

Annex 1

EXAMPLES OF ENVIRONMENTAL HEALTH INDICATORS

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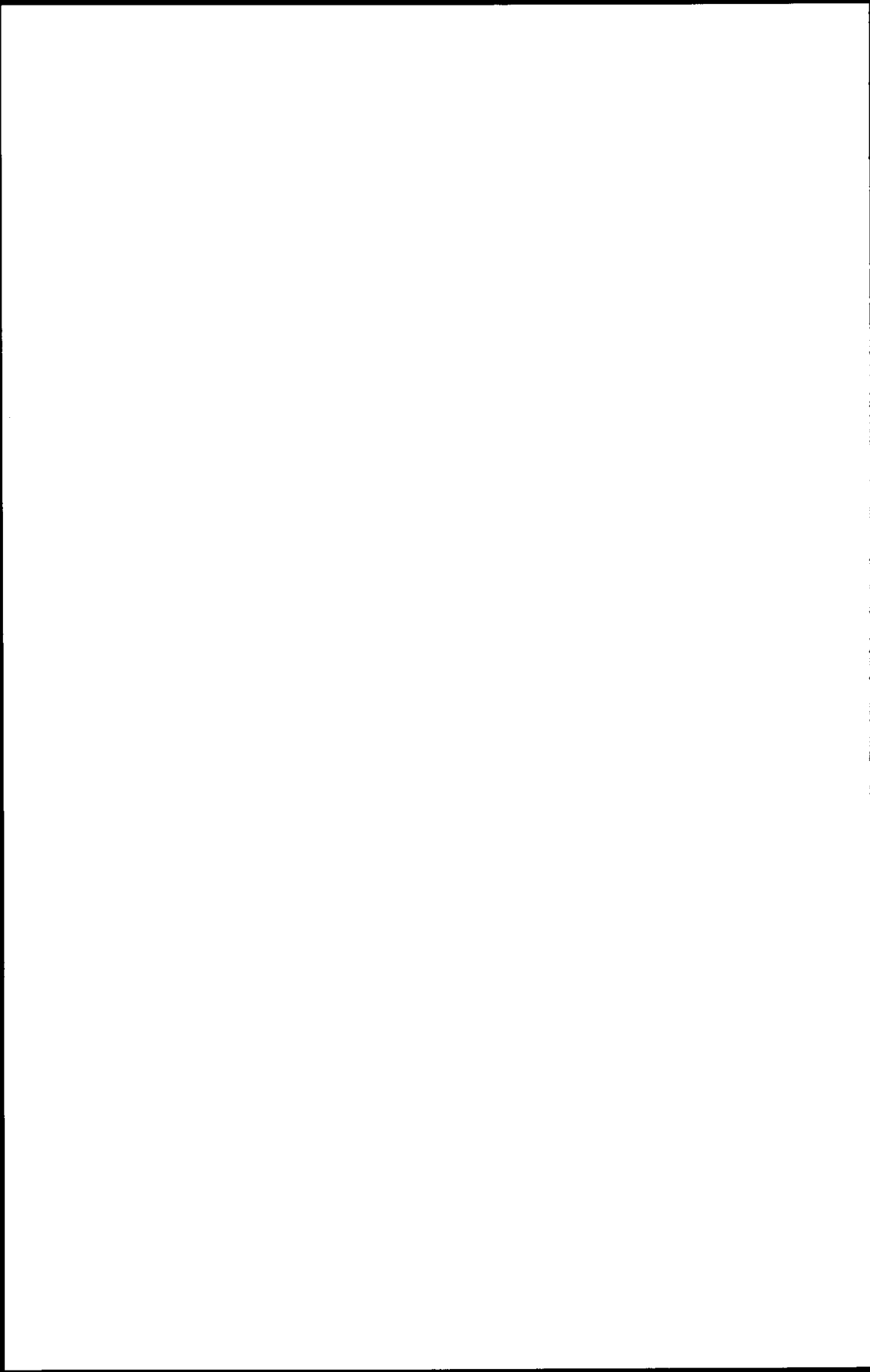


Table A

Population in informal settlements	An exposure indicator
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Indicator profile

Issue	Shelter
Rationale and role	<p>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.</p> <p>This indicator thus provides a measure of exposure to inadequate housing conditions. It can be used to:</p> <ul style="list-style-type: none"> • 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	<p>This indicator is one of a chain of indicators describing the health risks associated with inadequate shelter. Others are:</p> <ul style="list-style-type: none"> • Exposure: Population in informal settlements; <i>Population living in unsafe housing.</i> • Effect: <i>Accidents in the home.</i> • Action: <i>Urban planning and building regulations.</i> <p>However, the characteristics of, and health risks associated with, living in informal settlements extend more widely than this, and other relevant indicators include:</p> <ul style="list-style-type: none"> • Exposure: <i>Access to basic sanitation; Connections to piped water; Access to safe and reliable supplies of drinking water.</i> • Effect: <i>Diarrhoea morbidity in children; Diarrhoea mortality in children; Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness.</i>

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Table A Continued

Population in informal settlements	An exposure indicator
Alternative methods and definitions	<p>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.</p> <p>Where suitable data on population are not available, the indicator might alternatively be measured as the area (e.g. in km²) of informal settlements. This may be estimated from aerial photographs. It is liable to understate the scale of the problem, however, because it makes no allowance for population density, which is often higher in informal settlements than in formal settlements.</p> <p>Other measures of marginal human settlements have been formulated, many of which could be used to develop similar indicators. These include unplanned settlements, squatter settlements, marginal settlements, unconventional dwellings, non-permanent structures, inadequate housing, slums and housing in compliance.</p> <p>"Unconventional dwellings" are commonly defined by the number of housing units occupied by households, but considered inappropriate to human habitation.</p> <p>"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 (i.e. authorised housing).</p> <p>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.</p>
Related indicator sets	<p>UN Indicators of Sustainable Development:</p> <ul style="list-style-type: none"> • Area and population of urban formal and informal settlements.
Sources of further information	<p>UN 1996 <i>Indicators of Sustainable Development: Framework and Methodologies</i>. United Nations, New York.</p> <p>UNCHS (Habitat)/World Bank 1993 <i>The Housing Indicators Programme</i>. Report of the Executive Director (Volume I). United Nations Centre for Human Settlements (Habitat), Nairobi.</p>

