POPULATION GROWTH RATE IN AREAS ENDEMIC FOR INSECT-BORNE DISEASES	
GENERAL CONSIDERATIONS	
Issues	Insect-borne diseases
Type of indicator	Exposure (proximal/pressure)
Rationale	One of the main causes of increased exposure to insect-borne diseases is the growth of population in areas in which disease vectors are endemic. This indicator provides a measure of the population growth rate in these areas.
Issues in indicator design	Construction of this indicator requires two factors to be defined: the extent of areas endemic for insect-borne diseases and the population growth rate in these areas. In principle, the latter should pose little problem, for national censuses typically provide relatively reliable information on population numbers and change. Many of the areas most severely affected by insect-borne diseases, however, are also areas in which there have been major population displacements, either because of natural events (such as drought and famine) or because of war. In these areas, data on population change are far less reliable. Problems may also exist in defining the areas endemic for insect-borne diseases, especially in more remote areas where field data are scarce.
SPECIFICATION	
Definition	Mean annual rate of population growth in areas endemic for insect-borne diseases.
Terms and concepts	***Population growth:*** the average percentage change in the population within a pre-defined area, including long-term residents and displaced people, but excluding tourists and temporary visitors, relative to a base year. Note that the population change is measured within the same area (irrespective of any change in the extent of the endemic extent of the disease). ***Insect-borne diseases:*** vector-borne diseases for which insects act as a primary agent of transmission; these include malaria, dengue, yellow fever, onchocerciasis, leishmaniasis and trypanosiamiasis. ***Areas endemic for insect-borne:*** geographic areas in which conditions exist to allow the stable transmission of these diseases, from year-to-year.
Data needs	Boundaries of areas endemic for insect-borne diseases. Population numbers (for base and latest year).
Data sources, availability and quality	Data on the extent of areas endemic for insect-borne diseases are likely to come from several sources, including field-based and model-based research projects, and routine monitoring by national and international agencies. In some cases, where routine field monitoring occurs, endemic areas can be defined on the basis of direct observation either of the vector species or of disease rates. In other cases, they may need to be estimated by defining habitats and environmental conditions considered to favour stable transmission of the disease – e.g. vegetation, land use, climate. Satellite data are increasingly valuable data sources in this context. In either case, estimates of the area endemic for the insect vectors are susceptible to considerable uncertainties due to inadequacies in the source data and incomplete understanding of the habitat requirements and transmission processes. Data on population numbers can usually be obtained from national censuses, and where these are available the data may be considered broadly reliable. Censuses are usually carried out at relatively long intervals, so estimates for intermediate years may need to be made using modelling techniques, and will be open to greater uncertainty. Major uncertainties may also occur in

	areas affected by population displacement. Population numbers in the areas defined as endemic for insect-borne diseases may need to be calculated by intersecting the boundaries of these areas with maps of population data (e.g. using GIS techniques). Where the boundaries of the census districts are not concordant with the boundaries of the endemic area, interpolation techniques may be necessary to assess population numbers.
Level of spatial aggregation	Region
Averaging period	Decadal (or shorter term where suitable data exist)
Computation	The indicator can be computed as a simple percentage change: *100 * (Pcurr – Pbase) / (Years * Pbase)* where: *Pcurr* is the population in the endemic area in the current (or latest) year; *Pbase* is the population in the endemic area in the base year; *Years* is the number of years between the base and current year.
Units of measurement	Percentage change
Worked example	Assume that an area defined as endemic for insect-borne diseases contained a population of 1 558 000. Assume that 10 years later the population within the same endemic area is 1 910 700. In this case, the value of the indicator is: 100 * (1 910 700 – 1 558 000) / (10 * 1 558 000) = 2.3%
Interpretation	This indicator provides a measure of the population growth rate in areas considered to be endemic for insect-borne diseases. As such, an increase in the indicator can be interpreted as evidence of a rise in the number of people at risk; a reduction can be interpreted as evidence of a decline in the numbers at risk. Because population growth is also in many cases associated with land use and other changes affecting the potential for disease transmission and habitat availability for the insect vectors, the indicator also provides indirect information on potential future changes in disease risk. Considerable care is needed in interpreting the indicator, because of uncertainties in the source data, and difficulties in defining precisely areas endemic for insect-borne diseases and the populations affected. Crude population numbers are also not the only factor to determine the level of risk: the vector intensity within the area, the detailed distribution of the vector and target population, and population characteristics (e.g. general health, level of immunization) are important co-determinants. In addition, changes may occur in the extent of the endemic area over time, so this indicator is best interpreted in combination with other indicators on the extent of insect-borne diseases.

