SUMMARY

Making a Difference:

Indicators to Improve Children's Environmental Health

WORLD HEALTH ORGANIZATION
2003

Making a difference : indicators to improve children's environmental health: prepared by David Briggs.

1.Environmental health 2.Environmental exposure 3.Health status indicators
4.Child 5.Infant 6.Risk factors 7.Models, Statistical I.Briggs, David J. II.Title:
Indicators to improve children's environmental health : summary.

ISBN 92 4 159060 2 (NLM classification: WA 30)

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Printed in France

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Indicators to Improve Children's Environmental Health

SUMMARY

Prepared on behalf of the World Health Organization

by

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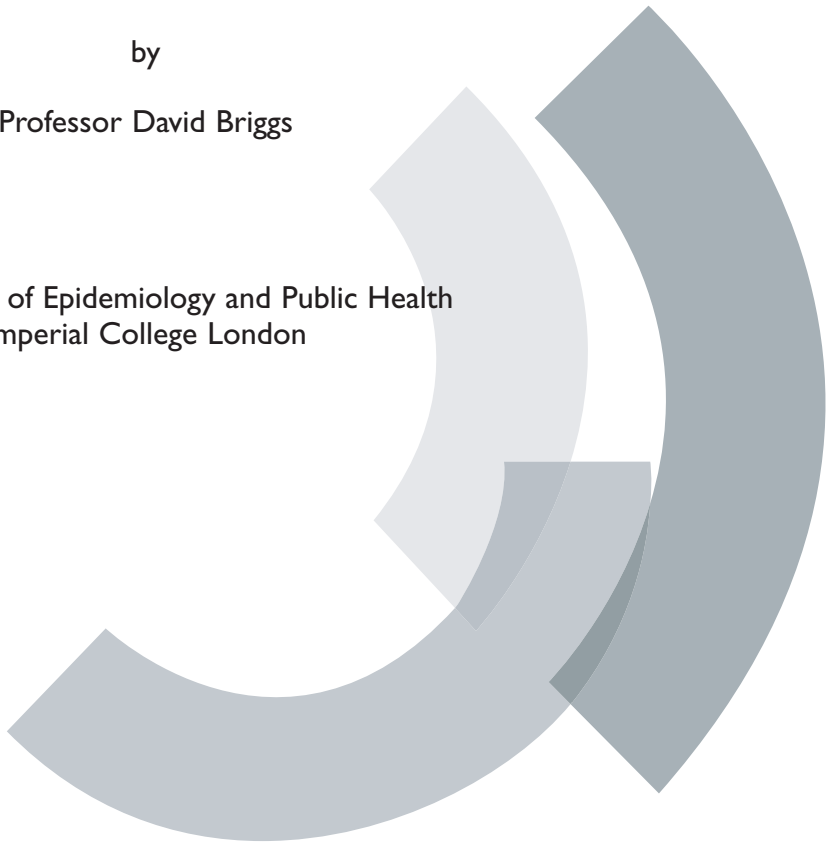

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INTRODUCTION

Over the last ten years considerable effort has been devoted to developing environmental health indicators to support policy. In only a few cases, however, can the material effects of these indicators, in terms of reduced health inequalities or mortality rates, be seen. In many cases this is because the problems that face us are intractable and complex. In many instances it is because the problems have long latency times, so that it will take many years for the effects of interventions to become detectable. In some cases, too, it is because the indicators themselves have not been especially relevant or applicable.

Now, increasingly, recognition is growing that our first priority should be the very young. They are the future, but they also bear the burden of many of our failures and mistakes both now and in the past. The young have no voice nor power to control their own lives. And the young cannot wait. For them, therefore, the need for effective indicators is especially acute. We need to make progress quickly. We need to develop indicators that can truly make a difference, by focusing the minds and efforts of all those concerned on the plight of children, that we currently still neglect.

As a step in this direction, the World Health Organization commissioned a study to develop a set of indicators on children's environmental health with the purpose of:

- providing a basis for assessing environmental risks to children's health, in order to help prioritize policy at national and global level;
- acting as a basis for monitoring and evaluating the effectiveness of national and international initiatives to reduce environmental health risks for children;
- providing a template for developing other indicators, according to need, to address issues of specific local or national concern.

This summary provides an introduction to these indicators. It outlines the principles and concepts behind the choice of indicators, presents simplified models of each issue highlighting the key factors of concern, and lists the core indicators that should be developed in each case. Further details are provided in the full report[1].

CONCEPT AND PRINCIPLES

All lives matter, and risks that endanger any life either in terms of quality or duration should always be a matter of concern. But if we are to see some people and some risks as more important than others, then surely our main concern should be for the very young. This is not only because these are generally the most vulnerable and least able to help themselves, but also because it is often the events that happen in childhood that shape the rest of people's lives. Intervention early in life can thus have lifelong benefits not just for individuals but for society as a whole.

Early intervention, however, requires rapid recognition of what needs to be done by those whose decisions control children's worlds. This means not only those directly involved with children and their well-being, such as parents, teachers and medical professionals, but also the myriad of policy-makers, planners, business people, property owners and community leaders whose actions control the environment in which children grow up and live.

[1] World Health Organization. Making a difference: indicators to improve children's environmental health. Geneva: World Health Organization, 2003.

