies	WHO UNCHS (Habitat) UNEP National/regional waste authorities and companies Local authorities
EXAMPLE INDICATOR	
Definition of indicator	Percentage of households served by regular waste collection services.
Underlying definitions and concepts	The indicator is based on the following definitions: • **Solid waste:** solid materials which have no further useful purpose and are thus discarded. • **Regular waste collection service:** a regular and frequent service which collects and safely disposes of domestic waste from the door or a designated waste collection site. The frequency of collection should be such that it avoids the accumulation of uncontained rubbish. • **Household:** a single dwelling unit (e.g. a house or apartment) intended for permanent residence.
Specification of data needed	Total number of households covered by the waste collection service. Total households in the area of study.
Data sources, availability and quality	Data on the number of households covered by the waste collection services may be available from local authorities or from the waste collection agencies. Often, these data will be collated at national level by national statistical offices or by the relevant ministries. Data on the total number of households should be available through national census statistics, though care is needed in relation to the definition of a 'household' (e.g. how collective dwellings are classified). Alternatively, data can be collected via household or special surveys.
Computation	The indicator can be computed as: (W / H) * 100 where W is the number of households covered by the waste collection service; and H is the total number of households in the area.
Units of measurement	Percentage
Scale of application	Local to international.
Interpretation	This indicator provides a measure of the extent to which waste removal services are adequate to avoid health risks. As such, an increase in the proportion of households covered by the waste collection service may be interpreted as evidence of increased action, and reduced health risks; a reduction in the proportion covered would imply that action was unable to keep up with need, and a heightened health risk. For various reasons, however, the indicator needs to be interpreted with caution. The main problem concerns the reliability of the data, especially in remote or rural areas. The existence of a waste collection service, also, does not necessarily mean either that it operates effectively, or that the waste is then disposed of safely.

MUNICIPAL WASTE DISPOSAL	DPSEE**A**
INDICATOR PROFILE	
Issue	Waste management
Rationale and role	The development of an effective service for domestic waste collection is one of the primary ways of improving living conditions in urban areas, of reducing pollution of surface water and groundwater, and of reducing exposures (especially of children) to hazardous substances and pathogens in waste materials. While this indicator is thus primarily an **action** indicator, it also provides a measure of potential exposure to materials likely to affect health. It can be used: • to assess and compare the extent and effectiveness of measures to collect and remove wastes and progress towards waste management objectives; • to identify areas with poor waste collection facilities, where special action is required; • as a measure of potential exposures to unhealthy living conditions or hazardous/unsafe substances and pathogens in waste materials; • to help investigate relationships between exposures to waste and health effects.
Linkage with other indicators	This is part of a group of indicators assessing the action taken in terms of waste management. • *Municipal waste collection;* ***Municipal waste disposal****; Hazardous waste policies* However, as an indicator of potential exposure, it also has links to a number of indicators, including: • Exposure: *Population in informal settlements; Population living in unsafe housing* • Effect: *Diarrhoea morbidity in children; Diarrhoea mortality in children*
Alternative methods and definitions	This indicator needs to define the amount or proportion of solid waste disposed of in a safe and controlled way by (or on behalf of) municipal waste management services. Several alternative methods are possible for this indicator. It may, for example, be based on either the mass of solid waste or the volume. Data are often more readily available in terms of mass, but volume measures have the advantage that they reduce the effects of moisture content at point of disposal, and may be more relevant in the case of landfill. The indicator can also be expressed either in absolute terms (tonnes, m^3), in per capital terms (amount/head of population) or proportional terms (percentage of all solid waste). Each of these will convey slightly different messages and should be used to address different issues. Absolute measures, for example, indicate the total amount of waste being disposed of, but do not show the extent to which this is matching rates of waste generation. Per capital measures are useful for comparisons between countries, and highlight areas which are relatively profligate in terms of waste generation. Percentage measures show the extent to which the collection service is matching waste generation, but gives no indication of the total amounts of waste involved. The indicator might also be related to a measure of GDP as the denominator; this standardises the indicator for level of affluence or development. Where a measure is needed of the degree of **pressure** on the environment from waste disposal, unit land area may be used as the denominator (i.e. amount of waste disposed of per square kilometre). A further alternative is to express the indicator in terms of the method of disposal (e.g. by landfill, incineration, recycling, reuse).
Related indicator sets	UN *Indicators of sustainable development* • Municipal waste disposal • Waste recycling and reuse • Household waste disposal per capita
Sources of further	UN *1996 Indicators of sustainable development. Framework and methodologies.* New York:

information	UN. WHO 1981 *Development of indicators for monitoring health for all by the year 2000*. Geneva: WHO. WHO 1981 *Global strategy for all by the year 2000.* Geneva: WHO WHO 1982 *National and Global monitoring of water supply and sanitation.* CWS series of Cooperative Action for the Decade, No.2. WHO 1990 *Water supply and sanitation sector monitoring report (WSSMR*). WHO/UNICEF Joint Monitoring Programme. WHO 1994 *Ninth general programme of work covering the period 1996-2001*. Geneva: WHO.
Involved agencies	WHO UNCHS (Habitat) UNEP National/regional waste authorities and companies Local authorities
EXAMPLE INDICATOR	
Definition of indicator	The mass of solid waste disposed of by municipal waste management services
Underlying definitions and concepts	The indicator is based on the assumption that controlled waste collection and disposal helps to reduce exposures of the population to materials likely to have adverse effects on health, and improve the quality of the living environment. Underpinning definitions are: • **Municipal solid waste:** Waste materials produced and discarded by households and other municipal establishments (e.g. schools, offices, hospitals, hotels). The waste material is likely to be primarily non-hazardous, but may include small amounts of hazardous material. • **Amount of disposed waste**: the mass of controlled disposal or treatment of waste, which removes it from the open environment (e.g. by landfill, incineration, composting, recycling or reuse). • **Total population:** total resident population.
Specification of data needed	Amount of waste disposal by municipal waste authorities. Total population.
Data sources, availability and quality	Data on the amount of disposed waste are occasionally available through routine monitoring undertaken by the waste management companies or local authorities (e.g. using weighbridges at disposal sites). More commonly, however, data need to be derived from special surveys. In both cases, data tend to be highly uncertain, due to problems of ensuring accurate measurement, variations in the unit weight of the wastes (e.g. due to differences in moisture content), and ineffective reporting by the agencies concerned. Data on the total population are available from national censuses and should be reliable.
Computation	The indicator can be computed as: M_w / P where M_w is the mass of waste disposed of, and P is the total population.
Units of measurement	Tonnes per annum per capita.

Scale of application	Local to international, though at broader scales interpretation is limited by problems of data consistency and completeness.
Interpretatio	The volume of waste disposed by the municipality is an indicator which is related to the

n	efficiency and level of service provision for waste management. Generally, adequate waste management indicates that the authorities are aware of the preventative nature and reduction of important health and environmental risks resulting from poor waste management. If this waste disposal indicator is compared with waste generation rates, it will give some indication of both the amounts of waste that are dumped indiscriminately and that recycled and reused by the informal and formal sectors. In developing countries, service provision often cannot keep up with demand, and it can be assumed that there will be significant room for improvement. In more developed countries, where service provision is not such a problem, the indicator might better be replaced by a measure of the proportion of the waste generated by human settlements that is not recycled or re-used. As with all statistics on waste generation and disposal, this indicator faces severe problems of data accuracy. Major errors often exist in these statistics (often of several orders of magnitude), largely because of the difficulties of measuring waste disposal and the poorly developed monitoring systems which exist in most countries. Trends or patterns shown by the indicator thus need to be interpreted with the utmost caution. Moreover, disposal – especially in landfill - may not effectively remove the waste from human contact, unless the sites are properly managed and seepage into the environment is controlled. In addition, the mass (or volume) of total waste disposed of is not necessarily a reliable measure of the risk to health; in many cases, the main risks come from the relatively small component of hazardous wastes. It is the way in which these are disposed of which is often most important.