Table A Continued

Population in informal settlements	An exposure indicator
	<p>UNCHS (Habitat) 1995 <i>Monitoring the Shelter Sector</i>. Housing Indicators Review. United Nations Centre for Human Settlements (Habitat), Nairobi.</p> <p>UNCHS (Habitat) 1995 <i>Monitoring Human Settlements: Abridged Survey</i>. Indicators Programme. United Nations Centre for Human Settlements (Habitat), Nairobi.</p> <p>UNCHS (Habitat) Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/database/.</p>
Involved agencies	<p>UN Centre for Human Settlements (Habitat)</p> <p>The World Bank</p> <p>WHO — Healthy Cities Project</p>
Example indicator	
Definition of indicator	Percentage of the population living in informal settlements.
Underlying definitions and concepts	<p>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:</p> <p>"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:</p> <ul style="list-style-type: none"> i) residential areas where a group of housing units has been constructed on land to which the occupants have no legal claim or which they occupy illegally; and ii) unplanned settlements and areas where housing is not in compliance with current planning and building regulations (i.e. unauthorised housing). <p>"Unauthorised housing": excludes units where land titles, leases or occupancy permits have been granted (UN, 1996).</p> <p>"Total population": total resident population.</p> <p>It should be noted that informal settlements do not cover the homeless.</p>
Specification of data needed	<p>Number of people living in informal settlements.</p> <p>Total population.</p>
Data sources, availability and quality	<p>Data on the number of people living in informal settlements are often limited, because inhabitants are often only inadequately covered by formal censuses; census data may therefore not</p>

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Table A Continued

Population in informal settlements	An exposure indicator
	<p>provide a clear separation of those living in informal settlements. Where suitable census data do not exist, special surveys may be necessary.</p> <p>Data on total population should be available from national censuses and are generally reliable (except for those living in informal settlements).</p>
Computation	<p>The indicator is computed as:</p> $100 * (P_i / P_t)$ <p>where P_i is the population living in informal settlements and P_t is the total population.</p>
Units of measurement	Percentage.
Interpretation	<p>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.</p> <p>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.</p>

Table B

Population living in unsafe housing An exposure indicator

Indicator profile

Issue	Shelter
Rationale and role	<p>The adequacy of housing is an important determinant of health status in a number of ways. <i>Inter alia</i>, housing quality affects levels of exposure to indoor pollutants, food and water hygiene, levels of sanitation, exposures to physical hazards and injury, and the general quality of life.</p> <p>Housing may be unsafe 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. in 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.</p> <p>This indicator provides a general measure of the adequacy of the housing stock, and the level of exposures to those hazards which might thus occur. Potential uses include:</p> <ul style="list-style-type: none"> • 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	<p>This indicator is part of a chain of indicators which collectively describe the risks associated with inadequacy of shelter:</p> <ul style="list-style-type: none"> • Exposure: <i>Population in informal settlements</i>; Population living in unsafe housing. • Effect: <i>Accidents in the home</i>. • Action: <i>Urban planning and building regulations</i>.

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Table B Continued

Population living in unsafe housing	An exposure indicator
Alternative methods and definitions	<p>However, the characteristics of, and health risks associated with, unsafe, unhealthy or hazardous housing extend more widely than this, and other relevant indicators include:</p> <ul style="list-style-type: none"> • Exposure: <i>Access to basic sanitation; Connection to piped water; Access to safe and reliable supplies of drinking water.</i> • Effect: <i>Diarrhoea morbidity in children; Diarrhoea mortality in children; Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness; Outbreaks of waterborne diseases.</i> <p>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. However, defining the terms "unsafe", "unhealthy" and "hazardous" poses severe difficulties, as does obtaining data on houses which meet these criteria.</p> <p>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.</p> <p>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.</p> <p>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 map hazardous areas and overlay these with population data.</p>
Related indicator sets	<p>UNCHS (Habitat) Urban Indicators Programme:</p> <ul style="list-style-type: none"> • Permanent structures (percentage of housing units located in structures expected to 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).

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Table B Continued

Population living in unsafe housing	An exposure indicator
Sources of further information	<p>WHO 1994 <i>Implementation of the Global Strategy for Health for All by the Year 2000. Second Evaluation. Eighth Report on the World Health Situation.</i> (Volume 5: European Region). WHO Regional Office for Europe, Geneva.</p> <p>WHO 1997 <i>Health and Environment in Sustainable Development: Five Years after the Earth Summit.</i> World Health Organization, Geneva.</p> <p>UNCHS (Habitat) Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/database/.</p>
Involved agencies	<p>UN Centre for Human Settlements (Habitat)</p> <p>WHO — Healthy Cities Programme</p> <p>National, regional and local housing agencies</p>

Example Indicator

Definition of indicator	Percentage of the population living in unsafe, unhealthy or hazardous housing.
Underlying definitions and concepts	<p>This indicator requires the ability to identify, and measure the extent of, unsafe, unhealthy or hazardous housing. This poses significant difficulties, because 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:</p> <ul style="list-style-type: none"> • 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. in an area of flood or earthquake risk) or is sited on contaminated land (e.g. by chemical wastes or radioactivity); or • provides serious risks of exposures to indoor pollution (e.g. air pollutants) or pathogens (e.g. moulds, ticks and fleas); or • provides inadequate shelter (e.g. due to poor insulation or inadequate roofing) and few or no basic amenities (e.g. cooking facilities and heating). <p>In addition, a definition is required of the total population (i.e. the total resident population at the time of the census or survey).</p>

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Table B Continued

Population living in unsafe housing	An exposure indicator
Specification of data needed	<p>Number of people living in unsafe, unhealthy or hazardous housing. Total resident population.</p>
Data sources, availability and quality	<p>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.</p> <p>Data on the total resident population should be available from national censuses and should be reliable.</p>
Computation	<p>The indicator can be computed as:</p> $100 * (P_u / P_t)$ <p>where P_u is the number of people living in unsafe, unhealthy or hazardous housing and P_t is the total population.</p>
Units of measurement	Percentage.
Interpretation	<p>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.</p> <p>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.</p>

Table C

Accidents in the home	An effect indicator
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Indicator profile

Issue	Shelter
Rationale and role	<p>Accidents in the home are one of the main causes of injury and death. Although 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:</p> <ul style="list-style-type: none"> • 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	<p>This indicator is part of a chain of indicators that collectively describe the risks associated with inadequacy of shelter:</p> <ul style="list-style-type: none"> • Exposure: <i>Population in informal settlements; Population living in unsafe housing.</i> • Effect: Accidents in the home. • Action: <i>Urban planning and building regulations.</i>
Alternative methods and definitions	<p>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.</p>
Related indicator sets	None.
Sources of further information	
Involved agencies	WHO