For the environment is crucial. Not everything that relates to health can be attributed to the environment, for genetics, culture, lifestyle and chance all play major parts. Each of these, however, acts out its role on a wider stage — within a social and physical context. Each is also to some extent shaped by that context. So the environment within which children find themselves exerts a major influence on their well-being and destiny. It is both enabler and hazard. It provides the resources needed to allow children to grow and develop in safety and security, and it is the source (or at least the pathway) for many of the factors that threaten their survival and health. In many ways, in many areas of the world (but especially in developing countries), the best way to intervene is thus through improving children's environmental health — by enhancing the social and physical world in which they play out their lives.

The need for information

Action, however, requires information. Providing information to policy-makers and others whose decisions determine the state of the environment and its potential effects on health is therefore crucial if we are to make a difference to the quality of children's lives. If this information is to have the force to shake these people into action, it also needs to be clear, concise and powerful. If it is to stand up against the counter-force of complacency, cynicism or scientific doubt, it also needs to be well-founded and testable.

Indicators, environment and health

One way of providing this information is in the form of indicators. The use of indicators, in all sorts of areas of application, has expanded rapidly in recent years — though, sadly, the concepts and principles underlying them have not always been well thought-out. Indicators, however, are what the name implies: measures that indicate things (conditions, problems, trends) that we cannot otherwise quantify or describe.

In the case of environmental health, the indicators that are most relevant are those that represent the link between environment and health. This link can be looked at in two ways: 'backwards' from health to environment, or 'forwards' as the link from environment to health. The former focuses on the environmental contribution to the health outcome of concern; the latter considers the potential risks to health from exposures to a specific environmental hazard.

Where we are also concerned with policies, however, a further link is also of interest — that with the actions taken to reduce these risks. Interventions of this sort can, in fact, be targeted either at the health outcome or at the environmental hazard. The former tries to mitigate the health impacts (e.g. by providing treatment and access to health care); the latter tries to avoid problems by reducing exposures to environmental hazards.

There, too, this link is bi-directional. We can use indicators of health risks or attributable effects to deduce the need for intervention. Or we can look for the effects of policy interventions on either the environment (e.g. in terms of levels of environmental pollution) or on health outcome (e.g. disease rates).

The DPSEEA framework

These links between environment, health outcome and actions provide a useful and powerful way of considering problems of environmental health, and various ways have been developed to present them as a framework for developing and using environmental health indicators. One such framework is DPSEEA (pronounced 'Deepsea'), proposed some years ago by Corválan and colleagues[2]. This defines driving forces (D), that lead to pressures on the environment (P), which in turn change the state of the environment (S), resulting in human exposures (E1) and thence to health effects (E2). Actions (A) may then be taken at any point in this chain to mitigate or avoid unwanted health effects.

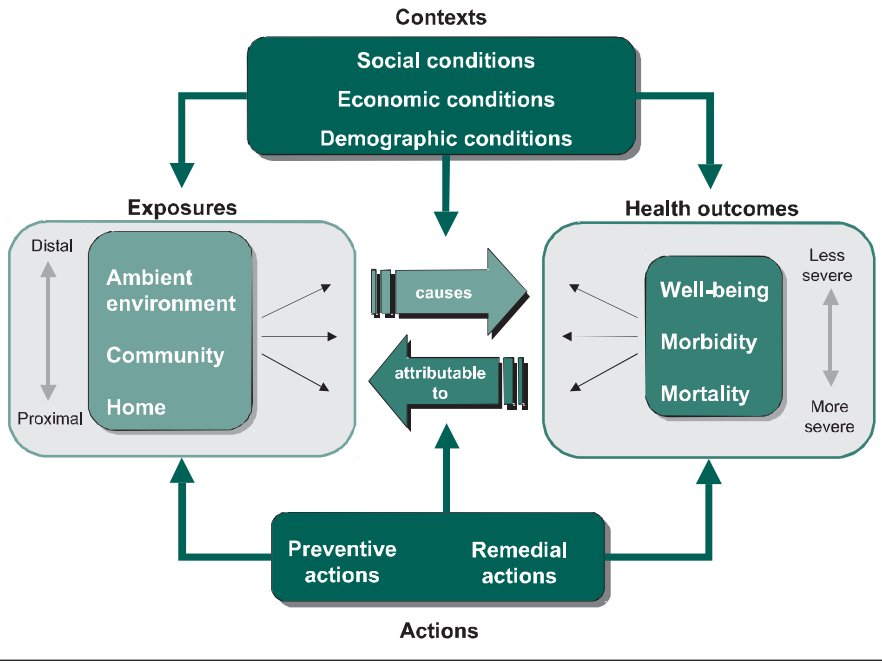
[2] Corválan C, Briggs D, and Kjellstrom T. Development of environmental health indicators. In: Linkage methods for environment and health analysis. General guidelines. (D Briggs, C Corvalan, M Nurminen, eds.). Geneva, UNEP, USEPA and WHO, 1996:19–53.

The DPSEEA model has much to commend it, and it has been widely adopted across the world. It was conceived, however, primarily to describe associations between ambient environmental pollution and health. It is far less appropriate when used in relation to other sorts of environmental hazard (such as natural hazards, vector-borne diseases or physical accidents), or in other environments of exposure (such as the home). For children, these hazards and environments of exposure are, in fact, especially important. Children spend a large proportion of their time at home — typically in the order of 80% or more when very young. There they are subject to a wide range of hazards, in addition to pollution. These hazards, also, do not work in isolation, nor do they lead only to singular and specific health effects, as sometimes implied (although not intended) by the DPSEEA model. Instead they act in consort. Individual health effects can therefore often be traced back to a wide variety of different exposures and causes — some more immediate or proximal, others more remote or distal. Likewise, individual exposures can lead to a wide array of health effects, varying both in their intensity and immediacy. If we are to encapsulate all this within a framework for indicator development, therefore, we need a rather more flexible model than DPSEEA provides.