HAZARDOUS WASTE POLICIES	DPSEE**A**
INDICATOR PROFILE	
Issue	Waste management
Rationale and role	Control of exposures to hazardous wastes depends to a large extent on the existence of effective policies, aimed at minimising their production as far as possible, and ensuring their safe storage, transport and disposal. This indicator is thus an **action** indicator, which is intended to show the effectiveness of policies on, and regulation of, hazardous wastes. It can be used: • to compare countries or regions in terms of their hazardous waste management policies; • to identify areas in which hazardous waste policies need strengthening; • to monitor progress towards international agreements or targets for hazardous waste management policy; • to help assess the effectiveness of hazardous waste management policies.
Linkage with other indicators	This indicator is one of a group of indicators describing the actions taken for waste management: • *Municipal waste collection; Municipal waste disposal;* ***Hazardous waste policies*** In addition, it relates to a chain of indicators on hazardous and toxic wastes: • Exposure*: Blood-lead levels in children* • Effect: *Mortality rate due to poisoning* • Action: *Contaminated land management*
Alternative methods and definitions	This indicator needs to be defined in a way which adequately assesses both the existence and effectiveness of legislation and mechanisms to control and treat hazardous waste. Probably the best way of doing this is to categorise the types of policy which is in place in terms of its scope and rigour: i.e. the range of waste sources/processes covered; the range of hazardous waste substances covered; and the degree of enforcement involved. More sophisticated indicators can also be devised using a scoring system for each of these factors, though these can become difficult to apply or interpret. A simpler indicator could be based simply on the existence or non-existence of legislation, though this is likely to disguise many of the important variations which occur in the effectiveness of policies. A further alternative could be based on the amount of expenditure on hazardous waste treatment (as proposed in the UN *Indicators of sustainable development*). This, however, may be difficult to interpret since low levels of expenditure may be due to limited production of hazardous wastes or to lack of commitment to safe treatment. If used, this indicator should be computed as *amount of expenditure per unit of hazardous waste generated or imported.* Alternatives to this indicator might also be developed for specific types of hazardous waste (e.g. medical wastes, radioactive wastes, chemical wastes).
Related indicator sets	UN *Indicators of sustainable development* • Expenditure on hazardous waste treatment • Imports and exports of hazardous waste • Generation of hazardous waste • Generation of radioactive waste
Source of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN.
Involved agencies	National/regional waste authorities WHO

EXAMPLE INDICATOR	
Definition of indicator	Effectiveness of hazardous waste policies and regulations
Underlying definitions and concepts	• **Hazardous waste:** waste materials (i.e. materials which are considered no longer to have value or utility and which are thus to be disposed of) which pose dangers to human health in the event of either long- or short-term exposures either to the wastes themselves or their decay products. Exposure may occur either directly (e.g. through contact with the waste) or indirectly (e.g. via seepage into soil, groundwater or surface water, release into the atmosphere or accumulation in the food chain. • **Hazardous waste policy and regulations:** formal legislation, acts of parliament or stated government intentions aimed at reducing the production of hazardous wastes (waste minimisation), at controlling the storage, transport, import/export and disposal of hazardous wastes (waste management).
Specification of data needed	Existence of effective policies and measures for hazardous waste minimisation and management.
Data sources, availability and quality	Information on the existence, scope and rigour of hazardous waste policies can best be obtained by scrutiny of the relevant legislation.
Computation	The indicator can be computed by ranking the strength and scope of the legislation as follows: 0 No legislation in existence 1 Guidance/voluntary procedures for some aspects of hazardous waste production, storage, transport, export/import and disposal, for some hazardous wastes 2 Guidance/voluntary procedures for most aspects of hazardous waste production, storage, transport, export/import and disposal, for most hazardous wastes 3 Guidance/voluntary procedures for all or most aspects of hazardous waste production, storage, transport, export/import and disposal, covering most hazardous wastes; mandatory controls on some aspects for a limited range of wastes 4 Mandatory controls on all aspects of hazardous waste production, storage, transport, export/import and disposal, covering a limited range of hazardous wastes; voluntary agreements or guidelines on most other hazardous wastes 5 Mandatory controls on all aspects of hazardous waste production, storage, transport, export/import and disposal, covering a wide range of hazardous wastes Note: as with all such scoring systems, qualitative judgements need to be made about which category is the most appropriate in any given situation, since the classes are not wholly exclusive or all-encompassing.
Units of measurement	Scale (1-5)
Scale of application	National to international.
Interpretation	This indicator provides a simple, yet reasonable robust measure of the scope, strength and effectiveness of policies and legislation on hazardous wastes. In general, the higher the score achieved, the more effective are the policies. In interpreting the indicator, however, it is important to bear in mind both the multivariate nature of hazardous waste policies (the nature of the policy instruments, their scope and the range of pollutants covered) and the simple, qualitative character of the indicator. The existence of legislation, also, does not necessarily translate into effective action: policies also need to be applied and enforced.

BLOOD LEAD LEVEL IN CHILDREN	DPS**E**EA
INDICATOR PROFILE	
Issue	Hazardous/toxic substances
Rationale and role	Lead is a widespread and persistent environmental pollutant, which is known to have both chronic and acute health effects. Particular concern relates to effects on the nervous system, blood pressure and haem biosynthesis. Major sources comprise road traffic, smelting, mining, manufacturing industry, coal combustion, waste incineration and water distribution pipes. Exposures occur through a variety of pathways, including drinking water, food, the atmosphere and soil. Children of pre-school age are considered to be a particularly high-risk group because of the combined effects of their behavioural characteristics (e.g. time spent outdoors and lower concern for hygienic conditions), their rate of food and water consumption relative to body weight, their higher rate of lead absorption in the gastrointestinal tract and the low threshold for health effects. The apparent link between lead levels and blood pressure also mean that adult males (especially in the 40+ age group) and pregnant women can also be considered as high-risk. This indicator provides a measure of **exposure** to lead in the environment from all main sources. Uses include: • monitoring levels of blood lead in high-risk groups, as a marker for trends in lead exposure in the wider population; • monitoring changes in blood-lead levels, in response to changing levels of emission (e.g. due to policy interventions, technological developments or changes in lifestyle); • mapping blood-lead levels in order to identify exposure hotspots which need special action; • analysing relationships between emission activity or environmental concentrations and lead exposure; • analysing relationships between lead exposures and health effects.
Linkage with other indicators	This indicator is one in a chain of indicators describing the risks of, and responses to, toxic substances and hazardous wastes in the environment: • Exposure: ***Blood-lead levels in children*** • Effect: *Mortality rate due to poisoning* • Action: *Contaminated land management* The indicator is also useful as an exposure measure in relation to several other issues, however, including air pollution and water quality. Other related indicators thus include: • State: *Ambient concentration of air pollutants in urban areas* • Exposure: *Connections to piped water supply* • Action: *Availability of unleaded fuel; Intensity of water quality monitoring*
Alternative methods and definitions	This indicator can best be defined as the percentage (or number) of children, within a specified age group, who have blood lead levels in excess of a specified threshold. For this purpose, the most relevant age group is 0-5, since children within this age range are especially vulnerable (as outlined above). Other vulnerable groups (e.g. older children, pregnant mothers, males aged 50-65) might, however, be used. Standardisation by age, gender and relevant socio-economic characteristics is also likely to be helpful in interpreting the indicator. A threshold concentration of 10 µg/dl is suggested as a basis for assessment; other threshold concentrations (e.g. 30 µg/dl) might also be applied. This indicator could also be represented in terms of average blood lead levels, but this is problematic due to the skewed nature of blood lead distributions. It would, however, be appropriate to present the percentage of children with blood lead levels in different concentration classes (e.g. <10, 10-15, 15-30, >30 µg/dl).
Related indicator sets	None

Sources of further information	UN 1996 *Indicators of sustainable development: framework and methodologies.* Report for the UN Commission on Sustainable Development, New York, USA, UN Department for Policy Coordination and Sustainable Development. WHO 1992 *Human exposure to lead.* Report on the Human Exposure Assessment Location (HEAL) Programme Meeting held in Bangkok, Thailand 16-19 November 1992. Geneva: WHO. WHO 1995 *Inorganic lead.* Environmental Health Criteria Series, Number 165. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization. Geneva: WHO.
Involved agencies	WHO – Environmental health division ILO - for occupational exposures
EXAMPLE INDICATOR	
Definition of indicator	Percentage of children with blood lead levels > 10 µg/dl
Underlying definitions and concepts	The indicator is based on the assumption that blood-lead levels provide a general measure both of exposure to lead in the environment, and of potential health effects. The focus on high-risk groups helps to strengthen the link with these health effects and to target those most at risk. Children aged 0-5 years of age are identified as the main high risk group in this case due to their tendency to receive high doses of lead (e.g. through playing in polluted areas), and their specific susceptibility to neurological and developmental effects. Underlying definitions are: • **Raised blood lead level:** blood lead concentrations, measured using standard tests, in excess of 10 µg/dl • **Children**: children aged under 5 years of age at the time of survey (or at the mid-point of the survey year).
Specification of data needed	Percentage of children with blood lead levels > 10 µg/dl
Data sources, availability and quality	Data on this indicator can sometimes be obtained through national surveys or surveillance programmes. These will normally be targeted at high risk groups. Variations in the definition of high risk groups and in the sampling methods used may mean that data from different areas, or different surveys, are inconsistent. Comparisons should therefore be made with caution. Where data are otherwise not available, special surveys may be required.
Computation	The indicator can be computed as: $100 * (N_h / N_t)$ where N_h is the number of children surveyed with blood-lead levels > 10µg/dl, and N_t is the total number of children in the survey. In order to ensure quality assurance, and aid interpretation, of the indicator, it is important also that blood sampling techniques and analytical procedures are specified.
Units of measurement	Percentage
Scale of application	Local to international

Interpretation	The level of lead in the blood represents one of the most important markers of exposure to environmental pollution. As well as providing an information on levels of exposure in high-risk groups, this indicator also gives an indication of general environmental concentrations of lead, and possible health risks. Increases in blood lead levels can usually be taken as indicative of increased environmental concentrations and exposures and raised levels of risk. Reductions

	in blood lead levels may be anticipated where policy action or other developments (e.g. technological changes or behavioural changes) result in lower exposures. Problems with interpreting the exposure relate primarily to the potential limitations in the data - in particular, the effects of possible sampling bias and inconsistencies or ambiguities in the definition of high-risk groups. These need to be taken into account when comparing data from different areas or surveys. The effects of potential confounding (e.g. by nutritional or behavioural factors in children, or by lifestyle factors in adults) also needs to be considered when the indicator is used to infer possible health risks. In using the indicator to identify possible policy responses, it is also important to recognise the many different sources and exposure pathways which may be involved.