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Table C Continued

Accidents in the home

An effect indicator

Example indicator

Definition of indicator	Incidence of injury by accidents in the home.
Underlying definitions and concepts	<p>"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.</p> <p>"Total population": total resident population.</p>
Specification of data needed	Number of reported accidents in the home. Total population.
Data sources, availability and quality	<p>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, although reported, may not be clearly classified as a result of an accident in the home. Probably the most useful source of data are hospital admission statistics, although these tend to cover the more severe, acute injuries. Other potential sources include data from GPs and household surveys.</p> <p>Data on the total population should be available from national census statistics, and should be reliable.</p>
Computation	<p>The indicator can be computed as:</p> $1,000 * (A / P)$ <p>where A is the total number of reported cases of injury by accidents in the home, and P is the total population.</p>
Units of measurement	Number per thousand head of population.
Interpretation	<p>This is a potentially useful indicator, which gives a general measure of injuries due to accidents in the home.</p> <p>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.</p>

Table D

Urban planning and building regulations	An action indicator
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Indicator profile

Issue	Shelter
Rationale and role	<p>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, for example, to:</p> <ul style="list-style-type: none"> • 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 and mortality relating to inadequate housing.
Linkage with other indicators	<p>This indicator is part of a chain of indicators which collectively describe the risks associated with inadequacy of shelter:</p> <ul style="list-style-type: none"> • Exposure: <i>Population in informal settlements; Population living in unsafe housing.</i> • Effect: <i>Accidents in the home.</i> • Action: <i>Urban planning and building regulations.</i>
Alternative methods and definitions	<p>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.</p> <p>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.</p>

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Table D Continued

Urban planning and building regulations	An action indicator
Related indicator sets	None.
Sources of further information	<p>UNCHS (Habitat)/World Bank 1993 <i>The Housing Indicators Programme</i>. Report of the Executive Director (Volume I). United Nations Centre for Human Settlements (Habitat), Nairobi.</p> <p>UNCHS (Habitat) 1995 <i>Monitoring the Shelter Sector</i>. Housing Indicators Review. United Nations Centre for Human Settlements (Habitat), Nairobi.</p> <p>UNCHS (Habitat) 1995 <i>Monitoring Human Settlements: Abridged Survey</i>. Indicators Programme. United Nations Centre for Human Settlements, Nairobi.</p> <p>UNCHS (Habitat) 1998 <i>People, Settlements, Environment and Development</i>. United Nations Centre for Human Settlements (Habitat), Nairobi.</p> <p>UNCHS (Habitat) Urban Indicators Programme web page: http://www.urbanobservatory.org/indicators/.</p>
Involved agencies	<p>UN Centre for Human Settlements (Habitat)</p> <p>WHO</p>
Example indicator	
Definition of indicator	Scope and extent of building regulations for housing.
Underlying definitions and concepts	<p>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 providing adequate standards for housing construction and design. Underlying definitions are:</p> <p>"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.</p> <p>"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.</p>

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Table D Continued

Urban planning and building regulations	An action indicator
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	<p>The indicator is computed by scoring 1 for each of the following components:</p> <ul style="list-style-type: none"> • formal planning consent required for all residential development; • strict land zoning in existence that defines areas suitable/ permissible for housing; • building regulations exist that define minimum space requirements and living conditions (e.g. lighting and insulation) for houses; • building regulations exist that control building methods and materials for houses; • building regulations exist that define safety standards for houses.
Units of measurement	Ordinal score (0–5).
Interpretation	<p>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.</p>

Table E

Access to basic sanitation	An exposure indicator
Indicator profile	
Issue	Sanitation
Rationale and role	<p>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:</p> <ul style="list-style-type: none"> • 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 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	<p>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:</p> <ul style="list-style-type: none"> • Exposure: Access to basic sanitation. • Effect: <i>Diarrhoea morbidity in children; Diarrhoea mortality in children.</i>
Alternative methods and definitions	<p>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).</p> <p>Where data are available, the indicator could be further refined according to the type of facilities (e.g. connection to public sewage system, cess-pit, pit latrines and facilities in house or outside).</p>

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Table E Continued

Access to basic sanitation **An exposure indicator**

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*. United Nations, New York.

WHO 1981 *Development of Indicators for Monitoring Health for All by the Year 2000*. World Health Organization, Geneva.

WHO 1982 *National and Global Monitoring of Water Supply and Sanitation*. WWS Series of Cooperative Action for the Decade, No.2. World Health Organization, Geneva.

WHO 1990 *Water Supply and Sanitation Sector Monitoring Report (WSSMR)*. WHO/UNICEF Joint Monitoring Programme. World Health Organization, Geneva.

WHO 1994 *Ninth General Programme of Work Covering the Period 1996–2001*. World Health Organization, Geneva.

WHO 1996 *Catalogue of Health Indicators: A Selection of Health Indicators Recommended by WHO Programmes*. World Health Organization, Geneva.

Involved agencies WHO — Programme for the Promotion of 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.

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Table E Continued

Access to basic sanitation	An exposure indicator
	<p>“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 (e.g. pit privies, pour-flush latrines and septic tanks), communal toilets and simple but adequate excreta disposal such as pit privies, pour-flush latrines and covered by latrines.</p> <p>“Total population”: total resident population.</p>
Specification of data needed	<p>The number of people with access to adequate excreta disposal facilities.</p> <p>Total population.</p>
Data sources, availability and quality	<p>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.</p> <p>Data on total population are available from national censuses and should be reliable.</p>
Computation	<p>The indicator can be computed as:</p> $100 * (P_e / P_t)$ <p>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.</p>
Units of measurement	<p>Percentage.</p>
Interpretation	<p>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 with 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 use and improved hygiene. Data may also be of uncertain quality.</p>

Table F

Diarrhoea morbidity in children An effect indicator

Indicator profile

Issue	Sanitation Access to safe drinking water Food safety and supply
Rationale and role	<p>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 sanitation, water and food.</p> <p>As a measurement of cause-specific morbidity, this indicator can serve several purposes:</p> <ul style="list-style-type: none"> • 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	<p>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.</p> <ol style="list-style-type: none"> 1. Sanitation <ul style="list-style-type: none"> • Exposure: <i>Access to basic sanitation.</i> • Effect: <i>Diarrhoea mortality in children; Diarrhoea morbidity in children.</i> 2. Access to safe drinking water <ul style="list-style-type: none"> • Exposure: <i>Connections to piped water supply; Access to safe and reliable supplies of drinking water.</i> • Effect: <i>Diarrhoea morbidity in children; Diarrhoea mortality in children; Outbreaks of waterborne diseases.</i> • Action: <i>Intensity of water quality monitoring (specifically for drinking waters).</i> 3. Food safety and supply <ul style="list-style-type: none"> • Effect: <i>Food-borne illness; Diarrhoea morbidity in children; Diarrhoea mortality in children.</i> • Action: <i>Monitoring of chemical hazards in food.</i>