The MEME model

The MEME model (Multiple Exposures — Multiple Effects), shown in Figure 1, is designed to do this. As befits its name, it emphasizes the divergent, multiple links between exposure and health effects. On the environmental side, it recognizes a spectrum of exposures, from more proximal to more distal, which can occur in a number of different settings – in the case of children, in the home, the community and the wider, ambient environment. On the health side it recognizes that effects may be expressed in different ways, and at different levels of severity (e.g. as morbidity or mortality). In addition, it recognizes that both exposures and health outcomes may be affected by more remote, contextual factors, such as social conditions, demographics and economic development that influence the susceptibility of the population to environmental health effects. As with the DPSEEA model, actions are seen to be taken either to remediate disease or, preventatively, to avoid it by reducing exposures in the environment. In the longer term, actions may also be targeted at the underlying factors — for example, by trying to alleviate poverty or enhance development. This is the model that is used here as a basis for developing indicators for children's environmental health (see Annex).

Figure 1. The MEME model



Focusing on what matters

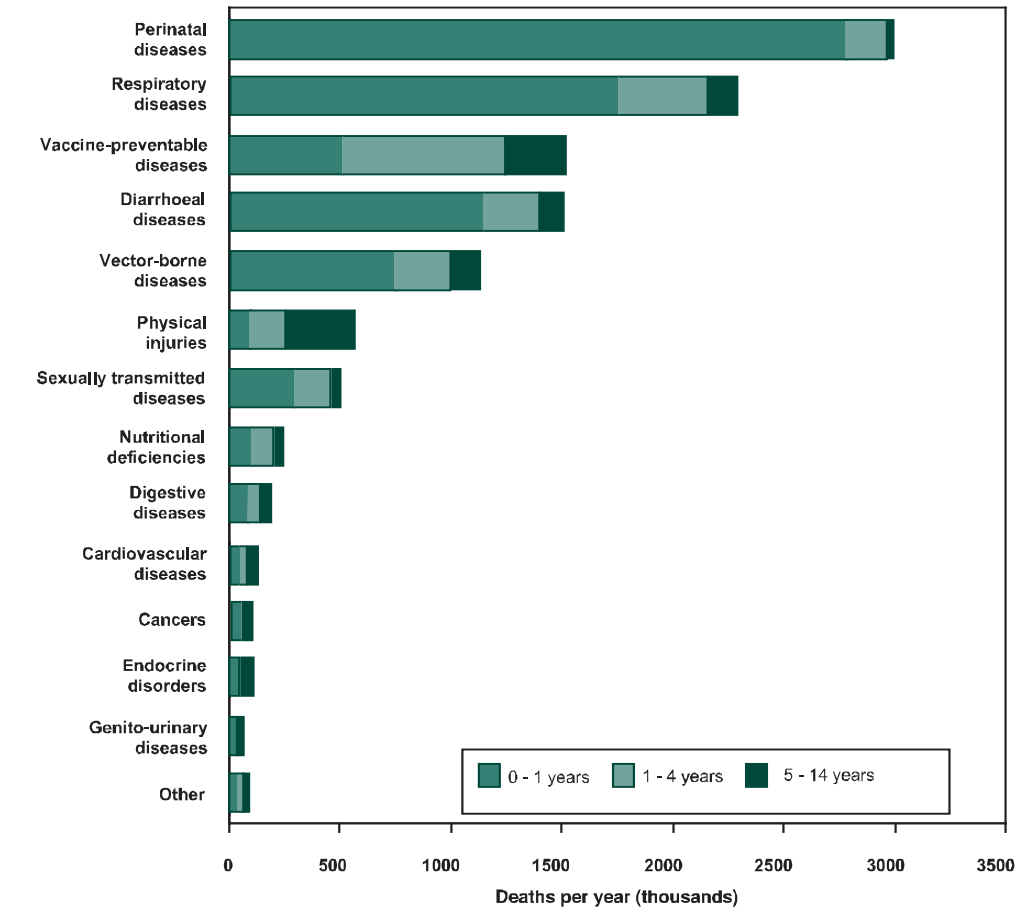
If the world is such a hazardous place, we clearly need to prioritize. Indeed, one of the main purposes of indicators is to help us decide what matters most, and how to respond. Yet no indicator can tell us all we need to know about children's environmental health, nor can we develop indicators of everything. Some sort of pre-selection is essential.

The most obvious way is in terms of the burden of disease. Global estimates of the burden of disease are already available, derived from an analysis of national statistics and research studies (Figure 2). Both the data and the science behind these estimates are admittedly approximate, but such is the scale of illness in the world that these uncertainties count for little. The major causes of death and illness – and thus the major focus of our concern — are all too evident. They dominate the statistics. Though they can be categorized in different ways, five main groups of disease demand attention:

- Perinatal illnesses — including low birthweight, stillbirths and congenital malformations.
- Respiratory diseases — including pneumonia, tuberculosis and asthma.
- Diarrhoeal diseases — including rotavirus infections, E. coli infections and cholera.
- Insect-borne diseases — especially malaria.
- Physical injuries — including traffic accidents, poisonings, drowning, falls and burns.