MORTALITY DUE TO POISONING	DPSE**E**A
INDICATOR PROFILE	
Issue	Hazardous and toxic substances
Rationale and role	The wide variety of chemicals which are now available on the market, or are used in industry or households, provides enormous opportunity for poisoning. Worldwide, pesticides, household chemicals and pharmaceutical are the most common causes of poisoning, either through deliberate ingestion or through acute accidental exposures. Health effects include death due to direct toxic effects and a large range of both acute and long-term injuries and illnesses. This indicator is designed to provide a measure of the **effect** of poisoning by hazardous and toxic substances. It can thus be used: • to monitor trends in the number of poisonings within the population - e.g. due to changing social factors and access to hazardous chemicals; • to assess the effectiveness of strategies aimed at reducing exposures to hazardous or toxic wastes (e.g. improved packaging and labelling of hazardous chemicals, hazardous chemical collection schemes, awareness raising programmes, help-lines); • to investigate geographic patterns of poisoning, in order to identify areas in need of special attention or possible causative factors; • to raise awareness about the problem of poisoning amongst policy-makers, product designers, industrialists and the public
Linkage with other indicators	This indicator is one of a group of indicators on hazardous and toxic wastes: • Exposure: *Blood-lead levels in children* • Effect: ***Mortality rate due to poisoning*** • Action: *Contaminated land management* Related indicators are also included under the themes: • Occupational health risks • Non-occupational health-risks
Alternative methods and definitions	This indicator can often most easily be defined as the mortality rate due to poisoning: i.e. the number of deaths due to poisoning per thousand head of population in a given year. For many applications, however, the indicator might usefully be further specified, according to circumstances of poisoning (e.g. deliberate, occupational or accidental), the category of chemical involved, and the age/gender of the victim. This would provide a clearer understanding both of the groups most at risk and the possible areas for policy intervention.
Related indicator sets	UN *Indicators of sustainable development* • Chemically induced poisonings
Sources of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN.
Involved agencies	National poison centres National surveillance systems WHO – IPCS
EXAMPLE INDICATOR	
Definition of indicator	Mortality rate due to poisoning
Underlying	This indicator is based on the following definitions:

definitions and concepts	• **Poisoning:** the deliberate, occupational or accidental, short- or long-term exposure to a substance of natural or anthropogenic origin at levels sufficient to cause injury or illness. • **Total population**: total resident population on a specified census date.
Specification of data needed	Total number of poisonings Total population
Data sources, availability and quality	Data on the mortality rates due to poisonings are often collected by the forensic services. Access to comprehensive data is nevertheless difficult, due to the number of agencies involved, incomplete reporting and differences in reporting methods. Data may be made available through national poison centres. Deliberate poisonings may be under-reported due to deliberate attempts to hide the cause by those concerned. Data on the total resident population can usually be obtained from national censuses and should be reliable.
Computation	The indicator can be computed as follows: N / P where N is the number of poisonings in the survey period, and P is the total population (thousands)
Units of measurement	Number per thousand head of population.
Scale of application	Local to international, though at broader scales interpretation is limited by problems of data consistency and completeness.
Interpretation	This indicator provides a general measure of the risk to health from poisoning. The varied nature of poisonings, the different health outcomes they may generate, and the many different factors which may affect the incidence of poisonings, however, all mean that the indicator needs to be interpreted with caution. In particular, it is important to remember that the mortality rate due to poisonings is influenced by: levels of chemical usage in both occupational and domestic settings; the toxicity of these pollutants; packaging and labelling practice; legal controls on access to dangerous chemicals; levels of awareness and education amongst the public; the effectiveness of reporting procedures; the efficiency and performance of the emergency and health services; cultural and social attitudes to substance abuse and suicide. Problems with access to, and the completeness of the data, are also significant, and may make comparisons between different areas or times difficult.

CONTAMINATED LAND MANAGEMENT	DPSEE**A**
INDICATOR PROFILE	
Issue	Toxic substances/hazardous waste
Rationale and role	Contaminated land represents an important, long-term environmental health risk. Exposures to contaminants may occur both directly (e.g. by contact with soil or vegetation on site), or indirectly (e.g. as a result of seepage into groundwater or surface water bodies, or by accumulation in the food chain). Use of contaminated land thus need to be carefully controlled (e.g. to ensure that housing development or food production is not permitted), and remedial action needs to be carried out where such land poses risks to human health. This indicator is an **action** indicator, designed to assess both the scope and rigour of the formal systems for identifying, managing and cleaning up contaminated land. It can be used: • to compare levels of action and commitment between countries or regions, and to identify areas with inadequate frameworks for control; • to monitor progress towards policy targets; • to investigate the effectiveness of land contamination strategies.
Linkage with other indicators	This indicator is one of a chain of indicators describing the health risks associated with exposure to toxic substances and hazardous wastes: • Exposure: *Blood lead level in children* • Effect: ***Mortality due to poisoning*** • Action: *Contaminated land management*
Alternative methods and definitions	Defining a meaningful indicator of the effectiveness of official systems for the identification, management and clean-up of contaminated land is difficult, for such systems vary greatly in terms of their character, extent, legislative authority and level of enforcement. Possibly the most effective approach is to devise a scoring system, based on these (and, if relevant, other) characteristics. Alternatively, the indicator can be based on an assessment of the area (or proportion) of contaminated land effectively remediated each year. This would require definition of 'effective remediation'. Measurement of the indicator as a proportion implies accurate knowledge of the total area of contaminated land. Another alternative would be to report the total expenditure on remediation of contaminated land each year, though reliable statistics on this might be difficult to acquire, since much expenditure is done by private companies and contractors.
Related indicator sets	UN *Indicators of sustainable development* • Area of land contaminated with hazardous wastes
Sources of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN.
Involved agencies	National contaminated land agencies Local authorities WHO
EXAMPLE INDICATOR	
Definition of indicator	Effectiveness of official systems for the identification, management and clean-up of contaminated land

Underlying definitions	The indicator is based on the following definitions:

and concepts	• **Contaminated land:** land which has been affected, either on the surface or at depth, by pollutants (e.g. organic or inorganic chemicals, radioactivity) which are likely to persist on site (i.e. for periods of several years or decades) and which might have adverse effects on the environment or human health. The effectiveness of the system for identification, management and clean-up of contaminated land is based on recognition of the following arrangements: • **Formal definitions of contaminated land:** formal, legislative standards, limit values or other descriptors for defining contaminated land. • **Register of contaminated land:** an officially designated and maintained system for the identification, monitoring, mapping and recording of contaminated land. • **Liability:** legally established and recognised liabilities on the owners of contaminated land for the safe management of the land and for any impacts on human health. • **Development controls**: legislative controls on the use and development of contaminated land. • **Contaminated land agency:** a formally established agency responsible for management and remediation of contaminated land, or the allocation of these responsibilities to an official agency or agencies (e.g. local authorities).
Specification of data needed	Existence of: • formal definitions of contaminated land • contaminated land register • legal liabilities for contaminated land • development controls for contaminated land • contaminated land agency
Data sources, availability and quality	Information on the existence and scope of these measures can be obtained either from the formal agencies concerned (where these exist) or by examination of the relevant legislation.
Computation	The indicator can be computed on a five point scale, according to the number of these measures in place.
Units of measurement	Scale (1-5)
Scale of application	National to international
Interpretation	This indicator provides a simple yet effective means of assessing the scope and rigour of policies on contaminated sites. In general, the higher the score on the indicator, the more rigorous and effective these policies will be. Care is nevertheless needed in interpreting the indicator, because of the qualitative nature of the criteria used. For example, formal definitions of contaminated land may be more or less stringent (e.g. they may be based on tight or lax reference levels). Contaminated land registers may be more or less complete. Contaminated land agencies may have strong or weak powers.