Continued

Table F Continued

Diarrhoea morbidity in children	An effect indicator
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 olds). 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 hospitals.
Related indicator sets	WHO Catalogue of Health Indicators: <ul style="list-style-type: none"> • Annual incidence of diarrhoea in children under five years of age.
Sources of further information	<p>WHO 1992 <i>Readings on Diarrhoea: Student Manual</i>. Division for the Control of Diarrhoea and Acute Respiratory Disease, World Health Organization, Geneva.</p> <p>WHO 1994 <i>Ninth General Programme of Work Covering the Period 1996–2001</i>. World Health Organization, Geneva.</p> <p>WHO 1994 <i>Household Survey Manual: Diarrhoea and Acute Respiratory Infections</i>. WHO/CDR/94.8. World Health Organization, Geneva.</p> <p>WHO 1996 <i>Catalogue of Health Indicators: A Selection of Health Indicators Recommended by WHO Programmes</i>. World Health Organization, Geneva.</p> <p>WHO 1997 <i>Health and Environment in Sustainable Development: Five Years After the Earth Summit</i>. World Health Organization, Geneva.</p>
Involved agencies	<p>WHO — Department of Child and Adolescent Health and Development (CAH)</p> <p>WHO — Programme for the Promotion of Environmental Health</p> <p>UNICEF</p>
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.

Continued

Table F Continued

Diarrhoea morbidity in children	An effect indicator
	<p>"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.</p> <p>"Incidence of diarrhoea morbidity": the total number of episodes of diarrhoea during a one-year period amongst the children surveyed.</p> <p>"Total population of children under five years of age": the number of children less than five years of age in the survey, at the time of the survey.</p>
Specification of data needed	<p>Data on the number of episodes of diarrhoea among children under five years of age.</p> <p>Population data for the total number of children under five years of age.</p> <p>Disaggregating data such as socio-economic status, geographic area and age/sex of children.</p>
Data sources, availability and quality	<p>Morbidity data for diarrhoeal disease do not tend to be collected on a routine basis, and usually depend on special surveys.</p> <p>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).</p> <p>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.</p>
Computation	<p>The indicator can be computed as:</p> I_c / P_c <p>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.</p>
Units of measurement	<p>Number of cases per child per year.</p>

Continued

Table F Continued

Diarrhoea morbidity in children	An effect indicator
Interpretation	<p data-bbox="361 336 1014 631">This indicator is a powerful measure of the health status of children, especially under conditions of inadequate water and food hygiene, and poor 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.</p> <p data-bbox="361 649 1014 730">Interpretation of the indicator can be assisted by disaggregating the data by age and gender of the child, economic status of the parents and by geographic area.</p>

Table G

Diarrhoea mortality in children	An effect indicator
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Indicator profile

Issue	Sanitation Access to safe drinking water Food safety and supply
Rationale and role	<p>Diarrhoea and related gastro-intestinal illnesses continue to be among the most important causes of illness and death worldwide, especially amongst vulnerable groups such as young children. Much of this illness is due to exposure 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 <i>Salmonella</i>, <i>Shigella</i>, <i>Campylobacter</i>, <i>E. coli</i> and rotavirus.</p> <p>This indicator provides a measure of the extent and severity of these effects. It can thus be used:</p> <ul style="list-style-type: none"> • 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 to target policy action; • to assess and monitor the effectiveness of intervention programmes; • to analyse relationships between environmental exposures and health.
Linkage with other indicators	<p>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.</p> <ol style="list-style-type: none"> 1. Sanitation <ul style="list-style-type: none"> • Exposure: <i>Access to basic sanitation</i>. • Effect: Diarrhoea mortality in children; <i>Diarrhoea morbidity in children</i>. 2. Access to safe drinking water <ul style="list-style-type: none"> • Exposure: <i>Connections to piped water supply</i>; <i>Access to safe and reliable supplies of drinking water</i>. • Effect: <i>Diarrhoea morbidity in children</i>; Diarrhoea mortality in children; <i>Outbreaks of waterborne diseases</i>. • Action: <i>Intensity of water quality monitoring (specifically for drinking waters)</i>.

Continued

Table G Continued

Diarrhoea mortality in children	An effect indicator
	<p>3. Food safety and supply</p> <ul style="list-style-type: none"> • Effect: <i>Food-borne illness; Diarrhoea morbidity in children; Diarrhoea mortality in children.</i> • Action: <i>Monitoring of chemical hazards in food.</i>
Alternative methods and definitions	<p>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. under one year) where appropriate. Stratification by gender may be useful in some cases.</p>
Related indicator sets	<p>WHO Catalogue of Health Indicators:</p> <ul style="list-style-type: none"> • Deaths due to diarrhoea among infants and children under five years of age.
Sources of further information	<p>WHO 1992 <i>Readings on Diarrhoea: Student Manual</i>. Division for the Control of Diarrhoea and Acute Respiratory Disease, World Health Organization, Geneva.</p> <p>WHO 1994 <i>Ninth General Programme of Work Covering the Period 1996–2001</i>. World Health Organization, Geneva.</p> <p>WHO 1994 <i>Household Survey Manual: Diarrhoea and Acute Respiratory Infections</i>. WHO/CDR/94.8. World Health Organization, Geneva.</p> <p>WHO 1996 <i>Catalogue of Health Indicators: A Selection of Health Indicators Recommended by WHO Programmes</i>. World Health Organization, Geneva.</p> <p>WHO 1997 <i>Health and Environment in Sustainable Development: Five Years After the Earth Summit</i>. World Health Organization, Geneva.</p>
Involved agencies	<p>WHO — Department of Child and Adolescent Health and Development (CAH)</p> <p>WHO — Programme for the Promotion of Environmental Health</p> <p>UNICEF</p>

Continued

Table G Continued

Diarrhoea mortality in children	An effect indicator
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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 mid-point 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 one of a number 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 through 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:

$$1,000 * (M_c / P_c)$$

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.