Together, these kill some 8.5 million children below the age of fifteen every year, of whom about 90% are under the age of five. These are therefore the main diseases for which indicators are developed here.

Figure 2. The global burden of childhood disease



THE INDICATORS

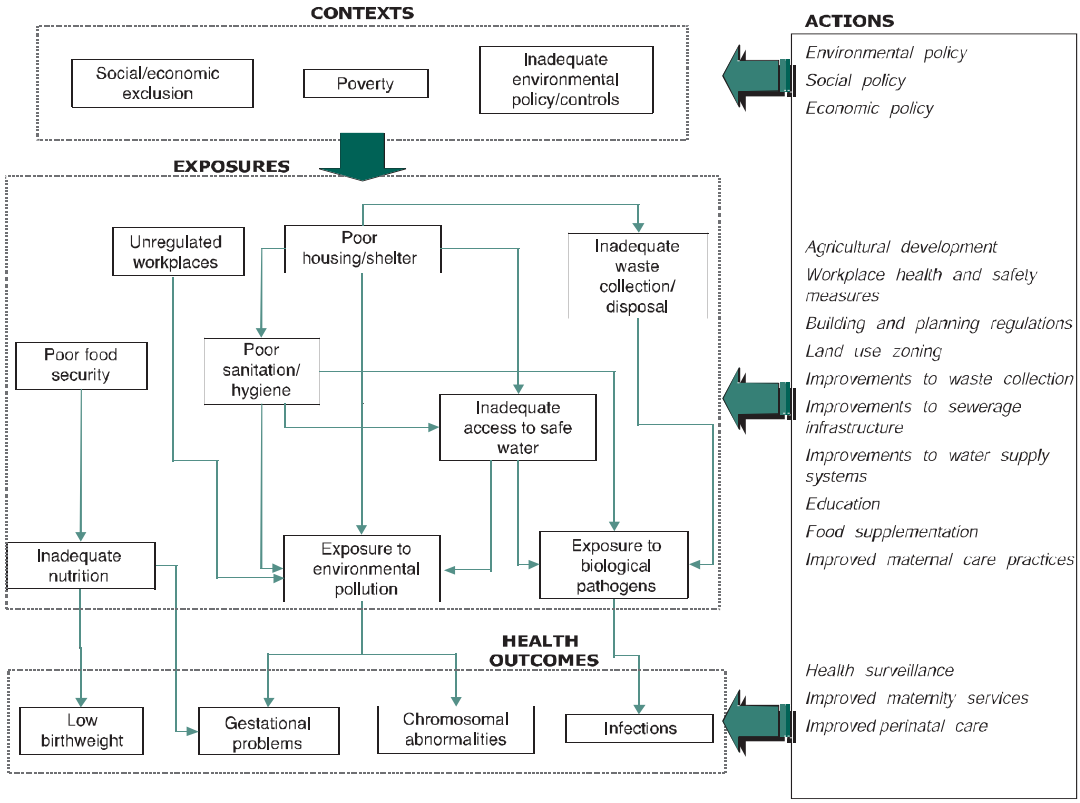
Perinatal diseases

Perhaps more than at any other time in their lives, children are at risk during the period immediately prior to, and soon after, birth. Perinatal diseases thus represent one of the major causes of loss of life and illness among children, worldwide. Definitions of perinatal diseases vary from country to country, but WHO defines them as those that occur between the 22nd week of gestation and the end of the first week after birth. They take many different forms. Globally, the main contributors to ill-health or death are gestational problems (e.g. prematurity, post-prematurity and stillbirths), intrauterine growth retardation, neonatal infections (e.g. sepsis, pneumonia), fetal blood loss, physical injuries before or during birth (e.g. asphyxia or birth trauma) and chromosomal conditions (Figure 3).

Various environmental factors contribute to these health effects. The main concerns focus on maternal exposures, care practices and nutrition during the prenatal period, and conditions in the home in the days immediately following childbirth. More remotely, important risk factors include famine, poor housing and poverty.

Action to reduce these risks thus includes interventions targeted both at improving health care for pregnant women and mothers, and improving the environment into which children are born (especially in terms of the home and nutrition).