Variations and alternatives	The indicator proposed here is non-specific in that it includes all forms of insect-borne diseases. In many situations, however, it may be more appropriate to define the indicator separately for different diseases – e.g. malaria, yellow fever. This is especially the case where these have different distributions and potentially affect different populations, with different growth dynamics.
Examples	WHO *Environmental health indicators: framework and methodologies* • **Population at risk from vector-borne diseases**
Useful references	MARA (Mapping Malaria Risk in Africa) website: http://www.mara.org.za WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide. AFRO/CTD/MAL/ 94.3.* Brazzaville: World Health Organization Regional Office for Africa. WHO 1999 *Environmental health indicators: framework and methodologies.* Geneva: World Health Organization. (Available at http://www.who.int/docstore/peh/archives/EHIndicators.pdf)

TOTAL AREA OF INSECT VECTOR HABITATS	
GENERAL CONSIDERATIONS	
Issues	Insect-borne diseases
Type of indicator	Exposure (distal/state) Can also be used as an action indicator for interventions aimed at eliminating or managing insect vector habitats.
Rationale	The distribution of insect-borne diseases is largely determined by the availability of suitable habitats. The existence of these habitats does not always imply disease risk, for in some cases they occur far from human habitation, so the chances of disease transmission are small. To a large, and in many cases increasing, extent, however, these habitats are a result of human management of the land – for example, irrigation, drainage, vegetation clearance, and cropping. Opportunities for disease transmission are therefore great, and likely to rise as populations in these areas increase. The total area of available habitats thus provides a measure of the potential for insect-borne diseases.
Issues in indicator design	Defining the extent of habitats suitable for insect vectors is not always easy. The habitat requirements of the insects concerned are often complex, and depend not only on the availability of suitable breeding and feeding grounds, but also an ecological niche within which stable populations can develop. Factors such as species diversity, predator numbers, and details of the life cycle of all the other species on which the insect vector depends are therefore crucial. Even when habitat requirements and ecological dependencies are known, difficulties may be encountered in obtaining reliable and up-to-date information. Use of Earth observation (e.g. satellite) data has greatly enhanced the ability to model and map vector habitats, and the body of field information is also increasing in many countries. Nevertheless, for many insect vectors, in many areas, it is still necessary to rely on models of habitat suitability and extent that have not been well-validated at the local level.
SPECIFICATION	
Definition	Percentage (or total) of area providing actual or potential insect vector habitats.
Terms and concepts	***Insect vector:*** an insect species that is instrumental in the transmission of a human disease. Many of the most important insect vectors are mosquitoes (e.g. for malaria, dengue) or flies (e.g. sleeping sickness). ***Insect vector habitat:*** an area of land (often defined in terms of its vegetation, land use and climate) which provides an actual or potential habitat in which the insect may breed and maintain a population over the long term. Many of the most important habitats are associated with water bodies, such as ditches, streams, reservoirs or lakes.
Data needs	Boundaries (or estimated extent) of areas suitable as stable habitats for insect vectors. Total land area.
Data sources, availability and quality	Data on the distribution and extent of insect vector habitats may come from two main sources: from field observation of the distribution of the species concerned, or from modelling of their potential habitats (e.g. using satellite and other data). The reliability of modelling has improved greatly in recent years, as the range of data on land cover and meteorology has expanded. A growing body of information is also becoming available from field monitoring of insect vectors (e.g. by research groups and aid agencies). Even so, maps and estimates of the distribution of suitable habitats may be subject to considerable error, especially in more remote areas where validation is difficult, or in areas where rapid land use change may cause marked changes in habitat condition and extent. In particular, it is often difficult to define clear boundaries to many habitats because of the transitional nature of

	the land cover and climate. This means that comparisons between estimates made by different people, or with different techniques, need to be made with caution.
Level of spatial aggregation	Region (or more local where detailed data exist)
Averaging period	Annual-decadal (depending on data availability)
Computation	The indicator can be expressed as a simple percentage: *100 * (Avect / Atot)* where: *Avect* is the area of habitat suitable for the insect vector; *Atot* is the total land area.
Units of measurement	Percentage (or total) area
Worked example	Assume that an area contains 14 600 ha of habitat suitable for insect vectors, from a total land surface of 360 200 ha. In this case the value of the indicator is calculated as: 100 * (14 600 / 360 200) = 4.1%
Interpretation	This indicator provides a simple measure of the extent of insect vector habitats. As such, an increase in the indicator can be considered to represent an increase in the potential risk of disease transmission, a reduction a decline in risk. In interpreting the indicator, however, it is important to recognize that it takes no account of the intensity of risk – e.g. due to variations in the density of either insect or human populations. Uncertainties are also likely in the estimates of habitat area, and differences in methodology may mean that comparisons between estimates from different areas (or at different times) need to be made with care.
Variations and alternatives	An alternative (and possible improvement) to this indicator would be to base it on an estimate of the density, rather than the extent, of the insect vectors. This is possible where reliable data on the size and distribution of the insect vectors are available. Information on the extent of the habitats can also be combined with data on the number of children resident in each area, to provide an indicator of the exposure risk. However, because the numbers at risk may vary because of population changes, this indicator cannot be interpreted directly in relation to habitat extent.
Examples	WHO *Environmental health indicators: framework and methodologies* • **Population at risk from vector-borne diseases**
Useful references	MARA (Mapping Malaria Risk in Africa) website: http://www.mara.org.za WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide. AFRO/CTD/MAL/ 94.3.* Brazzaville: World Health Organization Regional Office for Africa. WHO 1999 *Environmental health indicators: framework and methodologies.* Geneva: World Health Organization. (Available at http://www.who.int/docstore/peh/archives/EHIndicators.pdf)