FOOD-BORNE ILLNESS	DPSE**E**A
INDICATOR PROFILE	
Issue	Food safety
Rationale and role	Poor food hygiene is a major source of infection and ill health, worldwide. Problems may occur throughout the food chain, from primary food production, through processing, manufacturing and sale, to preparation and use in the home. This indicator provides a measure of the **effect** of exposures to food-borne pathogens. It can be used: • to determine the magnitude of the public health problem posed by food-borne diseases; • to monitor trends in the incidence of food-borne diseases, as a basis for prioritising and planning action; • to help raise awareness about the issues of food hygiene amongst food producers, health officials and the public; • as part of epidemiological studies, to help investigate relationships between specific risk factors or exposures and human health; • to monitor and assess the effectiveness of programmes to improve food safety.
Linkage with other indicators	This indicator is part of a chain of indicators, collectively describing the effects of food contamination on health: Effect: ***Food-borne illness****; Incidence of diarrhoea morbidity in children; Diarrhoea mortality in children* Action: *Monitoring of chemical hazards in food*
Alternative methods and definitions	The rate of food-borne illness in the population can be determined in two main ways: in terms of the number of cases (often referred to as the incidence rate) or in terms of the number of outbreaks (the outbreak rate). For policy purposes, the latter is often most useful, since events often occur as outbreaks, associated with a common food source. Much of the policy and management effort is thus aimed at preventing or controlling outbreaks. Given this, one of the most useful ways of defining this indicator is as the number of outbreaks of food-borne illness per thousand head of population, within a given time period. A relatively small proportion of cases arise as part of detectable outbreaks, however, so the indicator tends to under-estimate the magnitude of total public health problem. Where data permit, this indicator can usefully be disaggregated to provide information on the outbreak rates for different categories of food-borne illness. Disaggregation by age, gender, socio-economic character and geographic area is also likely to be informative in many cases. As an alternative, an indicator might also be devised to provide information on the incidence rate of food-borne illness – i.e. the number of individual cases per thousand heads of population. This provides a better measure of the overall public health problem, but is less useful as a guide to intervention.
Related indicator sets	WHO *Catalogue of health indicators* • Annual incidence of diarrhoea in children under 5 years of age • Deaths due to diarrhoea among infants and children under 5 years of age
Sources of further information	WHO 1989 *Evaluation of Programmes to ensure food safety*. Geneva: WHO. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO Programmes.* Geneva: WHO. WHO 1997 *Health and environment in sustainable development. Five years after the Earth Summit.* Geneva: WHO.
Sources of further	WHO 1997 *Surveillance of food-borne diseases: what are the options?* WHO/FSF/FOS/97.3. Geneva: WHO Food Safety Unit.

information	WHO 1997 *Prevention and control of Enterohaemorrhagic Escherichia coli (EHIC) infections.* Report of a WHO Consultation, Geneva, Switzerland, 28 April-1 May 1997. WHO/FSF/FOS/97.6. Geneva: WHO Food Safety Unit. WHO *Guidelines for investigation and control of food-borne disease outbreaks.* Geneva: WHO. In preparation.
Involved agencies	WHO - Food Safety Unit FAO National food protection agencies. National ministries of agriculture.
EXAMPLE INDICATOR	
Definition of indicator	Outbreak rate of food-borne illness
Underlying definitions and concepts	The indicator is based on the following definitions: • **Food:** any substance, whether processed, semi-processed or raw which is intended for human consumption, including drinks, chewing gum and any substance which has been used in the manufacture, preparation or treatment of 'food' but excluding cosmetics, tobacco and substances used only as drugs. • **Food-borne illness:** medically certified condition(s) (i.e. presence of pathogen/toxin and adequate clinical symptoms) arising from the ingestion of food or water. • **Outbreak**: two or more linked cases of the same illness. • **Total population**: total resident population.
Specification of data needed	Number of outbreaks or number of cases, per year (or other specified survey period). Total population.
Data sources, availability and quality	Outbreaks of food-borne diseases may be reported by a wide range of individuals and agencies, including the public, the media, health care providers and practitioners, and laboratories dealing with samples referred for analysis. In many countries, statutory notification systems also exist for some types of food-borne disease. Data on outbreaks are often collated by public health authorities. In all cases, however, the quality and the completeness of the data may be variable, because of incomplete reporting (many cases may not be referred to health services) and inconsistencies in diagnosis. Post hoc investigations of outbreaks may also be undertaken, though these are likely to cover only more severe or unusual outbreaks. Data on total population are available from national censuses and should be reliable.
Computation	The indicator can be computed as: $1000 * (O_f / P_t)$ where O_f is the number of outbreaks of food-borne illness f in the survey period, and P_t is the total population.
Units of measurement	Number of outbreaks per thousand head of population.
Scale of application	Local to international, though problems of data consistency and completeness may limit applications at broader scales.

Interpretation	This indicator provides a measure of the health burden associated with exposure to food-borne pathogens. In general terms, therefore, an increase in the rate of outbreaks may be interpreted as evidence of a deterioration in health conditions and an indication of increased problems of food hygiene; a reduction in the rate of outbreaks of illness may be taken as an implication of an improvement in health conditions and in food hygiene.

	Problems of data quality and availability, however, need to be taken into account. Different methods of monitoring and reporting are liable to give very different results, and care is needed in comparing or pooling data from different sources. Substantial uncertainties in the data also arise due to variations in diagnosis, reporting methods, health system infrastructure and the perceptions of the public. The episodic nature of food-borne disease outbreaks also means that long-term trends should not be inferred from short runs of data; the clustered nature of outbreaks similarly means that national patterns should not be deduced from local surveys. It also needs to be borne in mind that only a small proportion of the total number of cases of food-borne illness occur in the form of outbreaks. As specified here, therefore, this indicator cannot be used directly to infer the incidence rate (or the magnitude of the total public health problem) of food-borne illness.

MONITORING OF CHEMICAL HAZARDS IN FOOD	DPSEE**A**
INDICATOR PROFILE	
Issue	Food safety
Rationale and role	Foodstuffs are an important source of exposure to a wide range of chemical hazards, which occur either as a natural constituent of the food or are introduced during production, storage, processing or distribution. Routine monitoring and analysis of foodstuffs provides one way of detecting these hazards, and of directing action to reduce health risks. This indicator is thus designed as an **action** indicator, which assesses the scope and effectiveness of monitoring programmes. It can be used: • to compare areas or countries in terms of their monitoring strategies (e.g. to identify good practice or to detect areas with inadequate food monitoring systems); • to monitor the dissemination of good practice and progress towards agreed targets for food surveillance; • to provide contextual information to help interpret trends or patterns in the reported incidence or prevalence of food-borne illness.
Linkage with other indicators	This indicator is part of a chain of indicators, collectively describing the effects of food contamination on health: • Effect: *Food-borne illness; Incidence of diarrhoea morbidity in children; Diarrhoea mortality in children* • Action*: Monitoring of biological hazards in food****; Monitoring of chemical hazards in food***
Alternative methods and definitions	Where suitable data are available, a useful indicator on monitoring of chemical hazards is given by the proportion of chemical hazards monitored in food. This is best done by defining contaminant/food combinations considered of posing hazards to health, and assessing the proportion of these subject to routine and effective monitoring. Lists of relevant contaminant/food combinations, for developed and developing countries, have been developed for this purpose by the WHO Food Safety Unit (UN 1996). Where suitable data exist, this indicator could be further refined to measure the number of analyses carried out on the listed contaminant/food combinations, per thousand head of population per year. This would provide a more effective measure of the intensity of monitoring. It would, however, fail to distinguish between frequent monitoring of more common (and perhaps less hazardous) combinations, and the less frequent monitoring of rarer, but potentially more hazardous combinations. The indicator could also be defined as the proportion of analyses failing food standards. This, however, would not take account of either the range of contaminant/food combinations monitored, or the frequency of monitoring.
Related indicator sets	UN *Indicators of sustainable development* • Proportion of potentially hazardous chemicals monitored in food
Sources of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN.
Involved agencies	FAO Local authority environmental health officers National food agencies National ministries of health, environment, agriculture UNEP WHO - Food Safety Unit