Figure 3. Perinatal diseases

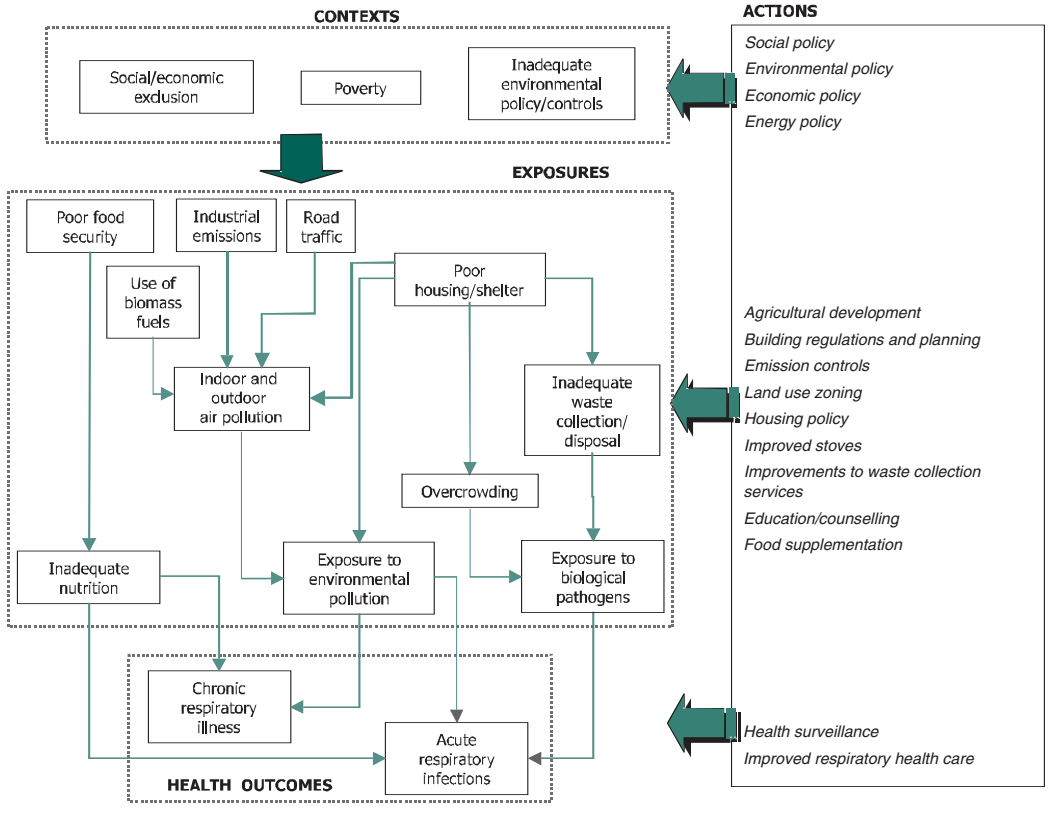


Respiratory diseases

After perinatal diseases, respiratory illness represents the most important source of ill-health and mortality among young children. Figure 4 summarizes the main risks and effects. Acute respiratory infections (ARI) tends to be the main concern, and takes many forms. Globally, bacterial pneumonia is the most important form, but viral infections, measles, whooping cough, and a wide range of allergies (e.g. rhinitis) are also widespread. Chronic respiratory illness is also a growing problem in many parts of the world, however, in part as a result of exposures to ambient and indoor air pollution.

Many different environmental risk factors are implicated in these diseases. Some, such as the bacteria causing pneumonia, are more-or-less ubiquitous; risks are therefore dependent mainly on the ability of children or their mothers to resist infection. As well as genetic factors and general state of health, social and environmental conditions may be important in this respect. Inadequate diet, poor housing and overcrowding may all work to reduce resistance. Because children spend most of their time at home, indoor exposures to air pollution are also extremely important. Not all indoor exposures derive from indoor emission sources, but burning of biomass fuels (especially in poorly ventilated fires or stoves), and environmental tobacco smoke, are often major culprits. Poor housing, inadequate waste management and poor regulation of emissions from industry and road traffic are all important, albeit more distal, causal factors. As with most forms of childhood illness, poverty is also a major risk factor.