CHILDREN AGED 0-14 YEARS LIVING IN HOUSEHOLDS PROVIDING SUITABLE CONDITIONS FOR INSECT-BORNE DISEASE TRANSMISSION	
GENERAL CONSIDERATIONS	
Issues	Insect-borne diseases
Type of indicator	Exposure (proximal) Can also be used as an indicator of action aimed at increasing awareness of, or eliminating, insect vectors in the home.
Rationale	Children's contact with insect vectors occurs most commonly in or near the home. The opportunities of contact thus increase when the home or local environment provide habitats in which insects may breed, feed and survive. Suitable micro-environments often include loose waste, faecal material or stagnant water bodies. The presence of rats or other animals that provide hosts for the insects also increases risks of human exposure. This indicator therefore provides a measure of the risk of exposure as a result of the presence of these micro-environments.
Issues in indicator design	The main difficulties in developing this indicator are to define relevant micro-environments that might act as risk factors for insect-borne diseases, and to obtain reliable data on their extent or density in the home environment. Because of the complex nature of these features, some form of qualitative survey of housing conditions is likely to be more informative in many cases than attempts to quantify individual micro-environments in the home. An age range of 0-14 years is used for this indicator because risks to children are not strongly age-dependent.
SPECIFICATION	
Definition	Percentage (or number) of children aged 0-14 years living in households providing suitable micro-environments for insect-borne disease transmission
Terms and concepts	***Suitable micro-environment for insect-borne disease transmission:*** a microenvironment or organism in or near to the home (i.e. within ca, 50 metres) that provides a potential habitat or host for insect populations that might transmit disease. Examples include: loose waste in the road, waste dumps, faecal material in the road, unsealed latrines, stagnant water pools, rats, livestock.
Data needs	Numbers of children aged 0-14 years by household. Classification of households in terms of presence of vector microhabitats.
Data sources, availability and quality	Data for this indicator are only likely to come from household surveys. Where these can be designed specifically to collect this information, they are likely to be reliable; less precise assessments may, however, be possible by inference from other data (e.g. on level of provision of services such as water, waste and sanitation). In these cases, households might be scored in terms of the potential risk they pose based on the number of key services not provided.
Level of spatial aggregation	Community or administrative district
Averaging period	Annual or longer term
Computation	The indicator can be computed as a simple percentage: $100 * Cmicro / Ctot$ where: *Cmicro* is the number of children living in homes with microhabitats

	suitable for insect vectors; *Ctot* is the total number of children.
Units of measurement	Percentage or number
Worked example	Assume that a household survey shows that 765 children, from a total of 2 200, live in homes providing suitable microenvironments for insect-borne disease transmission. In this case, the value of the indicator is calculated as: 100 * (765 / 2 200) = 34.8%
Interpretation	This indicator provides a useful measure of conditions in the home likely to affect the risks of disease transmission by insect vectors. As a proximal measure of exposure, it is especially important for pin-pointing children at risk, and thus for targeting intervention. An increase in the indicator can be seen to represent an increased level of risk; a reduction in the indicator implies a decreased risk. Where the indicator can be determined on the basis of purposely-designed household surveys, it is likely to be reliable and few problems in interpretation should occur. Care is needed in comparing between areas, however, because differences in sample design or survey methodology may affect the indicator. Where the indicator is derived indirectly (e.g. from data on service provision), greater caution is necessary for it is not simply the existence of key services, so much as their quality and level of maintenance, that is often most important.
Variations and alternatives	As noted, the main alternative to the proposed indicator is to base it upon the availability of basic services to the home (water, sanitation, waste collection). In this case, two main approaches are possible. All households lacking any one of these services may be considered to be 'at risk'; or alternatively households may be scored depending on the number of services lacking. If the latter approach is used, the indicator should be computed as follows: $100 * \Sigma (Clack_i / Ctot) / Nserv$ where: $Clack_i$ is the number of children living in households lacking service i; *Ctot* is the total number of children; *Nserv* is the number of services considered.
Examples	None known
Useful references	McGranahan G, Leitmann, C. and Surjadi, C. 1997 *Understanding environmental problems in disadvantaged neighbourhoods: broad spectrum surveys, participatory appraisal and contingent valuation.* Stockholm: Stockholm Environment Institute.