Continued

Table G Continued

Diarrhoea mortality in children	An effect indicator
Interpretation	<p>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.</p>

Table H

Ambient concentrations of air pollutants in urban areas A state indicator

Indicator profile

Issue	Air pollution
Rationale and role	<p>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:</p> <ul style="list-style-type: none"> • 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	<p>This indicator represents one in a chain of indicators that together describe the effects of air pollution on health:</p> <ul style="list-style-type: none"> • State: <i>Ambient concentrations of air pollutants in urban areas.</i> • Exposure: <i>Sources of indoor air pollution.</i> • Effect: <i>Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness.</i> • Action: <i>Capability for air quality management; Availability of lead-free petrol.</i>
Alternative methods and definitions	<p>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 (for example, CO, particulates (PM₁₀, PM_{2.5}, SPM), black smoke, SO₂, NO₂, O₃, 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 (although in this case comparisons need to be made with care because of possible changes or differences in the guideline values).</p>

Continued

Table H Continued

Ambient concentrations of air pollutants in urban areas	A state indicator
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Where monitoring data are unavailable, estimates of pollution levels may be made using air pollution models. Dispersion models are, however, dependent 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*. (Volume I and II). World Health Organization, Geneva.

UN 1996 *Indicators of Sustainable Development: Framework and Methodologies*. Report for the UN Commission on Sustainable Development. United Nations, New York.

WHO 1987 *Air Quality Guidelines for Europe*. WHO Regional Publications, European Series No. 23. World Health Organization, Geneva.

(Updated in 1998; see <http://www.who.int>).

WHO 1991 *Global Strategy for Health for All by the Year 2000*. World Health Organization, Geneva.

WHO 1994 *Ninth General Programme of Work Covering the Period 1996–2001*. World Health Organization, Geneva.

WHO 1998 *Healthy Cities Air Management Information System (AMIS)*. AMIS v. 2.0. CDROM. World Health Organization, Geneva.

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 CO, particulates (PM₁₀, PM_{2.5}, SPM), SO₂, NO₂, O₃ and lead in the outdoor air in urban areas.

Continued

Table H Continued

Ambient concentrations of air pollutants in urban areas	A state indicator
Underlying definitions and concepts	<p>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.</p> <p>Underlying definitions are:</p> <p>“Mean annual concentration”: mean concentration of the pollutant of concern, averaged over all hours of the year.</p> <p>“Percentile concentration”: concentration of pollutant of concern exceeded in 100 – X% of hours, where X is the percentile as defined by the relevant standards.</p>
Specification of data needed	<p>Mean annual and percentile concentrations for CO, PM₁₀, PM_{2.5}, SPM, SO₂, NO₂, O₃ and lead.</p> <p>Site location, site type (e.g. kerbside, intermediate or background), monitoring method (e.g. passive sampler or continuous monitor) and sampling frequency.</p>
Data sources, availability and quality	<p>Data on ambient air pollution concentrations can be obtained from national or local monitoring networks, using either continuous (fixed-site) monitors or passive samplers.</p> <p>In addition, a growing volume of data can be obtained from the WHO Healthy Cities Air Management Information System (AMIS).</p>
Computation	<p>The indicator can be presented as:</p> <ul style="list-style-type: none"> • the mean annual concentration, • the relevant (e.g. 98th) percentile concentration, <p>or otherwise as appropriate (e.g. number of days/hours in excess of air pollution standard).</p>
Units of measurement	<p>µg m⁻³, ppm or ppb as appropriate, or percentage of days when standards/guideline values are exceeded.</p>
Interpretation	<p>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).</p>

Continued

Table H Continued

Ambient concentrations of air pollutants in urban areas

A state indicator

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 are 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.

Table I

Sources of indoor air pollution An exposure indicator

Indicator profile

Issue	Air pollution
Rationale and role	<p>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:</p> <ul style="list-style-type: none"> • 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	<p>This indicator represents one in a chain of indicators that together describe the effects of air pollution on health:</p> <ul style="list-style-type: none"> • State: <i>Ambient concentrations of air pollutants in urban areas.</i> • Exposure: Sources of indoor air pollution. • Effect: <i>Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness.</i> • Action: <i>Capability for air quality management; Availability of lead-free petrol.</i>
Alternative methods and definitions	<p>This indicator can be computed as the number or proportion of households (or population) that 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 surveys.</p> <p>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.</p>
Related indicator sets	None.

Continued

Table I Continued

Sources of indoor air pollution	An exposure indicator
Further sources of information	WHO 1994 <i>Implementation of the Global Strategy for Health for All by the Year 2000. Second Evaluation. Eighth Report on the World Health Situation. (Volume 5: European Region)</i> . WHO Regional Office for Europe, Geneva WHO 1998 <i>Healthy Cities Air Management Information System (AMIS)</i> . AMIS v. 2.0. CDROM. World Health Organization, Geneva.
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 definitions and concepts	This indicator is based on the assumption that use of kerosene, wood, coal or dung for heating 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 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 the 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, although care is needed in relation to the definition of a "household" (e.g. how collective dwellings are classified).

Continued

Table I Continued

Sources of indoor air pollution	An exposure indicator
Computation	<p>The indicator can be computed as:</p> $(H_c / H_t) * 100$ <p>where H_c is the number of households using coal, wood, dung or kerosene as the main source of cooking/heating fuel, and H_t is the total number of households.</p> <p>The indicator should normally be calculated for a specified census date.</p>
Units of measurement	Percentage.
Interpretation	<p>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.</p> <p>In applying and interpreting the indicator, however, it should be noted that:</p> <ul style="list-style-type: none"> • it takes no account of use of other sources of indoor pollution (e.g. smoking, furnishings and 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.

