Review article:

Child health promotion in developing countries: the case for integration of environmental and social interventions?

JOHN E EHIRI and JULIE M PROWSE
Centres for Occupational and Environmental Health, and Faculty of Health and Community Studies, De Montfort University, Leicester, UK

In spite of improving epidemiological knowledge in relation to child health, the challenge of promoting the survival and quality of life of infants and children in most parts of the developing world remains an abiding public health problem, for both the countries and the international agencies involved. Current infant and child health programmes largely reflect western style medical care, with emphasis placed on reducing mortality, and the preventive aspects confined mainly to immunisation, improved nutrition, provision of micronutrients, promotion of breast-feeding and birth spacing. In contrast, environmental and social factors which underpin the proliferation of disease agents are receiving minimal attention. This paper presents a critical review of current strategies for promoting child health in developing countries, and examines the environmental, social, and political factors that influence child health. Presenting a specific example of infant and childhood diarrhoea, the authors argue that in order for a real reduction in mortality, and improvements in quality of life to be sustained, attention needs to be focused equally on the environmental and social factors that underlie much of the childhood diseases in the developing world. This will involve the adoption of a broader strategy aimed at reducing childhood diarrhoea, using the hazard analysis critical control point (HACCP) system in combination with other methods.

Introduction

Until fairly recently, it was generally believed that much of the global improvements in health were the result of specific medical interventions. An important contributor to this perspective was people’s experience of the treatment of disease by health professionals who draw on a range of technological innovations available for medical and diagnostic procedures (Ashton and Seymour 1993). The successful global eradication of smallpox and typhus, the significant declines in maternal and child mortality, and the apparent increases in life expectancy have all helped to shape this view about the power of curative medicine. This belief has been reinforced by both international agencies and developing countries who continue to utilize this approach to health care. Consequently, global improvements in child health are being marred by factors which lie outside the domain of curative medicine. This belief has been reinforced by both international agencies and developing countries who continue to utilize this approach to health care. Consequently, global improvements in child health are being marred by factors which lie outside the domain of curative medicine. Thus, despite the investment of substantial resources, less developed countries continue to carry a heavy burden of disease and the attendant problems. This paper presents a critical review of current strategies for promoting child health in less developed countries, and considers the environmental and social factors that influence child health. The authors present a specific example of childhood diarrhoea, and consider a range of issues that underpin its proliferation in less developed countries. The purpose is to stimulate debate on the need to identify and channel resources into basic environmental health and social interventions that are effective, and should constitute part of an integrated strategy that incorporates HACCP (hazard analysis critical control point) evaluation of food preparation.

In reviewing the factors that contributed to improvements in health and the growth of the population of England and Wales (McKeown 1976), data indicates that the high death rates of the past were largely attributable to a combination of infectious diseases, nutritional and environmental factors. It was estimated that from the beginning of the 18th Century to the present day between 80% to 90% of the total reduction in death rate was a result of a decline in deaths caused by infections, water- and food-borne diarrhoeal diseases. With the exception of vaccination against smallpox (associated with less than 2% of the decline in death rates from 1848 to 1871), it was unlikely that immunization or therapy had any significant effect on infectious diseases before the 20th Century as much of the reduction in mortality from tuberculosis, respiratory, water- and food-borne diseases had already occurred before effective immunization or treatment were available. In fact, these improvements in health had resulted more from ‘environmental public health’, political, economic, and social measures than from specific medical or therapeutic interventions.

Prior to the Alma Ata declaration of primary health care (WHO/UNICEF 1978), the health systems of most developing countries existed mainly in the form of hospital-oriented medical care. Efforts were principally focused on treating the...
sick and child health programmes were mainly disease-oriented and vertical (Field 1989). However, the apparent failure to contain preventable diseases engendered a new school of thought on the most effective strategy to promote child health – that which considers the inter-relationship between disease and socio-economic development, poverty, and the collaborative role of agencies such as the World Health Organization (WHO), the World Bank, national governments, and non-governmental organizations (NGOs). This approach was embodied within the Alma Ata declaration of primary health care (WHO/UNICEF 1978) which defines primary health care as ‘essential health care based on practical, scientifically sound and socially acceptable methods, made technologically and universally available to individuals and families in the communities through their full participation, and at a cost the community and country can afford to maintain at every stage of their development, in the spirit of self-reliance and self-determination’.

WHO asserts that primary health care forms an integral part of a country’s development and health system. It is the first level of contact for the individual, family and community with the health system, bringing health care as close as possible to where people live and work, and constitutes the first element of a continuing health care process (WHO/UNICEF 1978). Primary health care was intended to cover the following key areas:

- health education
- food supply and nutrition
- water and sanitation
- maternal and child health
- immunization
- prevention and control of locally endemic diseases
- treatment of common diseases and injuries
- provision of essential drugs.

Although WHO has achieved some significant success in strengthening health care systems through training, research and information exchange following the Alma-Ata declaration, it has been argued (Sterky et al. 1996) that the agency could have achieved more if its activities had been better co-ordinated and less disparate. There is also some evidence to suggest that WHO’s policies and priorities are ‘donor driven’ (Vaughan et al. 1996), with its traditional role as a leader of international health initiatives being challenged by other agencies (Walt 1993) – a situation that may well exacerbate current problems of international collaboration and co-operation. Equally, evidence suggests that despite the intervention of a range of agencies during the last 50 years, the populations of developing countries continue to suffer from preventable diseases, and to be exposed to an unacceptable number of health and environmental problems.