EXAMPLE INDICATOR	
Definition of indicator	Proportion of chemical hazards monitored in food
Underlying definitions and concepts	• **Chemical monitoring of food:** the routine sampling and analysis of food commodities, including drinking water, with the aim of assessing dietary exposure of the population to hazardous chemical contaminants or constituents. Hazardous concentrations are usually defined in relation to nationally or internationally agreed standards or tolerable/acceptable levels. • **Contaminant/food combination:** a specific combination of a chemical constituent or contaminant and food, considered to pose potential threats to human health. Three standard lists of contaminant/food combinations have been developed by GEMS/Food based on knowledge of potentially hazardous chemicals and the foods in which they are known to occur. These lists reflect the different priorities which may be expected for countries at different stages of development. The core list for lesser developed countries contains 153 combinations of contaminants and foods which offer basic protection of the consumer from known chemical hazards. The intermediate list for developing countries contains 358 combinations of contaminants and foods which offer improved protection of the consumer, especially as development increases the number and amount of potentially hazardous chemicals used in the country. The comprehensive list for industrialised countries includes 394 combinations which provide assurance that the full range of potentially toxic chemicals are being monitored in the food supply.
Specification of data needed	Number of contaminant/food combinations monitored (as specified by the GEMS/Food lists) Total number of potential contaminant/food combinations of concern
Data sources, availability and quality	Information on the contaminant/food combinations which are monitored can be obtained from the relevant agencies (e.g. ministries of health, environment or agriculture). Careful scrutiny of this information is advised to ensure that only those combinations monitored on a routine and reasonably intensive basis, across the whole area of concern, are counted. Information on the total number of potential contaminant/food combinations of concern can be obtained from the GEMS/Food lists.
Computation	The indicator can be computed as: $100 * (F_m / F_p)$ where Fm is the number of listed contaminant/food combinations subject to routine and intensive monitoring, and F_p is the total number of listed contaminant/food combinations.
Units of measurement	Percentage
Scale of application	Regional to international
Interpretation	In general terms, this indicator provides a measure of the commitment to food monitoring for public health purposes: the greater the percentage of contaminant/food combinations monitored, the more stringent is the policy. Nevertheless, like most action indicators, this one needs to be interpreted with care. In particular, the GEMS/Food lists are generalised categories, which may not suit all circumstances (especially where the indicator is applied at the sub-national level). The indicator also fails to take account of either the frequency or geographic extent of monitoring. Without high-frequency monitoring, short-term contamination episodes may go undetected; without effective sampling across the entire population and food supply system, local events may similarly be missed. Monitoring, also, does not necessarily lead to effective action either to remove foods from the supply chain, or to tackle the problem at source, when contamination is detected. Ideally, therefore, this indicator should be interpreted in association with information on the frequency of monitoring, and the proportion of failed analyses.

CUMULATIVE RADIATION DOSE	DPS**E**EA
INDICATOR PROFILE	
Issue	Radiation
Rationale and role	Environmental exposures to radiation represent an important health risk. Major sources of exposure include radon in indoor air, emissions from the nuclear energy sector, and the presence of radioactive substances in household materials and food. Health risks include leukaemia and other cancers (e.g. of the lung, breast). This indicator is designed to provide a general measure of **exposure** to environmental radiation from many of these natural and anthropogenic sources. It can be used to: • assess the general radiation dose across the population; • monitor levels of exposure in the general population, as a basis for assessing potential health risk; • mapping the distribution of exposure to identify at-risk groups or areas where special actions may be needed to reduce risk; • identify environmental media with particularly high levels of radiation, in order to target control measures; • assess the effectiveness of policy or other measures (e.g. improvements in housing standards, emission controls from the nuclear industry, improved food standards) in reducing exposures; • analysing relationships between exposure and health effects.
Linkage with other indicators	This is one of a group of indicators describing exposures to environmental radiation: • ***Cumulative radiation dose****; UV light index*
Alternative methods and definitions	This indicator can be defined either as the average radiation dose of the population of interest, or as the percentage (or number) of the population receiving a cumulative radiation dose in excess of a defined threshold. In the latter case, the threshold might be set at 1, 5 or 10 mS/yr depending upon the local circumstances (i.e. levels of background, natural radiation). The indicator might also be constructed to provide a measure of the effective dose by source (e.g. from medical, cosmic, indoor, internal and other sources). This would require the capability to estimate exposures via different pathways. Where data on effective dose are not available, a weaker indicator can be developed, using monitored data on radiation levels in environmental media. For most purposes, this should include two main media: indoor air and foodstuffs. Monitoring for these environmental levels are widely undertaken, both as part of national programmes and as part of international initiatives (e.g. GERMON).
Related indicator sets	UN *Indicators of sustainable development* • Generation of radioactive waste
Sources of further information	IAEA 1994 *International basic safety standards for protection against ionizing radiation and for the safety of radiation sources.* Safety Series No. 115-I. Vienna: IAEA. UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN.
Involved agencies *Involved agencies*	IAEA ICRP FAO WHO UNEP

- *continued*	National radiation protection authorities
EXAMPLE INDICATOR	
Definition of indicator	Percentage of the population receiving a cumulative radiation dose in excess of 5 mS/yr.
Underlying definitions and concepts	• **Environmental radiation:** ionising radiation in environmental media - i.e. in the air, soil, water and foodstuffs. This thus includes radiation from cosmic, geological and many anthropogenic sources but excludes radiation from medical treatment (e.g. X-rays) and non-ionising radiation (e.g. from the sun or from electromagnetic fields). • **Cumulative dose:** the total body dose of radiation, from all sources, calculated to reflect overall impact on health. • **Total population:** total resident population.
Specification of data needed	Number of people receiving a cumulative radiation dose in excess of 5 mS/year. Total population
Data sources, availability and quality	Data on the cumulative radiation dose of the population may be obtained either dosimetry studies or from modelling based on measured activity levels in environmental media (e.g. as part of the GERMON programme). Sampling for environmental monitoring is conducted according to a consistent protocol and results are therefore likely to be broadly comparable. Nevertheless, marked local variations in levels of radioactivity may occur (especially in relation to radon and around local emission sources), and the quantity of monitoring is limited. Estimates can thus be interpreted only as general indications of levels of exposure to radiation across the population. Data on total population are usually available from national censuses and should be reliable.
Computation	The indicator can be computed as: $100 * (N_{>5} / N_s)$ where $N_{>5}$ is the number of people in the survey with an cumulative dose of greater than 5 mS/yr and N_s is the total number of people in the survey.
Units of measurement	Percentage
Scale of application	Regional to international
Interpretation	This indicator poses considerable problems of interpretation, primarily because of the varied nature and multiple sources of radiation, the many different pathways of exposure, and the limited available data. Broad trends can be detected, where monitoring is carried out consistently over several years; broad geographic patterns in radiation levels can also be identified for some forms of radiation (e.g. radon or radiation in drinking water and the ambient air). Estimates are, however, highly dependent on the coefficients used to integrate exposures to different types of radiation, from different sources.

UV LIGHT INDEX	DPS**E**EA
INDICATOR PROFILE	
Issue	Radiation
Rationale and role	Exposures to excessive levels of solar radiation can pose serious risks to health. Adverse health effects include non-melanoma skin cancer, eye damage (including cataracts) and possible deleterious effects on the immune system. In the context of ozone depletion, global climate change and more extensive holiday travel, solar radiation thus represents an increasingly important source of health risk. This indicator is intended to provide a measure of potentially adverse **exposures** to ultra-violet radiation. It may be used to: • assess levels of exposure across the population - e.g. to help identify those most at risk of deleterious health effects; • raise public awareness about the potential risks of exposures to solar radiation; • monitor the effectiveness of public information and other campaigns, aimed at reducing exposures; • provide an early warning of excess exposures to those most at risk; • help develop and promote standards for protection against UV radiation; • help analyse relationships between exposure to solar radiation and health outcome.
Linkage with other indicators	This is one of a group of indicators describing exposures to environmental radiation: • *Cumulative radiation dose;* ***UV light index***
Alternative methods and definitions	This indicator needs to define the amount of short-wave, ultra-violet radiation from the sun which reaches the ground surface. One useful approach to this is provided by the UV light index (ICNIRP 1995), which is a time-integrated measure of UV radiation. Several variations on this index are available, for example using different action spectra or different methods for integrating measured irradiation over time. Several different scaling systems have also been devised, to convert the resultant values into a simple measure of health risk (e.g. the minimum erythema dose, MED).
Related indicator sets	None
Sources of further information	ICNIRP 1995 *Global solar UV index.* Oberschleissheim: ICNIRP.
Involved agencies	WHO WMO International Commission on Non-Ionizing Radiation Protection (ICNIRP)
EXAMPLE INDICATOR	
Definition of indicator	UV light index
Underlying definitions and concepts	**UV light index:** a time-integrated measure of the amount of short-wave, ultra-violet radiation from the sun which reaches the ground. **Weighted irradiance:** a measure of the solar radiation, defined as the weighed integral of the spectral radiance over direction and wavelength at ground level. This is based on the CIE erythemal action spectrum.

Specification of data	Weighted irradiance

needed	
Data sources, availability and quality	Data on levels of UV radiation are generally available from national meteorological services, and may be considered reliable. Monitoring networks are, however, often sparse, so they may be unable to detect local variations in UV levels.
Computation	The indicator is based on the Global solar UV index (ICNIRP 1995). It is computed as: $I_t * 40$ where I_t is the time-weighted average effective irradiance (W/m^2).
Units of measurement	W/m^2
Scale of application	Regional to international
Interpretation	This indicator provides a direct measure of the levels of exposure to UV radiation: the higher the index, the greater the level of exposure and the greater the potential risk of adverse health effects. The relationship between levels of UV radiation and health outcome are, however, complex: they are fundamentally affected by lifestyle and behavioural factors, such as time spent outdoors, choice of clothing and use of UV protection. Skin colour is also important.