Table J

Childhood morbidity due to acute respiratory illness	An effect indicator
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Indicator profile

Issue	Air pollution
Rationale and role	<p>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.</p> <p>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:</p> <ul style="list-style-type: none"> • 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 and awareness raising campaigns).
Linkage with other indicators	<p>This indicator represents one in a chain of indicators that together describe the effects of air pollution on health:</p> <ul style="list-style-type: none"> • State: <i>Ambient concentrations of air pollutants in urban areas.</i> • Exposure: <i>Sources of indoor air pollution.</i> • Effect: Childhood morbidity due to acute respiratory illness; <i>Childhood mortality due to acute respiratory illness.</i> • Action: <i>Capability for air quality management; Availability of lead-free petrol.</i>
Alternative methods and definitions	<p>This indicator can be defined as the incidence of morbidity due to acute respiratory illness in children under five years of age. Because acute respiratory illness tends to be more common in boys than in 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.</p>

Continued

Table J Continued

Childhood morbidity due to acute respiratory illness	An effect indicator
	<p>Variations on this indicator are possible, depending on the availability of morbidity data. Sales of respiratory medication (e.g. inhalers) can be used as a proxy, although 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, for example:</p> <ul style="list-style-type: none"> • acute lower respiratory infection (ALRI), i.e. an acute infection of the larynx, trachea, bronchi, bronchioles or lung; • acute upper respiratory infection (AURI), i.e. an acute infection of the nose, pharynx (throat) or middle ear. <p>Similar indicators might also be developed for other age groups considered to be at risk (e.g. the elderly).</p>
Related indicator sets	<p>WHO Catalogue of Health Indicators:</p> <ul style="list-style-type: none"> • Care-seeking for children with acute respiratory infections.
Sources of further information	<p>WHO 1992 <i>The Measurement of Overall and Cause-specific Mortality in Infants and Children</i>. Report of a Joint WHO/UNICEF Consultation, 15–17 December 1992. World Health Organization, Geneva.</p> <p>WHO 1994 <i>Ninth General Programme of Work Covering the Period 1996–2001</i>. World Health Organization, Geneva.</p> <p>WHO 1994 <i>The Management of Acute Respiratory Infections in Children: Practical Guidelines for Outpatient Care</i>. Division for the Control of Diarrhoea and Acute Respiratory Disease, World Health Organization, Geneva.</p> <p>WHO 1996 <i>Catalogue of Health Indicators: A Selection of Health Indicators Recommended by WHO Programmes</i>. World Health Organization, Geneva.</p> <p>WHO 1997 <i>Health and Environment in Sustainable Development: Five Years After the Earth Summit</i>. World Health Organization, Geneva.</p>
Involved agencies	<p>WHO — Department of Child and Adolescent Health and Development (CAH) UNICEF</p>
Example indicator	
Definition of indicator	<p>Incidence of morbidity due to acute respiratory infections in children under five years of age.</p>

Continued

Table J Continued

Childhood morbidity due to acute respiratory illness	An effect indicator
Underlying definitions and concepts	<p>This indicator is based on the following definitions:</p> <p>“Acute respiratory infection (ARI)”: an acute infection of the ear, nose, throat, epiglottis, larynx, trachea, bronchi, bronchioles or lung.</p> <p>“Total population of children under five years of age”: number of live children less than five years of age at the mid-point of the year (or other survey period).</p>
Specification of data needed	<p>Number of cases of acute respiratory infection in children under five years of age.</p> <p>Total number of children under five years of age.</p>
Data sources, availability and quality	<p>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. Furthermore, GP data are generally difficult to acquire. For most purposes, therefore, the best available data are likely to come either from hospital admissions records or from 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.</p> <p>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.</p>
Computation	<p>The indicator can be computed as:</p> $1,000 * (R_c / P_c)$ <p>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.</p>
Units of measurement	<p>Number per thousand children under five years of age.</p>

Continued

Table J Continued

Childhood morbidity due to acute respiratory illness	An effect indicator
Interpretation	<p>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.</p> <p>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.</p>

Table K

Childhood mortality due to acute respiratory illness	An effect indicator
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Indicator profile

Issue	Air pollution
Rationale and role	<p>Acute respiratory illness is the single largest cause of mortality in children under five 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.</p> <p>As a measurement of cause-specific mortality, this indicator can serve several purposes:</p> <ul style="list-style-type: none"> • 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 as a result of exposure to domestic indoor air pollution from coal and biomass burning.)
Linkage with other indicators	<p>This indicator represents one in a chain of indicators that together describe the effects of air pollution on health:</p> <ul style="list-style-type: none"> • State: <i>Ambient concentrations of air pollutants in urban areas.</i> • Exposure: <i>Sources of indoor air pollution.</i>

Continued

Table K Continued

Childhood mortality due to acute respiratory illness	An effect indicator
	<ul style="list-style-type: none"> • Effect: <i>Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness.</i> • Action: <i>Capability for air quality management; Availability of lead-free petrol.</i>
Alternative methods and definitions	<p>This indicator can be defined as the annual mortality rate due to acute respiratory illness in children under five years of age. Because acute respiratory infections tend to be more common in boys than in 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.</p> <p>The indicator could also be compiled and presented for other, more specific categories of acute respiratory illness, for example:</p> <ul style="list-style-type: none"> • acute lower respiratory infection (ALRI), i.e. an acute infection of the larynx, trachea, bronchi, bronchioles or lung; • acute upper respiratory infection (AURI), i.e. an acute infection of the nose, pharynx (throat) or middle ear. <p>In this way, the indicator could be applied to monitor or investigate disease-specific mortality. In developing countries, this might focus on the problem of pneumonia associated with 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.</p> <p>Similar indicators might also be developed for other age groups considered to be at risk (e.g. the elderly).</p>
Related indicator sets	<p>WHO Catalogue of Health Indicators:</p> <ul style="list-style-type: none"> • Under-five deaths due to acute respiratory infections.
Sources of further information	<p>WHO 1992 <i>The Measurement of Overall and Cause-specific Mortality in Infants and Children</i>. Report of a Joint WHO/UNICEF Consultation, 15–17 December 1992. World Health Organization, Geneva.</p> <p>WHO 1994 <i>Ninth General Programme of Work Covering the Period 1996–2001</i>. World Health Organization, Geneva.</p> <p>WHO 1994 <i>The Management of Acute Respiratory Infections in Children: Practical Guidelines for Outpatient Care</i>. Division for the Control of Diarrhoea and Acute Respiratory Diseases, World Health Organization, Geneva.</p>

Continued

Table K Continued

Childhood mortality due to acute respiratory illness	An effect indicator
	<p>WHO 1996 <i>Catalogue of Health Indicators: A Selection of Health Indicators Recommended by WHO Programmes</i>. World Health Organization, Geneva.</p> <p>WHO 1997 <i>Health and Environment in Sustainable Development: Five Years After the Earth Summit</i>. World Health Organization, Geneva.</p>
Involved agencies	<p>WHO — Department of Child and Adolescent Health and Development (CAH)</p> <p>UNICEF</p>
Example indicator	
Definition of indicator	Annual mortality rate due to acute respiratory infections in children under five years of age.
Underlying definitions and concepts	<p>This indicator is based on the following definitions:</p> <p>“Acute respiratory infection (ARI)”: an acute infection of the ear, nose, throat, epiglottis, larynx, trachea, bronchi, bronchioles or lung.</p> <p>“Total population of children under five years of age”: number of live children less than five years of age at the mid-point of the year (or other survey period).</p>
Specification of data needed	<p>Annual number of deaths of children under five years of age due to acute respiratory infections (ARI).</p> <p>Total number of children aged under five years at the mid-point in the survey year.</p>
Data sources, availability and quality	<p>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.</p>
Computation	<p>This indicator can be computed as:</p> $1,000 * (M_c / P_c)$ <p>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.</p>