CHILDREN AGED 0-14 YEARS LIVING IN AREAS ENDEMIC FOR INSECT-BORNE DISEASES	
GENERAL CONSIDERATIONS	
Issues	Insect-borne diseases
Type of indicator	Exposure (proximal)
Rationale	Insect-borne diseases are a major source of both illness and death amongst children, especially in the developing world. These diseases take many different forms, are transmitted by a wide range of different carrier insects (including mosquitoes and flies), and are associated with a wide range of different environments (though most show a close affinity for water). Young children are especially at risk, because of their poorly developed immunity or defence mechanisms. This indicator is intended to give a measure of the numbers of children at risk on the basis of the population of children living in areas in which the insect vectors are endemic.
Issues in indicator design	This indicator requires the definition of areas in which insect-borne diseases are endemic (i.e. in which transmission is stable) and of the populations living in those regions. Both pose some problems. The areas in which insect vectors are endemic are not always clearly or precisely defined; and though national censuses generally provide relatively reliable measures of population numbers, they may give only partial and inaccurate information in areas subject to population displacement and rapid migration. An age range of 0-14 years is used for this indicator because overall risks to children are not strongly age-dependent.
SPECIFICATION	
Definition	Number of children aged 0-14 years living in areas endemic for insect-borne diseases.
Terms and concepts	***Insect-borne diseases:*** vector-borne diseases for which insects act as a primary agent of transmission; these include malaria, dengue, yellow fever, onchocerciasis, leishmaniasis and trypanosiamiasis. ***Areas endemic for insect-borne:*** geographic areas in which conditions exist to allow the stable transmission of these diseases, from year-to-year. ***Total number of children aged 0-14 years*****:** total resident population of children aged 0-14 years at the time of survey.
Data needs	Extent of area endemic for insect-borne diseases. Distribution and number of children aged 0-14 years.
Data sources, availability and quality	Reliable data on the at-risk population are difficult to obtain, but estimates can be made by analysis of national census data and information on the extent of the vector-borne diseases of interest. Geographic information system (GIS) techniques might usefully be applied in order to estimate the number of people living in the endemic area (e.g. by overlaying boundaries of the infected area on population data). Where data on the extent of the endemic area are not directly available, estimates may be made on the basis of the distribution of potential vector habitats (e.g. using remotely sensed data). Alternatively, they can be modelled using information on climate, land cover and other determinants. In these cases, the endemic area may be defined by buffering around each potential habitat at an appropriate distance

	(depending on the parasite and vector concerned). Data on the total number of children aged 0-14 years can usually be obtained from national censuses and should be reliable. Estimates for inter-censual years (or where census data are not available) may be made using population models or from births and deaths data. In areas subject to major population movements or disruption, population estimates may be unreliable.
Level of spatial aggregation	Region
Averaging period	Annual or longer term
Computation	The indicator can be computed as the children of people living within endemic areas, or living within a specified distance of potential vector habitats. This is usually estimated by intersecting information on the extent of the endemic area for the vector-borne disease of interest, with information on population distribution. The population at risk is then calculated by areal-weighting of the areas of overlap. Thus the number at risk is computed as: *(Aibd / Atot) * Ctot* where: *Aibd* is the area of the study zone that is endemic for the insect-borne disease(s) of concern; *Atot* is the total area of the study zone; *Ctot* is the total number of children in the study zone .
Units of measurement	Number
Worked example	Assume that a vector-borne disease is endemic across an area of 64 000 km^2 within a region of 140 000 km2; assume also that the whole area includes a total of 87 150 children aged 0-14 years. In this case, the value of the indicator in that region is: (64 000 / 140 000) *87,140 = 39835
Interpretation	This indicator provides a general measure of the children at risk from insect-borne diseases: an increase in the numbers of children living in endemic areas may be taken to imply an increased risk, a reduction the reverse. Nevertheless, in interpreting the indicator it is important to take account both of the potential uncertainties in the data, and the possible complexities in the relationship between place of residence and risk. Data on the extent of the endemic area, for example, may be unreliable both because of omission (i.e. exclusion of unknown endemic areas) and commission (inclusion of non-endemic areas). These errors are likely to increase as the scale of mapping becomes smaller (i.e. less detailed). The actual risk across the population living within an endemic area is also likely to vary substantially, depending on local conditions (below the resolution of the available data), socio-economic status and family characteristics. There are, for example, important micro-epidemiological differences in malaria, so that even at the community level the disease may be clustered in certain families. It is also important to remember that children are not static, but move both within and through the area (especially during periods of migration – e.g. due to drought or war). Thus the at-risk population may change over time.
Variations and alternatives	This indicator may be developed either for insect-borne diseases in general or for individual (or specific groups of) insect-vectors and diseases. It can also be applied to other age ranges (e.g. 0-1 years, 0-4 years) and can be

	expressed as a percentage of all children in the country. Where data are available on vector density (e.g. based on field counts of infestations), then the indicator can be defined in terms of the infestation rate, either per unit area or per head of population.
Examples	WHO *Environmental health indicators: framework and methodologies* • **Population at risk from vector-borne diseases**
Useful references	WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide.* AFRO/CTD/MAL/ 94.3. Brazzaville: World Health Organization Regional Office for Africa. WHO 1999 *Environmental health indicators: framework and methodologies.* Geneva: World Health Organization. (Available at http://www.who.int/docstore/peh/archives/EHIndicators.pdf)