MORTALITY FROM MOTOR VEHICLE ACCIDENTS	DPSEEA
INDICATOR PROFILE	
Issue	Non-occupational health risks
Rationale and role	Motor vehicle accidents continue to be a major cause of death and injury throughout the developed world, and are increasing in many developing countries. Marked differences in rates of mortality due to road traffic accidents are also seen between countries, apparently reflecting variations in road and vehicle safety, driving behaviour, environmental conditions and performance of the emergency and health services. This indicator provides a measure of the **effect** of road traffic on health through non-occupational injury. Potential applications include: • Monitoring trends in traffic accident deaths, in order to help prioritise policy and management needs. • Mapping the distribution of road traffic deaths, in order to identify local or regional hotspots, and to identify areas in need of special action. • Comparing the effectiveness of emergency services and hospital treatment of road traffic victims. • Assessing the effectiveness of interventions - e.g. traffic management, public transport schemes, road improvements, vehicle safety measures or educational initiatives - on road traffic deaths. • Assessing the effects of changes in travel behaviour (e.g. a modal shift from car to public transport, or changes in attitudes and behaviour regarding drinking and driving) on road traffic deaths. • Analysing relationships between road traffic volumes and traffic accident mortality.
Linkage with other indicators	This indicator represents one of a group of indicators recording different effects of non-occupational health risk: • Effect*: **Mortality from motor-vehicle accidents**; Injuries to children; Poisonings of young children*
Alternative methods and definitions	This indicacor can be defined as the death rate due to road traffic accidents. Where appropriate, the indicator might be usefully standardised both by age- and gender and subdivided according to travel mode - e.g. motor vehicle (car, truck, bus, rail, air), bicycle and pedestrian. In many cases, children and young adult men are the most common victims of road traffic accidents; deaths amongst pedestrians also tend to outnumber those of car drivers or passengers. The indicator can be presented either in absolute terms (e.g. total number of deaths), as a population rate (e.g. number of deaths per thousand people), in terms of the total traffic volume (e.g. vehicle kilometres travelled) or in terms of the number of trips. Each will convey a somewhat different meaning and suffers from different problems of interpretation. Data on the absolute numbers of deaths, for example, make no allowance for differences in population, and thus should not be used for comparisons between different areas or countries. Rates based on the population number take account of changes or differences in population size, but do not reflect differences in traffic conditions (e.g. traffic volumes or speed). Indicators based on traffic volume or number of trips provide a means of assessing driver/traffic safety, but do not indicate the size of the public health problem. The indicator thus needs to be constructed differently, according to its intended purpose.
Related indicator sets	None
Sources of further information	WHO European Centre for Environment and Health 1997 *Atlas of mortality in Europe*. Subnational patterns 1980/1981 and 1990/1991. Bilthoven: WHO Regional Publications, European Series. No. 75.

Involved agencies	National transport ministries Local/regional highways authorities WHO
EXAMPLE INDICATOR	
Definition of indicator	Death rate due to road traffic accidents
Underlying definitions and concepts	The indicator is based on the following definitions: • **Deaths due to road traffic accidents:** all deaths directly or indirectly attributable to involvement in a motor vehicle traffic accident, however caused. This includes deaths of vehicle drivers, passengers and pedestrians/cyclists. It also includes both immediate and delayed deaths (though the latency period is rarely clearly defined). This definition is based on the assumption that data on cause of death defines the source of the injury. • **Total population:** total resident and visiting population. (Note: for this indicator the total resident and visiting population is more appropriate as the denominator, since many deaths in road accidents occur to tourists or other visitors.)
Specification of data needed	Total number of deaths due to road traffic accidents (ICD E810-E819) Total resident and visiting population
Data sources, availability and quality	Data on deaths due to road traffic accidents should be available at the national level from official statistics, and at the regional/local level from either registrations of cause of death or from police statistics. These statistics have a number of weaknesses, including the way in which cause of death is defined (reference may be made only to the nature of the injury causing death, not its source), the method of geocoding (individuals will usually be defined by place of residence, not the location of the accident), and lack of distinction between deaths of pedestrians and vehicle users. Data on total resident population should be available from national censuses and should be reliable. Some census statistics also provide a measure of the number of temporary residents (i.e. visitors) at the time of survey, though definitions tend to vary between countries, and the data may not be representative of the number of visitors at other times in the year. Where appropriate, separate estimates of the number of visitors may be obtained from tourist statistics.
Computation	The indicator can be computed as: $1000 * (M_t / P)$ where M_t is the total number of deaths due to traffic accidents and P is the total population.
Units of measurement	Number per thousand head of population.
Scale of application	Local to international, though problems of data consistency and availability may limit interpretations at broader scales.
Interpretation	This indicator is in general relatively easy to interpret, in that the link between cause and health effect is explicit. Changes in the indicator may nevertheless imply different processes. For example, a reduction in the mortality rate may be due, inter alia, to: a reduction in total traffic volume, reduced traffic speeds (e.g. due to increased congestion), an improvement in road design, improved traffic management, improvements in vehicle safety, improvements in driver behaviour, improved environmental conditions (e.g. weather), fewer pedestrians or cyclists, greater segregation of pedestrians from road traffic, improved emergency services, or improved health services. Problems inherent in the data also need to be considered, especially where different countries or regions, with different reporting systems, are being compared. Difficulty also exists in allowing for the number of visitors (especially in transit), which may be significant in some areas.

INJURIES TO CHILDREN	DPSEEA
INDICATOR PROFILE	
Issue	Non-occupational health risks
Rationale and role	Children are amongst the most vulnerable groups to injury, both in the home and on the street for a range of reasons: because of the tendency for the world around them to be designed and structured with little regard for children's safety; because of the limited development of their own risk perceptions and behaviours; and because of their inherent physical vulnerability. This indicator is intended to provide a measure of the health effects on children of exposure to physical risks. It can be used: • to compare areas or countries in terms of their level of injuries to children; • to monitor the effects of campaigns or strategies aimed at reducing the incidence of childhood injuries; • to raise awareness about the risks to children in specific environments.
Linkage with other indicators	This indicator represents one of a group of indicators recording different effects of non-occupational health risk: • Effect*: Mortality from motor-vehicle accidents;* ***Injuries to children****; Poisonings of young children*
Alternative methods and definitions	This indicator can be defined as the incidence rate of physical injuries to children below the age of five within a specified period (e.g. a year). Since boys tend to be more prone to accidents than girls, the indicator might usefully be stratified by gender. Where suitable data are available, it could also be separately assessed for major types/causes of injury (e.g. burns and scalds, falls, road accidents, violence).
Related indicator sets	None
Sources of further information	Manciaux, M. and Romer, C.J. 1991 *Accidents in childhood and adolescence*. The role of research. Geneva: WHO.
Involved agencies	WHO UNICEF
EXAMPLE INDICATOR	
Definition of indicator	Incidence of physical injury to children less than 5 years of age
Underlying definitions and concepts	• **Physical injury**: accidental or deliberate injury of sufficient severity to require medical attention. • **Total number of children aged less than 5 years**: total resident population of children aged less than 5 years, at the time of survey.
Specification of data needed	Incidence of physical injuries to children aged less than 5 years Total number of children aged less than 5 years
Data sources, availability and quality	Data on the number of childhood injuries should usually be available from routine medical statistics (e.g. hospital admissions/discharges). Though these data should be broadly reliable, discrepancies may occur because of differences in referral rates, diagnosis and reporting methods. Where these data are not available, special surveys may be needed. Data on the total number of children less than 5 years of age should be available from national censuses and should be reliable.

Computatio	The indicator can be computed as:

n	$1000 * (I_c / P_c)$ where I_c is the number of reported cases of injury to children under the age of 5 years, and P_c is the total population of children aged less than 5 years.
Units of measurement	Number per thousand head of children aged less than 5 years per year
Scale of application	Local to international, though problems of data consistency and availability may limit interpretations at broader scales.
Interpretation	This indicator provides a simple and direct measure of the incidence of physical injuries to children; as such, it gives an indication both of risks to children specifically, and of the more general hazardousness of the non-occupational environment. An increase in the incidence of childhood injuries may be interpreted as evidence of increased levels of risk; a reduction implies the reverse. Care is, however, needed in making interpretations because of likely inadequacies in the available data and the range of other factors which may affect injury rates. Significant differences in reported rates may occur either geographically or over time, for example, because of differences in reporting methods and referral rates - e.g. due to differences in accessibility of the health care services. Rates of injury are also affected by often subtle variations in cultural, lifestyle and behavioural factors (e.g. in play behaviour of children, in the design and layout of homes and play areas, in parental attitudes to supervision). Where possible, the indicator should therefore be interpreted in the context of other cultural information.