Figure 4. Respiratory diseases



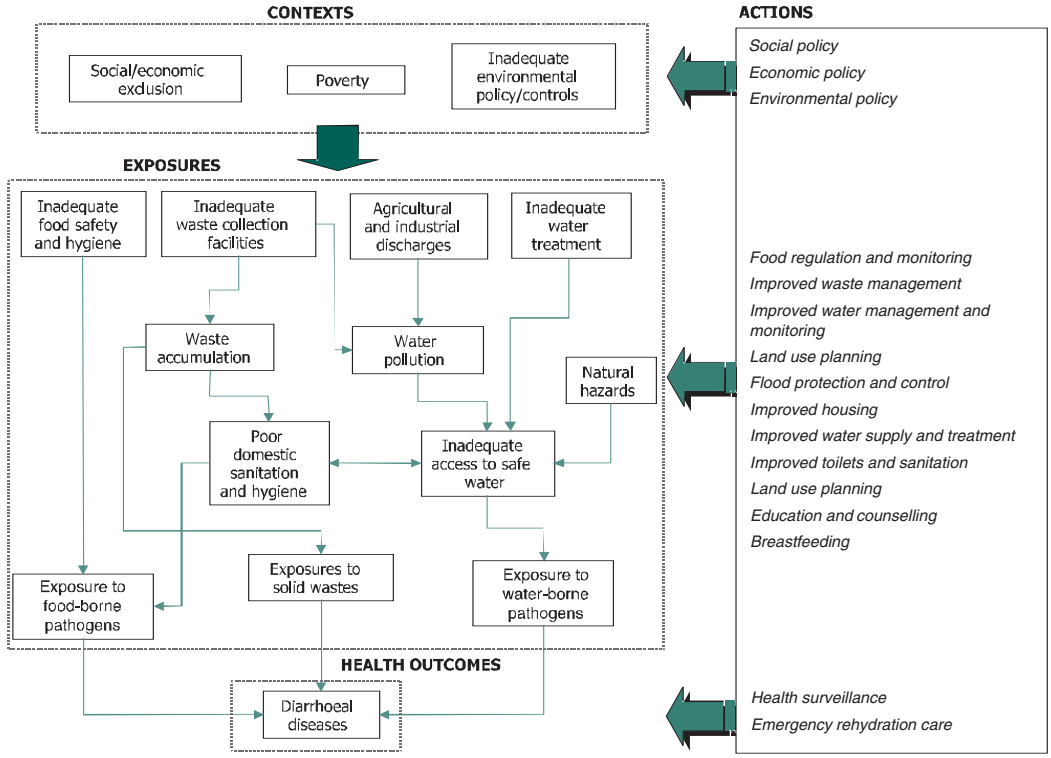
Diarrhoeal diseases

Diarrhoeal diseases are a worldwide problem. Like most other diseases of children, however, they are far more prevalent in the developing world than they are in developed countries — 12.5 times more so in the case of mortality[3]. Children below the age of five are especially susceptible, and amongst the many forms of disease that they may encounter, by far the most severe, in terms of their clinical manifestations, are cholera, rotavirus infections and dysentery.

Major pathways of infection are via human or animal faeces, food, water and human contact (Figure 5). Poor domestic sanitation and hygiene, lack of safe drinking water, and exposures to solid wastes (e.g. through waste picking or waste accumulation in the neighbourhood) are therefore all important risk factors. These, in turn, are often associated with poor facilities for waste and water management, lack of adequate safety procedures within the food supply system (e.g. during livestock management, food storage and retailing), and inadequate control of environmental pollution (e.g. by agricultural wastes). Epidemics may also occur as a result of major pollution episodes or natural disasters, such as floods. Beyond these lie many of the more generic causes of ill health in children — poverty, social exclusion and poor environmental policies and controls.

Actions to mitigate risks from diarrhoeal diseases obviously need to be targeted at the underlying environmental and social problems that create the conditions for disease. Improvements to water supply, sanitation, waste management and food hygiene thus need to take precedence. By the same token, education in personal and food hygiene are important measures to reduce risks. In the short term, however, there is also a need to deal with more immediate crises. Diarrhoea death rates can be greatly reduced by ensuring that oral rehydration therapy is quickly applied.

Figure 5. Diarrhoeal diseases



[3] Based on EIP/WHO. Mortality Data 2000, version 2 (unpublished).

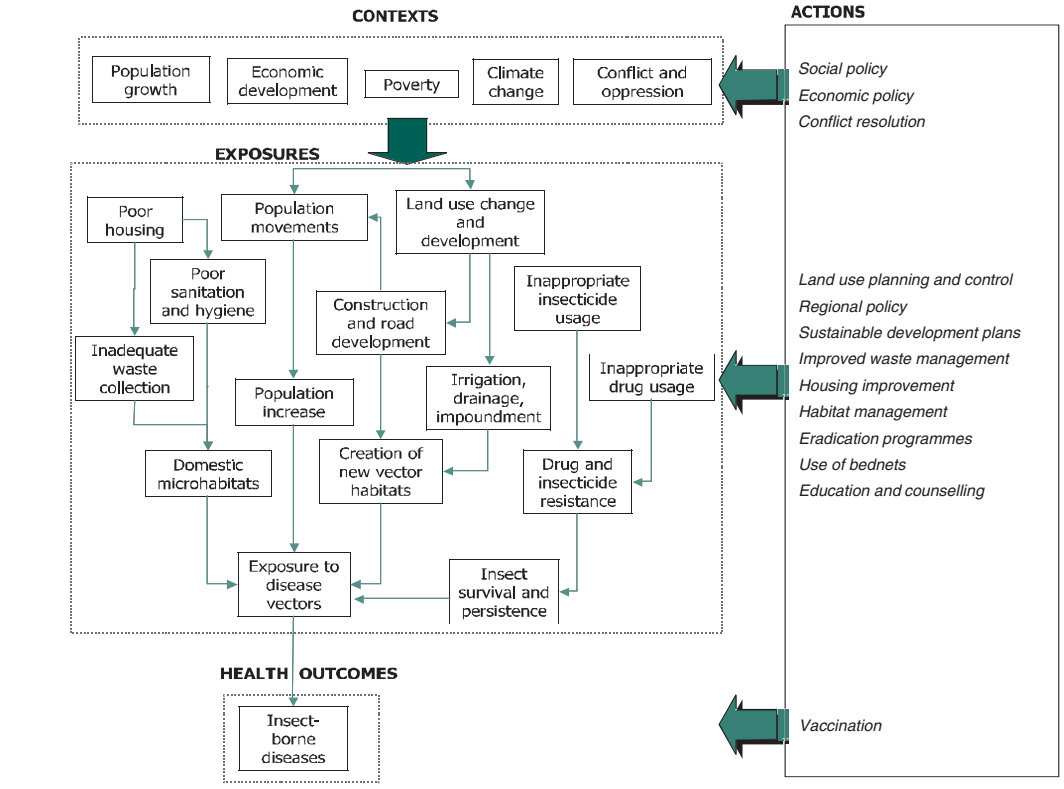
Insect-borne diseases

A wide range of insect-borne diseases threaten children. Dengue, onchocerciasis, leishmaniasis and sleeping sickness all take a large toll. In terms of children especially, however, by far the greatest cause for concern is malaria.