MORTALITY RATE OF CHILDREN AGED 0-4 YEARS DUE TO INSECT-BORNE DISEASES

GENERAL CONSIDERATIONS	
Issues	Insect-borne diseases
Type of indicator	Health outcome
Rationale	Insect-borne diseases are a major source of both illness and death amongst children, especially in the developing world. These diseases take many different forms, are transmitted by a wide range of different insects (e.g. mosquitoes, flies) and are associated with a wide range of different environments (though most show a close affinity for water). Young children are especially at risk, because of their poorly developed immunity or defence mechanisms. This indicator is intended to show the impact of insect-borne diseases on children.
Issues in indicator design	This indicator can be designed in many different ways, at different levels of specificity. A major issue is the definition of 'insect-borne diseases'. Common insect-borne diseases include malaria, yellow fever, dengue fever, river blindness (onchocerciasis), filiariasis and sleeping sickness. Many of the most important insect-borne diseases are water-related, in that the insect vectors concerned breed or pass part of their lifecycle in or close to water. Insect-borne diseases have thus been exacerbated in many cases by inappropriate water-engineering (e.g. irrigation) or poor management of water resources and wastes (e.g. poor sanitation). Some insect-borne diseases are also animal-related (e.g. Lyme's disease), in that the insect vectors are associated with specific animal hosts. In these cases, land use and land cover are important factors in their distribution and prevalence. The activity of many insect vectors is dependent on climate, so marked variations may occur geographically, and from year to year, in response to climatic fluctuations. For general, global comparisons, the overall mortality rate amongst children from all forms of insect-borne diseases has some value. For more local application, however, it is usually more appropriate to define the indicator in terms of specific diseases of particular concern. Since young children tend to be the most vulnerable (especially in terms of mortality), the indicator is perhaps best based on the 0-4 year age group (though 0-1 years may be more appropriate in some cases). For some applications, however, it may be extended to include older children.
SPECIFICATION	
Definition	Mortality rate of children aged 0-4 years of age due to insect-borne diseases.
Terms and concepts	***Insect-borne diseases:*** vector-borne diseases for which insects act as a primary agent of transmission; these include malaria, dengue, yellow fever, onchocerciasis, leishmaniasis and trypanosiamiasis. ***Total number of children aged 0-14 years*****:** total resident population of children aged 0-4 years at the time of survey.
Data needs	Number of deaths of children aged 0-4 years due to insect-borne diseases. Total number of children aged 0-4 years.
Data sources, availability and	Data on the number of deaths due to insect-borne diseases can generally be obtained from routine health service sources, either nationally or locally. For some forms of insect-borne disease, mortality statistics are also collated as

quality	part of national or international surveillance programmes. Where routine data do not exist, special surveys may be necessary. In all cases, data may be subject to some uncertainties, due to incomplete or inconsistent reporting as a result both of the complex disease syndromes and limitations in the reporting services. Data on the total number of children aged 0-4 years can usually be obtained from national censuses and should be reliable. Estimates for inter-censual years (or where census data are not available) may be made using population models or from births and deaths data.
Level of spatial aggregation	Health district
Averaging period	Annual
Computation	The indicator can be computed as a simple mortality rate: *1000 * (Dibd / Ctot)* where: *Dibd* is the number of deaths due to insect-borne diseases of children aged 0-4 years within the survey period; *Ctot* is the total population of children aged 0-4 years.
Units of measurement	Number per thousand
Worked example	Assume that during one year 1 320 deaths of children aged 0-4 years due to insect-borne diseases are reported in an area containing 26 630 children aged 0-4 years. In this case, the value of the indicator is: 1 000 * (1 320 / 26 630) = 49.6 per thousand
Interpretation	In general terms, this indicator provides a direct measure of the health effects on young children of insect-borne diseases: an increase in the mortality rate may be interpreted as evidence of an increase in the health impacts, a reduction the reverse. As a mortality indicator, however, it provides information only on the most severe effects of these diseases; it does not show the much larger burden of morbidity which exists. Mortality rates are also highly dependent on the quality of the health care service, and on factors such as remoteness and access to health care. Differences in mortality rate need to be interpreted in this context. When expressed as a general indicator of mortality through all insect-borne diseases, it also has limited interpretability: differences in mortality rates may clearly be due to many different types of vector and disease. For most applications, therefore, the indicator should be applied to a defined set of diseases or vectors. Some problems of data consistency and accuracy may occur, especially in remote or less developed areas where routine reporting is limited. Many insect-borne diseases also show natural periodicity (related, for example, to seasonal or inter-annual fluctuations in the vector population). Short-term trends, therefore, need to be interpreted with caution, and care is needed in inferring effects of intervention strategies over short periods.
Variations and alternatives	The main variations on this indicator relate to the definition of insect-borne diseases. As noted, it may be applied at a more or less specific level, though for most applications it is more appropriate to specify the indicator closely in terms of a single disease or insect vector. The indicator can also be applied to different ages of children (e.g. 0-1 years, 0-14 years), depending on the