POISONINGS OF YOUNG CHILDREN	DPSEEA
INDICATOR PROFILE	
Issue	Non-occupational health risks
Rationale and role	Because of their natural curiosity – and often because of poor safety precautions in the home - young children are especially vulnerable to accidental poisonings. The incidence of reported poisonings of young children thus provides a sensitive measure of the health risks from poisoning in non-occupational environments. This indicator can be used: • to provide an overall assessment of risks of accidental poisoning in non-occupational settings; • to compare rates of poisoning in different areas or countries - e.g. as a basis for identifying factors which affect poisoning rates and to develop good practice at poisoning avoidance; • to monitor trends over time - e.g. in order to assess whether the non-occupational environment is becoming more or less hazardous; • to help raise awareness about the risks of childhood poisonings; • to assess the effectiveness of specific educational, awareness raising or risk reduction programmes.
Linkage with other indicators	This indicator represents one of a group of indicators recording different effects of non-occupational health risk: • Effect: *Mortality from motor-vehicle accidents; Injuries to children;* ***Poisonings of young children***
Alternative methods and definitions	This indicator can be expressed as the number of reported poisonings per year (or other survey period) in children under 5 years of age. Where appropriate, different age groups might also be defined. Since the rate of poisoning in children tends to be higher amongst boys than girls, it would often be useful to stratify the indicator by gender. Where suitable data on poisoning incidents are not available, an alternative would be to base the indicator on mortality due to poisoning. Mortality rates, however, are likely to be severely affected by the effectiveness of, and access to, the health care service.
Related indicator sets	UN *Indicators of sustainable development* • Chemically induced poisonings
Sources of further information	UN 1996 *Indicators of sustainable development. Framework and methodologies.* New York: UN.
Involved agencies	National poisons centres National surveillance systems WHO – IPCS
EXAMPLE INDICATOR	
Definition of indicator	Number of reported poisonings per year in children under 5 years of age
Underlying definitions and concepts	Poisoning: the deliberate, occupational or accidental, short- or long-term exposure to a substance of natural or anthropogenic origin at levels sufficient to cause injury or illness. Total number of children less than 5 years of age: total resident population of children aged less than 5 years at the time of survey
Specification of data	Number of cases of poisoning of children aged less than 5 years

needed	Total number of children less than 5 years of age
Data sources, availability and quality	In many countries, data on the number of cases of poisoning of children aged less than 5 years can be obtained from national poison centres. Quality assurance of these data is generally good, and the data may thus be considered reliable. Where poison centres are not operative, alternative sources include data from hospital admissions/discharge records or special surveys. Data on the total number of children under 5 years of age should usually be available from national censuses and should be reliable.
Computation	The indicator may be computed as: $1000 * (P_c / N_c)$ where P_c is the total number of poisonings reported in children under 5 years of age, and N_c is the total number of children aged less than 5 years at the time of survey.
Units of measurement	Number per thousand children under 5 years of age
Scale of application	Local to international, though problems of data consistency and availability may limit interpretations at broader scales.
Interpretation	Where reliable data exist, this indicator can be interpreted as a direct measure of the health risks of poisonings in the home and thus of the hazardousness of the home environment. Nevertheless, care is needed because not all poisonings are accidental, and inaccuracies and inconsistencies in the available data may occur due to differences in rates of referral and reporting.

EXPOSURE TO UNSAFE WORKPLACES	DPS**E**EA
INDICATOR PROFILE	
Issue	Occupational environment
Rationale and role	Hazards in the occupational environment are a major cause of injury, ill health and death. These hazards arise from a number of sources: from poorly guarded or designed machinery, from unsafe working practices, from the use of hazardous substances or materials, from poor ventilation and environmental control in the workplace, and from a wide array of everyday accidents. These types of working environment tend to be most common in small, informal workshops and domestic workplaces, but may also occur in many larger premises in some sectors. This indicator provides a measure of the levels of potential exposure to such hazards in the workplace. Because of limitations of data it is mainly applicable at a local scale, where it might be used: • to monitor levels of occupational exposure in the workplace; • to monitor the effects of technological or other changes on workplace exposures and their potential health risks; • to identify specific occupations and workplace settings which pose hazards for workers, as a basis for targeting action; • to assess levels of compliance with health and safety or other legislation aimed at improving working practices and protecting workers; • as part of epidemiological studies to investigate relationships between occupational hazards and health effects.
Linkage with other indicators	This indicator is part of a chain of indicators which collectively describe the risks associated with the occupational environment. Other indicators are: • Exposure: ***Exposure to unsafe work places*** • Effect: *Incidence of occupational injury; Mortality from occupational health hazards*
Alternative methods and definitions	Assessment of exposures to unsafe working environments poses enormous problems, both because of the difficulties of defining what is 'safe' and 'unsafe' and in obtaining the relevant data. For this reason, this indicator can realistically be applied mainly at the local level; at broader scales, it can be used only in a general and qualitative manner. Where suitable data are available the indicator might be expressed either as the number of workers exposed or as the percentage of workers exposed. Each conveys a somewhat different message and might be used to address different questions. The total number of workers helps to identify those work places or practices which pose the greatest threat to health and gives a measure of the overall occupational health risk. For long term monitoring, however, it is susceptible simply to changes in the number of people employed, and as such may vary more due to economic factors than positive intervention. The percentage of the work force exposed may therefore be more useful when examining long-term effects of health and safety measures. Where possible, the indicator should be compiled and presented separately for different employment sectors, for different sizes of workplace, and for different types of hazard. This would help to identify more clearly the sources of exposure and those most at risk. In some cases, a more rigorous alternative to this indicator may be possible: the actual levels of exposure to specific workplace pollutants. This might be assessed by micro-environmental monitoring in the workplace, by personal monitoring (as occurs for radioactivity) or by use of biomarkers (e.g. analysis of hair, urine or blood samples).
Related indicator sets	None

Sources of further information	
Involved agencies	WHO National health and safety executives
EXAMPLE INDICATOR	
Definition of indicator	Percentage of workers exposed to unsafe, unhealthy or hazardous working conditions
Underlying definitions and concepts	This indicator requires the ability to identify, and measure the extent of, unsafe, unhealthy or hazardous workplaces, and the number of people employed therein. Definitions of such workplaces are likely to vary substantially, both between different countries and between different industries. Characteristics of unsafe, unhealthy or hazardous working conditions might include: • work which involves open exposure to hazardous substances or materials (e.g. chemicals); • work involving the unprotected use of dangerous machinery or equipment (e.g. saws, lathes, crushing equipment, motor vehicles); • work which involves operation in dangerous places (e.g. at height or below water) without adequate safety equipment; • workplaces which have poor environmental control (e.g. for air pollution, heat, light, noise); • workplaces which are over-crowded or physically badly laid out; • workplaces which lack adequate facilities for fire prevention or control; • workplaces in which unsafe or unhealthy working practices are carried out (e.g. highly repetitive physical work, stressful working environments). In addition, a definition is required of the total number of workers: i.e. people carrying out, or employed in, a trade or business.
Specification of data needed	Number of people working in unsafe, unhealthy or hazardous workplaces. Total number of workers.
Data sources, availability and quality	Data on the number of people working in unsafe, unhealthy or hazardous workplaces are not usually collected in any routine way. Estimates thus have to be made either from specially designed surveys, or by extrapolation from previous studies. In both cases, care is needed because studies and surveys tend to be targeted at workplaces which are known or suspected to be unhealthy or unsafe; available data may thus contain considerable bias. Data on the total number of workers are usually available from national employment statistics or from company records. Such statistics, however, tend to omit those employed in informal or casual work or who have multiple (and often unregistered) jobs.
Computation	The indicator can be computed as: 100 * (H / W) where H is the number of people working in unsafe, unhealthy or hazardous housing and W is the total number of workers.
Units of measurement	Percentage
Scale of application	Mainly local
Interpretation	Interpretation of the indicator must be undertaken with utmost care. The varied nature of occupational hazards, and the lack of any formal classification of hazards in the workplace, mean that definitions of what constitutes an unsafe, unhealthy or hazardous workplace are likely to vary greatly from country to country (and probably from one industrial sector to

	another). Estimates of the number of people working in these environments are also prone to considerable uncertainty due to the informal nature of much employment, and the lack of routine monitoring. Levels of exposure are also likely to vary greatly over time, due to changes in work activity, and between individuals (due to differences in work behaviour and practice). Even the total number of workers may be subject to significant error in some cases. In addition, it is important to recognise the implications for such interpretations of expressing the indicator in a percentage form; this may mask large industries or workplaces with small proportions, but large numbers, of exposed workers.