Although many different insects may be involved in disease transmission, the mosquito carries the major share of blame — though, in truth, mainly as an innocent agent of human folly. For while the distribution of these carriers determines to a large extent the distribution and intensity of these diseases, their own distribution and spread is determined primarily by the availability of hosts and habitats. And these, in turn, are governed by human action (Figure 6). Land use change, irrigation, drainage, water development, road development and forest clearance have created new habitats for mosquitoes and other insect vectors in some areas, and helped the diseases themselves to spread. Loss of impetus in control programmes has enabled diseases to regain a hold in areas from which they had previously been eradicated. Poor housing, inadequate waste management, domestic water storage, and ineffective sanitation and hygiene all contribute to risks of infection. Famine, war, oppression and development have also acted as forces for displacement, driving or drawing populations from non-endemic into endemic areas. In the longer term, climate change may add to these problems, by further encouraging shifts in the insect vectors, and mass human migration. For tomorrow's children as much as those of today, therefore, the prognosis remains bleak.

The distribution of insect-borne diseases, more generally, is dependent on the availability and extent of suitable habitats. As noted, these are widely influenced by land use practices and development. The availability of domestic micro-habitats in which the insects can breed, feed and take refuge are likewise important. And, more remotely, factors such as housing conditions, overcrowding, population growth and climate change also have an effect.

Figure 6. Insect-borne diseases



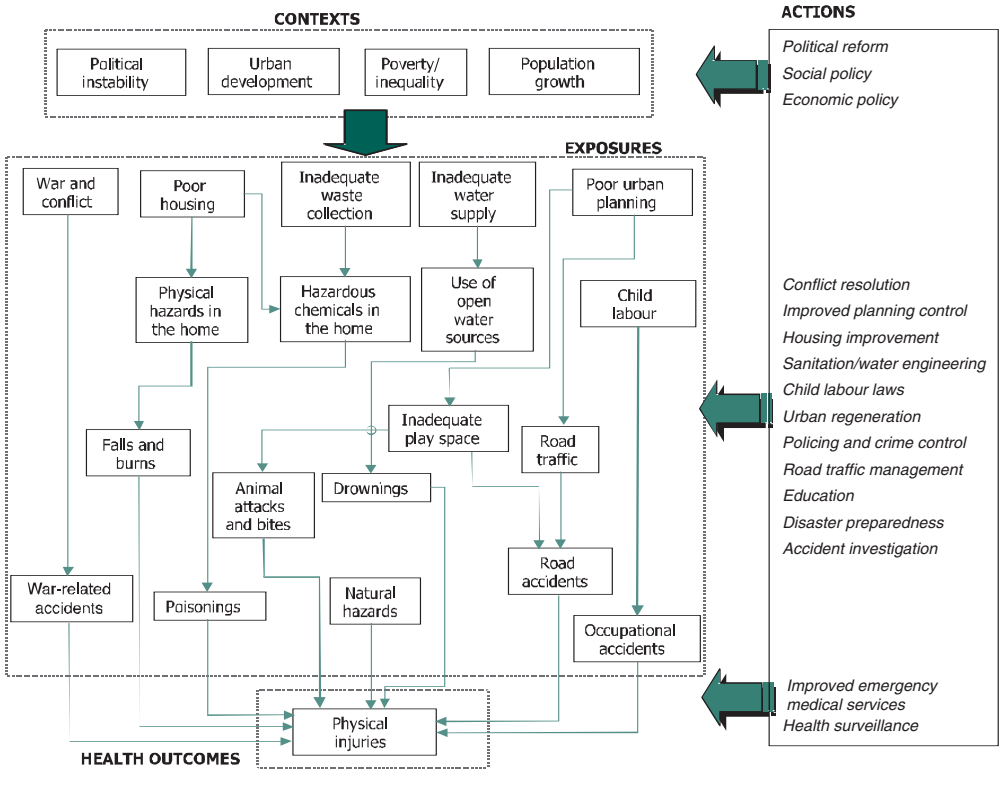
Three main approaches can be distinguished to the control of insect-borne diseases. The first is through habitat control, with the intention of reducing opportunities for breeding and transmission. The second is through the use of pesticides or other methods to eliminate the insects themselves (though these can pose health risks in their own right). The third is via vaccination of populations at risk. All three, to varying degrees, may be necessary and effective. The best strategies, however, are likely to be integrated measures that combine some element of all three.

Physical injuries

Of all forms of illness, injuries to children are perhaps the most pernicious. At best, they reflect individual or collective neglect; at worst, they are the product of deliberate and callous abuse. Injuries occur for many reasons, and take many forms. They include drownings, road accidents, falls and burns, accidental poisonings and injury by natural events such as earthquakes or storms. Often these may seem to be chance occurrences, and therefore excusable. In the case of some natural hazards, this may be largely true. More frequently, however, though chance plays some part in the timing or location of specific events, deeper social or environmental causes are at work, which are at least in part preventable. Avoidable risk factors, typically, are poor housing, lack of adequate play space, child labour, and exposures to wastes and chemicals (Figure 7). Reducing risks of unintentional injuries is therefore largely a matter of effective planning and education: planning to create environments in which children can live and play in safety; education to help them and the adults on whom they rely better to understand the hazards that exist.

Actions to reduce these risks are varied. General policies aimed at reducing poverty and improving living conditions are certainly important. Many of the most effective measures are, however, more specific. They include actions to reduce road traffic speeds, to make packaging of hazardous chemicals clearer and safer, to limit use of child labour, to improve housing safety and to provide easier access to specialist health care, such as poisons units.