	population of concern, and the demographic incidence of the disease. Where an assessment is required of the wider health burden on children, the indicator can be expressed in terms of morbidity or DALYs rather than mortality, though data on morbidity rates are often subject to major uncertainties.
Examples	WHO *Catalogue of health indicators* • **Incidence rate of severe malaria** WHO *Environmental health indicators: framework and methodologies* • **Mortality due to vector-borne diseases**
Useful references	WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide*. AFRO/CTD/MAL/ 94.3. Brazzaville: World Health Organization Regional Office for Africa. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO programmes*. Geneva: World Health Organization (under revision). WHO 1999 *Environmental health indicators: framework and methodologies.* Geneva: World Health Organization. (Available at http://www.who.int/docstore/peh/archives/EHIndicators.pdf)

PREVALENCE OF INSECT-BORNE DISEASES IN CHILDREN AGED 0-14 YEARS	
GENERAL CONSIDERATIONS	
Issues	Insect-borne diseases
Type of indicator	Health outcome
Rationale	Insect-borne diseases are a major source of both illness and death amongst children, especially in the developing world. These diseases take many different forms, are transmitted by a wide range of different insects (e.g. mosquitoes, flies) and are associated with a wide range of different environments (though most show a close affinity for water). Young children are especially at risk, because of their poorly developed immunity or defence mechanisms. This indicator is intended to show the impact of insect-borne diseases on children.
Issues in indicator design	This indicator can be designed in many different ways, at different levels of specificity. A major issue is the definition of 'insect-borne diseases'. Common insect-borne diseases include malaria, yellow fever, dengue fever, river blindness (onchocerciasis), filiariasis and sleeping sickness. Many of the most important insect-borne diseases are water-related, in that the insect vectors concerned breed or pass part of their lifecycle in or close to water. Insect-borne diseases have thus been exacerbated in many cases by inappropriate water-engineering (e.g. irrigation) or poor management of water resources and wastes (e.g. poor sanitation). Some insect-borne diseases are also animal-related (e.g. Lyme's disease), in that the insect vectors are associated with specific animal hosts. In these cases, land use and land cover are important factors in their distribution and prevalence. The activity of many insect vectors is dependent on climate, so marked variations may occur geographically, and from year to year, in response to climatic fluctuations. For general, global comparisons, the overall mortality rate amongst children from all forms of insect-borne diseases has some value. For more local application, however, it is usually more appropriate to define the indicator in terms of specific diseases of particular concern. Since infection by insect-borne diseases is often life-long if not treated, the proposed age range for this indicator is 0-14 years. For some applications, however, it may be restricted to a narrower age range (e.g. 0-4 years).
SPECIFICATION	
Definition	Numbers of children aged 0-14 years infected with insect-borne diseases.
Terms and concepts	***Insect-borne diseases:*** vector-borne diseases for which insects act as a primary agent of transmission; these include malaria, dengue, yellow fever, onchocerciasis, leishmaniasis and trypanosiamiasis. ***Total number of children aged 0-14 years*:** total resident population of children aged 0-14 years at the time of survey.
Data needs	Numbers of children aged 0-14 years diagnosed with insect-borne diseases at the time of survey. Total number of children aged 0-14 years.