Continued

Table K Continued

Childhood mortality due to acute respiratory illness	An effect indicator
Units of measurement	Number of deaths per thousand children below the age of five each year.
Interpretation	<p>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 worsening air pollution conditions; a reduction in mortality might imply a decrease in exposures and an improvement in air quality.</p> <p>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 ARI have remained broadly stable over recent decades, despite a large increase in morbidity.</p>

Table L

Capability for air quality management	An action indicator
Indicator profile	
Issue	Air pollution
Rationale and role	<p>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.</p> <p>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:</p> <ul style="list-style-type: none"> • 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	<p>This indicator represents one in a chain of indicators that together describe the effects of air pollution on health:</p> <ul style="list-style-type: none"> • State: <i>Ambient concentrations of air pollutants in urban areas.</i> • Exposure: <i>Sources of indoor air pollution.</i> • Effect: <i>Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness.</i> • Action: Capability for air quality management; <i>Availability of lead-free petrol.</i>
Alternative methods and definitions	<p>Developing indicators that 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:</p>

Table L Continued

Capability for air quality management	An action indicator
	<ul style="list-style-type: none"> • air quality measurement capacity (measured in terms of the capacity to measure chronic health effects, acute health effects, trends in pollutant concentrations, spatial distribution of pollutants, kerbside concentrations and data quality); • data assessment and availability (measured in terms of the capacity to analyse and disseminate data); • 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).
	<p>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, for example, 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.</p>
Related indicator sets	<p>GEMS/AIR:</p> <ul style="list-style-type: none"> • Management Capabilities Assessment Index.
Sources of further information	<p>MARC 1996 <i>Air Quality Management and Assessment Capabilities in 20 Major Cities</i>. GEMS/AIR. Monitoring and Assessment Research Centre, London.</p> <p>WHO 1998 <i>Healthy Cities Air Management Information System (AMIS)</i>. AMIS v. 2.0. CDROM. World Health Organization, Geneva.</p>
Involved agencies	<p>National air quality monitoring agencies National environment ministries UNEP WHO</p>
Example indicator	
Definition of indicator	Capability to implement air quality management.

Continued

Table L Continued

Capability for air quality management	An action indicator
Underlying definitions and concepts	<p>This indicator is 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:</p> <p>“Air quality management capability”: the existence, implementation and enforcement of instruments and measures aimed at controlling or reducing air pollution in the ambient environment.</p> <p>“Air quality standards”: legally specified limits for specific air pollutants which should not be exceeded over the specified averaging time.</p> <p>“Emissions controls”: legally specified limits for emissions from specific sources which should not be exceeded under the specified operating conditions.</p>
Specification of data needed	<p>Evidence of the following capabilities is required in order to support this indicator:</p> <ul style="list-style-type: none"> • 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	<p>Information on the existence of these instruments and measures.</p>
Computation	<p>The index is computed as:</p> $\sum (C_i)$ <p>where C_i is the score for component i.</p> <p>The full list of components (i) are as follows.</p> <ol style="list-style-type: none"> 1. A network of continuous monitoring sites covering residential areas for the following pollutants: <ul style="list-style-type: none"> • NO₂ • SO₂

Table L Continued

Capability for air quality management	An action indicator
<ul style="list-style-type: none"> • PM • CO • lead • O₃. 	Score 1 for each pollutant [max = 6].
<p>2. Open access to air quality information through:</p> <ul style="list-style-type: none"> • annual published reports • newspapers • the Internet. 	Score 1 for each pollutant [max = 3].
<p>3. Publication of air quality warnings during pollution episodes.</p>	Score 3 if present [max = 3].
<p>4. Requirement to measure and report emissions from:</p> <ul style="list-style-type: none"> • major combustion sources • large industrial sources • other point emission sources. 	Score 1 for each source [max = 3].
<p>5. Detailed emission inventories for NO₂, SO₂, PM, CO, metals (e.g. lead) and VOCs covering emissions from:</p> <ul style="list-style-type: none"> • industrial sources • transport sources • domestic sources • other sources. 	Score 0.25 for each source and 1 for each pollutant; score calculated as sum of (source score x pollutant score) [max = 6].
<p>6. Short-term (e.g. maximum daily) standards for:</p> <ul style="list-style-type: none"> • NO₂ • SO₂ • PM • O₃ • CO. 	Score 1 for each pollutant [max = 5].
<p>7. Long-term (e.g. mean annual) standards for:</p> <ul style="list-style-type: none"> • NO₂ • SO₂ • PM • lead. 	Score 1 for each pollutant [max = 4].

Continued

Table L Continued

Capability for air quality management	An action indicator
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 = 3].	
10. Emission controls for: <ul style="list-style-type: none"> • new road vehicles • domestic dwellings • industrial premises. Score 2 for each source [max = 6].	
11. Availability of unleaded petrol 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: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • industrial development • major road developments. Score 3 for each type of development [max = 6].	
Units of measurement	Ordinal score (0 – 60).
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.

Table M

Availability of lead-free petrol	An action indicator
Indicator profile	
Issue	Air pollution
Rationale and role	<p>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.</p> <p>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 action, and as such can be used to:</p> <ul style="list-style-type: none"> • 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. <p>This indicator can also be used as a proxy measure of potential exposure to lead, especially in broad-scale studies.</p>
Linkage with other indicators	<p>This indicator represents one in a chain of indicators which together describe the effects of air pollution on health:</p> <ul style="list-style-type: none"> • State: <i>Ambient concentrations of air pollutants in urban areas.</i> • Exposure: <i>Sources of indoor air pollution.</i> • Effect: <i>Childhood morbidity due to acute respiratory illness; Childhood mortality due to acute respiratory illness.</i> • Action: <i>Capability for air quality management; Availability of lead-free petrol.</i>
Alternative methods and definitions	<p>This indicator can be defined as the percentage (by volume) of total petrol 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 petrol consumption per head of population or</p>