Figure 7. Physical injuries



WHAT NEXT?

The indicators proposed here are merely empty vessels, waiting to be filled. To contribute anything, they must now be completed and put to work. This is no easy task. Many problems and barriers have to be overcome. One of the most important is the lack of data needed to apply these indicators at the national or local level. Problems of inadequacies in the available data should not be ignored, for any indicator is only as good as the data on which it is based. Yet nor should gaps or uncertainties in the data be used as an excuse to do nothing. Two solutions exist, and both should be adopted. The first — in the short term — is to do the best we can with the data that are available. With a little inventiveness (e.g. through the use of models, or by finding proxies) we can often bridge at least some of the data gaps. Applying the indicator with what data we have can also teach us a great deal both about how to construct the indicator more effectively and what we must do to acquire the data we need. And even partial information is better than nothing: highlighting gaps in the data by presenting indicators in an incomplete form can be a powerful motivation for essential monitoring.

The second action is implied by the first. We must try to collect the data that is lacking. Often that involves overcoming institutional as well as technical problems, for all too often the barriers to monitoring lie in the ways in which responsibilities and resources are spread amongst, and applied by, the many different organizations involved. But responsibilities for monitoring and reporting on environmental health do not have to lie with government agencies and official bodies alone. The public — local communities — are the main stakeholders in children's environmental health. They often have a wealth of knowledge and insight that can readily be tapped, and they have a stronger interest than most in understanding what is going on. Harnessing this commitment can be an especially powerful means not only of acquiring data, but also ensuring that it reaches those who need to know.

And therein lies a further step. For building indicators, monitoring, producing reports achieve nothing if the information they provide is not heeded. Finally, therefore, we have to listen and take note of what they tell us — then act accordingly.

All these things need to be done urgently, for while we ponder and prevaricate and wait children suffer and die. The indicators presented here are therefore not an answer or an ending, but a beginning and a challenge. The challenge is this: seek, listen and respond, for millions of children are calling.

ANNEX: OVERVIEW OF INDICATORS FOR

	CONTEXTS	EXPOSURES
PERINATAL DISEASES	Children aged 0-14 years living in poverty	Famine risk People living in informal settlements Women of childbearing age who are malnourished Women of childbearing age working in unregulated workplaces Births to mothers living in unsafe or hazardous housing
RESPIRATORY DISEASES	Children aged 0-14 years living in poverty	Children aged 0-14 years living in unsafe, unhealthy or hazardous housing Overcrowding Children aged 0-14 years living in proximity to heavily trafficked roads Mean annual exposure of children aged 0-4 years to atmospheric particulate pollution Children aged 0-4 years living in households using biomass fuels or coal as the main source of heating and cooking Children aged 0-14 years living in households in which at least one adult smokes on a regular basis Intrauterine growth retardation in newborn children
DIARRHOEAL DISEASES	Children aged 0-14 years living in poverty	Drinking water supplies failing national microbiological water quality standards People living in informal settlements Children aged 0-14 years living in disaster-affected areas Children aged 0-14 years living in households without basic services for water supply, sanitation and hygiene
INSECT-BORNE DISEASES	Population growth rate in areas endemic for insect-borne diseases	Total area of insect vector habitats Children aged 0-14 years living in households providing suitable conditions for insect-borne disease transmission Children aged 0-14 years living in areas endemic for insect-borne diseases
PHYSICAL INJURIES	Children aged 0-14 years living in poverty	People living in informal settlements Children aged 0-14 years living in disaster-affected areas Children aged 0-14 years living in proximity to heavily trafficked roads Children aged 0-14 years involved in routine employment Children aged 0-14 years living in unsafe, unhealthy or hazardous housing Children aged 0-14 years living in homes lacking access to a piped water supply

CHILDREN'S ENVIRONMENTAL HEALTH

HEALTH OUTCOMES	ACTIONS
Perinatal mortality rate Intrauterine growth retardation in newborn children Congenital malformations requiring surgical correction in children under 1 year of age	Women of childbearing age within one hour's travel of specialist maternity and perinatal care Attributable change in number of households lacking basic services Prevalence of stunting in children aged 0-4 years
Mortality rate for children aged 0-4 years due to acute respiratory illness Morbidity rate for children aged 0-4 years due to acute respiratory illness Prevalence of chronic respiratory illnesses in children aged 0-14 years	Attributable change in tobacco consumption Attributable change in atmospheric pollutant concentrations Attributable change in numbers of households relying on biomass fuels or coal as the main source of heating or cooking
Diarrhoea mortality rate in children aged 0-4 years Diarrhoea morbidity rate in children aged 0-4 years Recurrence rate of outbreaks of diarrhoeal disease among children aged 0-4 years	Attributable change in the number of households lacking basic services Attributable change in the number of food outlets failing food hygiene standards Children aged 0-4 years able to obtain rehydration therapy within 24 hours of need
Mortality rate of children aged 0-4 years due to insect-borne diseases Prevalence of insect-borne diseases in children aged 0-14 years	At-risk children aged 0-14 years covered by effective, integrated vector control and management systems
Mortality rate of children aged 0-14 years due to physical injuries Incidence of physical injuries to children aged 0-14 years requiring treatment	Children aged 0-14 years living within reach of specialist emergency medical services Attributable change in physical injuries to children aged 0-14 years requiring treatment