INCIDENCE OF OCCUPATIONAL INJURY	DPSE**E**A
INDICATOR PROFILE	
Issue	Occupational environment
Rationale and role	Occupational hazards are a major cause of ill health throughout the world. Major sources of health risk are exposures to physical dangers (e.g. accidents at work), and the effects of physically stressful working conditions. These may result in either acute or chronic occupational injuries. This indicator is intended to provide a general measure of the **effects** of occupational injuries. As such, it can be used: • to monitor trends in occupational injury rates; • to make inferences about changes in the extent of physically hazardous working environments (e.g. as a basis for policy development); • to identify physically hazardous occupations or working environments, where specific action may be needed; • to assess the effectiveness of occupational health and safety legislation or other interventions (e.g. awareness raising campaigns); • to help raise awareness about the need for safe working practices and a healthy workplace; • to analyse associations between occupational working conditions and ill health.
Linkage with other indicators	This indicator is part of a chain of indicators which collectively describe the risks associated with the occupational environment. Other indicators are: • Exposure: *Exposure to unsafe work places* • Effect: ***Incidence of occupational injury****; Mortality from occupational health hazards*
Alternative methods and definitions	This indicator can simply be defined as the incidence rate of occupational injuries within the total workforce. As such, it includes all reported physical injuries which require medical attention. The indicator can also usefully be measured and presented separately for different occupations (e.g. based on standard employment sector classifications), different classes of illness and by gender. Where there are a large number of part-time workers, use of 'total number of workers' may be inappropriate; instead, it may be more meaningful to base the indicator on the 'total number of worker years'. Problems with data availability mean that many variations on the indicator are possible, and may be necessary (e.g. by basing the indicator on different categories of illness). The definitions used need to be clearly stated in every case. Where other data are not available, a proxy can be used based on 'number of days off work'. This, however, is likely to include causes of illness other than occupational morbidity.
Related indicator sets	None
Sources of further information	WHO 1995 *Global strategy on occupational health for all*. Geneva: WHO.
Involved agencies	WHO ILO National health and safety agencies
EXAMPLE INDICATOR	
Definition of	Incidence of occupational injury

indicator	
Underlying definitions and concepts	This indicator requires the ability to identify cases of occupational injury due to accidents or inappropriate working conditions and practices. Underlying definitions are: • **Occupational injury**: a physical injury, requiring medical treatment, occurring at, or as a direct result of, work. • **Total number of workers**: the number of people carrying out, or involved in, a trade or business.
Specification of data needed	Number of cases of occupational injury Total number of workers
Data sources, availability and quality	Data on occupational injuries are available in many countries through routine reporting in accordance with employment or health-and-safety legislation (though considerable under-reporting tends to occur). Where these data are not available, they may need to be obtained from special surveys (e.g. using questionnaire techniques or by analysing company records). Such surveys may be subject to considerable inaccuracy, due to poor recording of worker injuries by the companies, and biased or incomplete recall and attribution of injuries by workers. Data on the total number of workers are usually available from national employment statistics or company records. Such statistics, however, tend to omit those employed in informal or casual work or who have multiple (and often unregistered) jobs.
Computation	The indicator can be computed as: $1000 * (M_o / W)$ where M_o is the total number of reported cases of occupational injury reported in the target workforce, and W is the total number of workers.
Units of measurement	Number per thousand workers.
Scale of application	Local to international, though problems of data consistency and availability may limit interpretations at broader scales.
Interpretation	Where reliable and consistent data are available, this indicator provides a potentially useful measure of the health risks associated with the occupational environment. In these situations, an increase in the level of work-associated morbidity may be used to infer a deterioration in the quality of the working environment; a reduction in the number of deaths may imply an improvement. For various reasons, however, this simple association will rarely apply. Problems of attributing illnesses to workplace exposures or injury, for example, mean that most estimates will be subject to considerable margins of error, especially in the case of effects with long latency times or non-specific causes. Problems in accurately quantifying the number of workers (or total number of worker years) may add to this uncertainty. Changes in the total number of people employed may also affect the rate, even though the total number of people subject to work-related illness or injury may not change.

MORTALITY FROM OCCUPATIONAL HEALTH HAZARDS	DPSE**E**A
INDICATOR PROFILE	
Issue	Occupational environment
Rationale and role	Occupational hazards are a major cause of death throughout the world. Hazards include physical dangers (e.g. accidents at work), exposures to dangerous substances (e.g. chemicals, organic pathogens), and the effects of stressful working conditions. Exposures to these hazards may be either acute or chronic exposures, and death may occur either swiftly or after a considerable latency period. This indicator is intended to provide a general measure of this **effect** of occupational exposures. As such, it can be used: • to monitor trends in occupational mortality rates; • to make inferences about changes in the level of safety of working environments (e.g. as a basis for policy development); • to identify high-risk occupations or working environments, where specific action may be needed; • to assess the effectiveness of occupational health and safety legislation or other interventions (e.g. awareness raising campaigns); • to help raise awareness about the need for safety in the workplace; • to analyse associations between occupational working conditions and mortality.
Linkage with other indicators	This indicator is part of a chain of indicators which collectively describe the risks associated with the occupational environment. Other indicators are: • Exposure: *Exposure to unsafe work places* • Effect: *Incidence of occupational injury;* ***Mortality from occupational health hazards***
Alternative methods and definitions	This indicator can be defined as the death rate across the workforce due to occupational health hazards. As such, it comprises deaths due to both acute and chronic exposures. Where data permit, it can usefully be measured and presented separately for different occupations (e.g. based on standard employment sector classifications), different causes of death, and by gender. Where there are a large number of part-time workers, use of 'total number of workers' may be inappropriate; instead, it may be more meaningful to base the indicator on the 'total number of worker years'. Problems with data availability mean that many variations on the indicator are possible, and may be necessary (e.g. by basing the indicator on different categories of cause of death). The definitions used need to be clearly stated in every case.
Related indicator sets	None
Sources of further information	WHO 1995 *Global strategy on occupational health for all.* Geneva: WHO.
Involved agencies	WHO ILO National health and safety agencies
EXAMPLE INDICATOR	
Definition of indicator	Mortality from occupational health hazards
Underlying definitions	This indicator requires the ability to identify cases of mortality due to accidents or exposures

and concepts	in the workplace, including: • acute exposure to hazardous substances or materials (e.g. chemicals or organic pathogens); • chronic exposure to hazardous substances of materials (e.g. due to poor environmental control or lack of adequate worker protection) • accidents and physical injury in the workplace (e.g. due to poorly guarded or unsafe equipment, work in dangerous places, fire, or poor working practices); • stress due to working in a psychologically unhealthy environment (e.g. highly repetitive work, bullying, excess levels of responsibility). The indicator also requires the definition of the total number of workers: i.e. those carrying out, or involved in, a trade or business.
Specification of data needed	Number of deaths due to occupational health hazards Total number of workers
Data sources, availability and quality	Data on acute occupational mortality (e.g. due to injuries at work) are generally available through notification systems (e.g. under health and safety legislation). These provide generally reliable data on mortality from accidents in the formal workplace. However, they do not usually include mortality due to chronic occupational exposures, nor are they likely to be accurate for the unregistered work sector. Cause specific mortality data are also available from vital registration statistics. Problems with these data occur in this context, however, because they do not necessarily, nor consistently, report the source of the exposure or injury leading to death. Thus, accurate identification of occupational, as opposed to other, causes of death is rarely possible. This problem is especially severe in the case of diseases with long latency times (such as cancer), and with causes of death which are non-specific (e.g. some cancers, cardio-vascular problems). For these reasons, this indicator may need to be based upon a restricted range of sentinel diseases and injuries, for which direct occupational causes can be reliably specified (e.g. asbestosis, silicosis, death due to injury at work). Data on the total number of workers are usually available from national employment statistics or company records. Such statistics, however, tend to omit those employed in informal or casual work or who have multiple (and often unregistered) jobs.
Computation	The indicator can be computed as: $1000 * (M_o / W)$ where M_o is the total number of deaths due to occupational health hazards and W is the total number of workers.
Units of measurement	Number per thousand workers.
Scale of application	Local to international, though problems of data consistency and availability may limit interpretations at broader scales.
Interpretation	Where reliable and consistent data are available, this indicator provides a useful measure of the health risks associated with the occupational environment. In these situations, an increase in the number of work-associated deaths may be used to infer deterioration in the level of safety in the workplace; a reduction in the number of deaths may imply an improvement in workplace safety. For various reasons, however, this simple association will rarely apply. Problems of attributing deaths to workplace exposures or injury, for example, mean that most estimates will be subject to considerable margins of error, especially in the case of effects with long latency times or non-specific causes. These margins of error should be clearly stated when this indicator is used. Problems in accurately quantifying the number of workers (or total number of worker years) may add to this uncertainty. Changes in the total number of people employed may also affect the rate, even though the total number of people killed at work may not change.