Data sources, availability and quality	Data on the numbers of children infected with insect-borne diseases may be obtained from a range of sources, including routine health surveillance systems, special surveys and sentinel disease monitoring systems. In many countries, at least for some insect-borne diseases, these systems are relatively well-established and data are collated and integrated at the international level. In more remote areas, however, monitoring and reporting may be less reliable – and all data are subject to considerable uncertainties (e.g. due to under-reporting, misdiagnosis or incomplete data collation at the regional or national level). Data may also not always be collected and reported by age. Data on the total number of children aged 0-14 years can usually be obtained from national censuses and should be reliable. Estimates for inter-censual years (or where census data are not available) may be made using population models or from births and deaths data.
Level of spatial aggregation	Health district
Averaging period	Annual
Computation	The indicator can be computed as a simple mortality rate: *1000 * (Mibd / Ctot)* where: *Mibd* is the number of reported cases of insect-borne diseases of children aged 0-14 years within the survey period; *Ctot* is the total population of aged 0-14 years.
Units of measurement	Number per thousand
Worked example	Assume that during one year 3 940 cases of insect-borne diseases of children aged 0-14 years due to insect-borne diseases are reported in an area containing 40 530 children aged 0-14 years. In this case, the value of the indicator is: 1 000 * (3 940 / 40 530) = 96.5 per thousand
Interpretation	In general terms, this indicator provides a direct measure of the health effects on children of insect-borne diseases: an increase in the prevalence rate may be interpreted as evidence of an increase in the health impacts, a reduction the reverse. Like all morbidity indicators, however, it is likely to be subject to considerable uncertainties in the data. For these reasons, minor variations or differences in the indicator should be interpreted with caution, and great care is needed when comparing different areas with different health surveillance systems. When expressed as a general indicator of morbidity for all insect-borne diseases, it also has limited interpretability: differences in prevalence rates may clearly be due to many different types of vector and disease. For most applications, therefore, the indicator should be applied to a defined set of diseases or vectors. Many insect-borne diseases also show natural periodicity (related, for example, to seasonal or inter-annual fluctuations in the vector population). Short-term trends, therefore, need to be interpreted with caution, and care is needed in inferring effects of intervention strategies over short periods.

Variations and alternatives	The main variations on this indicator relate to the definition of insect-borne diseases. As noted, it may be applied at a more or less specific level, though for most applications it is more appropriate to specify the indicator closely in terms of a single disease or insect vector. The indicator can also be applied to different ages of children (e.g. 0-1 years, 0-4 years), depending on the population of concern, and the demographic incidence of the disease. Where an assessment is required of the wider health burden on children, the indicator can be expressed in terms of DALYs (in association with mortality data).
Examples	WHO *Catalogue of health indicators* • **Incidence rate of severe malaria**
Useful references	WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide*. AFRO/CTD/MAL/ 94.3. Brazzaville: World Health Organization Regional Office for Africa. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO programmes*. Geneva: World Health Organization (under revision).

AT-RISK CHILDREN AGED 0-14 YEARS COVERED BY EFFECTIVE, INTEGRATED VECTOR CONTROL AND MANAGEMENT SYSTEMS	
GENERAL CONSIDERATIONS	
Issues	Insect-borne diseases
Type of indicator	Action
Rationale	Control of vector-borne diseases requires a varied and integrated approach. Prevention depends upon the implementation of appropriate development and land use strategies, which can reduce the extent of habitats for the disease vectors, or at least separate them effectively from human populations. Vector control programmes are needed to reduce or eliminate vector species (e.g. through use of insecticides). Treatment requires the existence of effective surveillance systems and treatment programmes, supported by adequate drug supplies. Programmes are needed to monitor drug and insecticide resistance. Education is also needed to help those concerned reduce their risks of exposure, recognize the symptoms of infection and follow the prescribed treatments effectively. This indicator is intended to evaluate the effectiveness of the available prevention, control and treatment systems.
Issues in indicator design	This indicator can be defined and assessed in various ways. Possibly the most feasible and informative in many situations is to determine the percentage of children at-risk who are covered by effective and integrated vector prevention, control and treatment systems, by disease type. This requires the ability to define and recognize the existence and extent of effective programmes. As alternatives, the indicator might be separately defined for different types of programme (e.g. prevention, control, treatment), or by disaggregating these programmes into their constituent activities. Where treatment, rather than control, is the main focus of interest, an indicator might be developed to assess the number of treatment centres specifically equipped to deal with the vector-borne diseases of interest per thousand children at risk. In this case, treatment centres might be defined in terms of the availability of trained staff and continuous and adequate supplies of drugs. Alternatively, an indicator could be defined in terms of the proportion of the at-risk population inoculated against infection. Where avoidance and control are the focus of attention, an indicator might be developed in terms of either: a) the number of children living in endemic areas (a measure both of exposure and of the effectiveness of actions taken; or b) the area of endemic land which has been cleared of the disease vector. An age range of 0-14 years is used for this indicator, since treatment needs to be available across the age range, in order to deal with chronic as well as acute infections.
SPECIFICATION	
Definition	Percentage (or number) of at-risk children covered by effective, integrated vector control and management systems.
Terms and concepts	***Vector-borne disease***: a disease which is transmitted by a biological agent (e.g. insects, snails, worms). ***Integrated vector control and management programme***: a programme