Continued

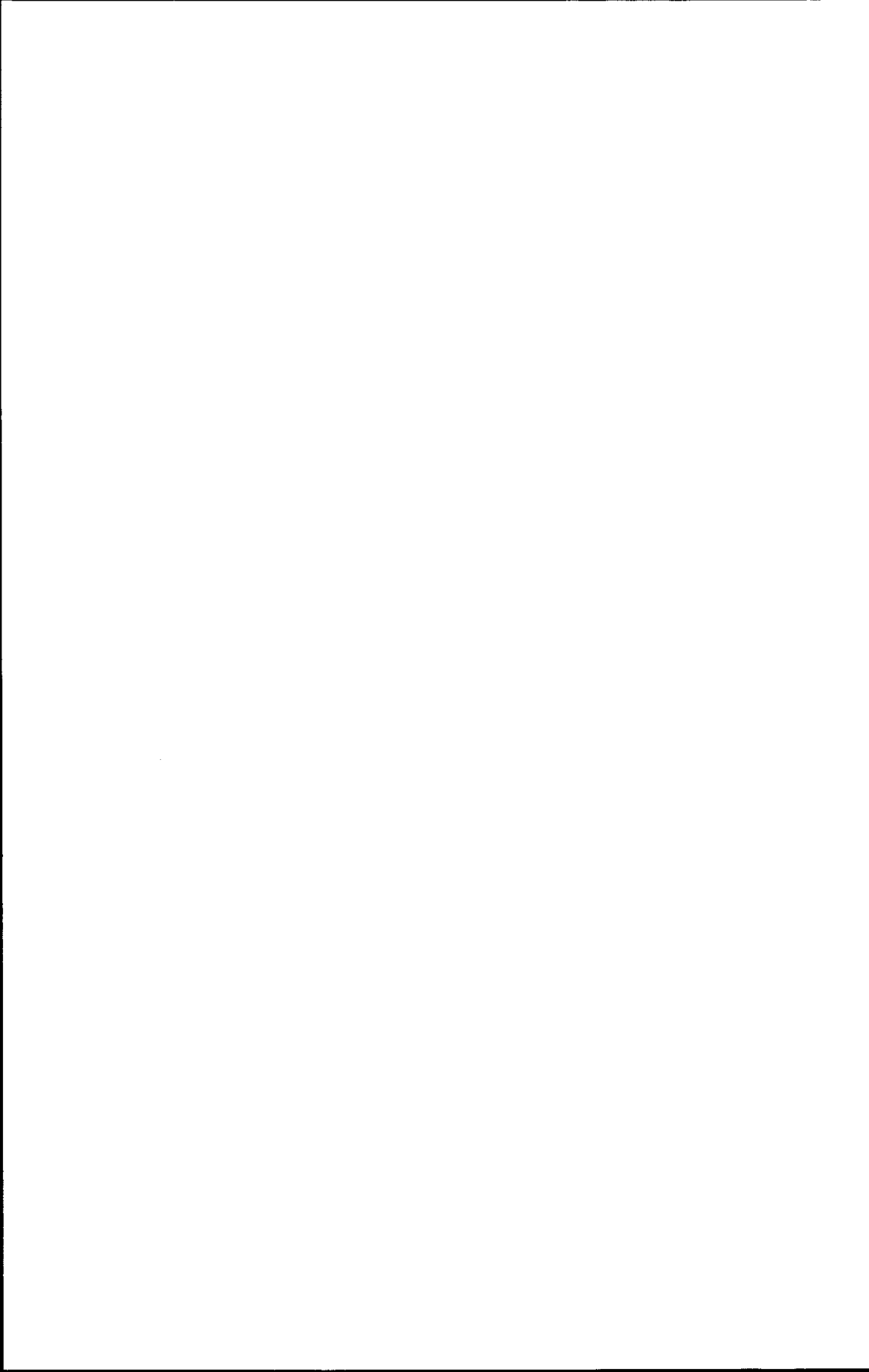
Table M Continued

Availability of lead-free petrol	An action indicator
	<p>per km²). 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 petrol. 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 emissions and higher atmospheric concentrations of lead.</p>
Related indicator sets	<p>GEMS/AIR Management Capabilities Assessment Index:</p> <ul style="list-style-type: none"> • Unleaded petrol available in the city.
Sources of further information	<p>MARC 1996 <i>Air Quality Management and Assessment Capabilities in 20 Major Cities</i>. GEMS/AIR. Monitoring and Assessment Research Centre, London.</p> <p>WHO 1992 <i>Human Exposure to Lead</i>. Report on the Human Exposure Assessment Locations (HEAL) Programme Meeting held in Bangkok, Thailand, 16–19 November 1992. World Health Organization, Geneva.</p> <p>WHO 1994 <i>Ninth General Programme of Work Covering the Period 1996–2001</i>. World Health Organization, Geneva.</p> <p>WHO 1995 <i>Inorganic Lead</i>. Environmental Health Criteria Series, Number 165. Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organisation, and the World Health Organization. World Health Organization, Geneva.</p> <p>http://www.who.int/dsa/cat97/zehc1.htm</p>
Involved agencies	<p>WHO</p> <p>Petroleum companies</p>
Example indicator	
Definition of indicator	<p>Consumption of lead-free petrol as a percentage of total petrol consumption.</p>
Underlying definitions and concepts	<p>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:</p> <p>"Unleaded petrol consumption": total sales (volume) of petrol not containing lead.</p> <p>"Total petrol consumption": total sales of all petrol (by volume).</p>

Continued

Table M Continued

Availability of lead-free petrol	An action indicator
Specification of data needed	Volume of unleaded petrol sold. Total volume of petrol sold.
Data sources, availability and quality companies.	Data on the amounts of petrol 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: $(G_u / G_t) * 100$ where G_u is the total volume of unleaded petrol sold, and G_t is the total volume of all petrol sold.
Units of measurement	Percentage.
Interpretation	This indicator is relatively simple to interpret, in that sales of unleaded petrol 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.



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FROM EVIDENCE TO ACTION

EDITED BY C. CORVALÁN, D. BRIGGS AND G. ZIELHUIS



This book examines the need for information in support of decision-making in environmental health. It discusses indicators of environmental health, methods of data collection and the assessment of exposure to and the health impact of different environmental risk factors. It also discusses approaches to linkage analysis of grouped environmental and health data, including statistical and epidemiological issues and geographical information systems.

The book will be an invaluable source of information for researchers in public health, epidemiology and social science, as well as for environmental health officers, especially those responsible for collecting and analysing environmental health data as part of local or national information systems.

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