	which is explicitly designed and implemented to control, manage and monitor vector-borne diseases at all relevant points of control, in a co-ordinated and integrated manner. Such programmes typically include actions to manage or remove habitats of the vector species, to control the vector species directly (e.g. by pesticides or biological controls), to educate and inform those most at risk, to provide early treatment to those at risk or affected, and to monitor the disease vectors (including their resistance to insecticides, drugs etc) and the effectiveness of the control programmes. Such programmes should usually include all of the following components: • *Vector control programme*: **a specific programme aimed at controlling the disease vectors, for example by use of pesticides, by introduction of biological controls (e.g. natural predators), habitat removal or by habitat management.** • *Development controls*: **specific controls on developments aimed at avoiding the construction of potential habitats for vectors. These might include the need for impact assessment as part of the development process, or the enforcement of specific design standards for developments.** • *Vector-borne disease surveillance programme*: **a system or programme for the routine monitoring and reporting of vector-borne diseases, operating over a sufficient geographic area, and at a sufficient frequency, to identify local/regional and short-term variations in disease incidence and prevalence.** • *Education programme*: **a programme of education and awareness raising, aimed at improving public understanding of the risks of vector-borne diseases, and the avoidance/treatment strategies which individuals should adopt.** • *Treatment programme:* **a specific programme of health care, aimed at early and effective treatment of the disease. This should include the availability of trained personnel with sufficient and continuous supplies of relevant drugs, with easy access to those at risk.** • *Children at risk*: **children at risk from vector-borne disease, by virtue of living in an infected area.** • ***Children covered by an effective integrated vector-borne disease control and management systems*: children living in areas where each of the above types of programme is in place and operational.**
Data needs	Number of children aged 0-14 years at-risk. Number of children aged 0-14 years covered by effective vector control systems.
Data sources, availability and quality	Reliable data on the at-risk population are difficult to obtain, but estimates can be made by analysis of national census data and information on the extent of the vector-borne diseases of interest. Where data on the extent of the endemic area are not directly available, estimates may be made on the basis of the distribution of potential vector habitats (e.g. using remotely sensed data). GIS techniques might usefully be applied in order to estimate the number of people living in the endemic area. Information on the extent and scope of management and control systems can best be obtained by examining relevant legislation and through direct contact with the health or other officials concerned. Where relevant data are not available, questionnaire surveys of relevant officials may be used.
Level of spatial aggregation	Region

Averaging period	Annual or longer term
Computation	The indicator can be computed as a simple percentage: *100 * (Cprog / Ctot)* where: *Cprog* is the number of children aged 0-14 years covered by an effective, integrated programme of vector-borne disease control and management; *Ctot* is the total number of children aged 0-14 years at risk from vector-borne diseases.
Units of measurement	Percentage
Worked example	Assume that a country contains 1 600 000 children aged 0-14 years at risk from vector-borne diseases; assume further that effective, integrated vector control and management systems are in place, covering 730 000 of these children. In this case, the value of the indicator is: 100 * (730 000 / 1 600 000) = 45.6%
Interpretation	This indicator provides a general measure of the adequacy and effectiveness of the actions taken to control and treat vector-borne diseases (including insect-borne diseases). In general, an increase in the percentage of at-risk children covered by these programmes, the more effective the actions. As with all action-based indicators, however, it is important to make a distinction between the existence of strategies or programmes and their impact on the ground. For this reason, the indicator is best interpreted in association with indicators of effect (e.g. the mortality rate due to vector-borne diseases) or exposure (e.g. the number of children at risk).
Variations and alternatives	This indicator can be further refined in a number of ways. One approach is to score vector-borne disease control programmes according to their degree of effectiveness: for example, one point might be given for each of the five components outlined above. In this case, the indicator can be computed as the product of the programme score (from 0 to 5) and the percentage of people covered: $\Sigma (Eprog_i * Cprog_i) / Ctot$ where: E_i is the effectiveness score for programme *i*; $Cprog_i$ is the number of children aged 0-14 years covered by that programme; *Ctot* is the total number of children aged 0-14 years in the area. The indicator may also be designed in relation to specific vectors or diseases or only to insect-borne diseases; these are, however, less preferable because they tend to diminish the importance of proper integration of vector-borne disease control programmes, across all vectors and diseases. They may also be based on different age ranges of children, as appropriate.

Examples	WHO *Catalogue of health indicators* • **Availability of anti-malaria drugs in health facilities** WHO *Environmental health indicators: framework and methodologies* • **Adequacy of vector control and management programmes**
Useful references	WHO 1994 *Information systems for the evaluation of malaria control programmes, a practical guide*. AFRO/CTD/MAL/ 94.3. Brazzaville: World Health Organization Regional Office for Africa. WHO 1996 *Catalogue of health indicators: a selection of health indicators recommended by WHO programmes*. Geneva: World Health Organization (under revision). WHO 1999 *Environmental health indicators: framework and methodologies*. Geneva: World Health Organization. (Available at http://www.who.int/docstore/peh/archives/EHIndicators.pdf)