It is within this context that Frenk et al. (1997) argue that the major agencies involved in international health co-ordination, including WHO, UNICEF, and the World Bank, have yet to respond adequately to the new picture of change and complexity, where health is influenced by such factors as environmental threats and the global movement of people. Consequently, realization of the targets cited in Health For All by the Year 2000 (WHO/UNICEF 1978) depends on the ability of the international community to create effective global health care systems to tackle both old and emergent health problems. In recognition of some of the issues confronting WHO, a recent address by the former Director General, Hiroshi Nakajima (1997), reflected on the need for better use of health resources, acknowledging that the changing context of health care delivery will impact on a nation’s ability to achieve Health for All.

The commitment of both the governments of developing countries and international agencies to respond to this challenge will play a vital role in such initiatives as promoting child survival and welfare by delivering sustainable policies based on a preventative rather than curative model of health care.

In addressing this debate, a number of authors (George and Sabelli 1994; Chossudovsky 1997; Caulfield 1997) have observed that the essence of the problem confronting the developing world, whether due to poor environmental health or poverty, is linked to the activities of the same agencies that purport to assist them. A variety of loans available from the International Monetary Fund (IMF) and the World Bank were devised to provide capital for a series of projects, including the construction of dams, roads, water, sanitation and health projects. Available research suggests that many of these loans have not been a qualified success (Ugalde and Jackson 1995), and rather than assisting developing countries, have contributed to their economic plight and increased poverty. In practice, developing countries are compelled to accept the conditions imposed by these institutions, which include the implementation of austere financial measures. Evidence (Cavanagh et al. 1994; George 1991) suggests that for many developing countries the burden of paying off their loan results in a spiral of growing debt burden and a reduction in expenditure available for health care.

In essence, the attempts of many developing countries to break this cycle are undermined, and as a consequence, programmes such as health and environmental projects are seriously compromised, as nations and international agencies continue to promote health policies and actions that may not be appropriate for the health care needs of the populations. In the light of this evidence it is vital that both international agencies and developing countries reflect on the lessons that can be learnt from other countries’ experiences and health care systems. Therefore, rather than continuing to invest in high technology and tertiary care, there must be a real commitment from all parties to direct resources towards preventative measures.

**Lessons from the selective primary health care experiment**

It is within the context of the arguments cited above that, following the Alma-Ata declaration, medical and health workers in both developed and developing countries grappled not only with a definition of their role in primary health care, but also with the most appropriate strategies for achieving the goals amidst limited resources. Almost simultaneously, Walsh
and Warren (1979) advocated the selective primary health care strategy. They maintained that as an alternative to comprehensive primary health care, the selective approach would be directed at preventing or treating the few diseases that are responsible for the greatest morbidity and mortality in less developed countries, and for which interventions of proven efficacy exist. It was envisaged that this approach would be used to tackle specific diseases in accordance with the results of cost-effectiveness analysis of potential interventions.

Subsequent endorsement and adoption of the selective approach by international agencies and developing countries have directed child health promotion activities primarily towards specific vertical programmes, which emphasized the promotion of immunization, oral rehydration therapy (ORT), growth monitoring, breast-feeding and related interventions. There is no doubt that these vertical programmes had a number of obvious advantages, especially since they enabled countries to concentrate their meagre resources on specific aspects of the problem. By adopting an incremental approach they were able to make progress and prevent health care resources from becoming over-stretched, whilst generating inter- and intra-country longitudinal and cross-sectional surveys that made it possible for health professionals to identify and monitor key diseases more effectively (USAID 1996).

However, the selective primary health care strategy has a number of significant shortcomings (Kamien 1987; Wisner 1988), relating particularly to the vertical approach to promoting child health. For example, addressing one problem at a time meant that vital opportunities for identifying and harnessing the contribution of other sectors (including those agencies outside the field of health) were missed. Equally, the vertical approach endorsed by international health agencies was greatly affected by a lack of co-ordination, overlapping remits and duplication of efforts (Frenk et al. 1997), with resources not concentrated in such areas as household or community environmental health where they may have the greatest long-term impact. As a consequence, vertical approaches to promoting child health typically involve resource-intensive strategies, and seldom emphasize sustainability, inter-sectoral collaboration or participation, upon which the principles of primary health care were originally founded.

Commenting on this change of ideology, Werner et al. (1997) criticize WHO and UNICEF for what they see as a movement from genuine popular participation to compliance; from social to technological interventions; from co-operative approaches to private enterprise; from process to product; from problem-posing learning to pre-chart training; from critical analysis to social marketing; from health for all to problem-posing learning to pre-chart training; from private enterprise to social to technological interventions; from co-operative to genuine popular participation to compliance; from resource-intensive strategies to resource-constrained interventions that are often proposed (Ehiri 1996), with the pitfalls becoming evident only after substantial resources have been committed.

Given that current child survival interventions were designed to cure children of specific diseases and not to tackle disease complexes and their root causes, the resource constraints on health systems have been alarming and show no signs of declining (Okun 1987, 1988). The situation remains still that developing countries are continuing to invest in tertiary level hospitals at the expense of cost-effective interventions that would yield increased results at the primary level (Perry et al. 1997). As Vaughan et al. (1996) observe, programmes that have a clear disease focus continue to attract more donor funding compared to those dealing with the development of health care systems and the implementation of appropriate preventive infrastructures.

With increasing demand for health care, and the ever-diminishing resources available to meet it, a rethink on current strategies based mainly on curative remedies is urgently needed in order to sustain the global gains in health improvement of the last few decades. International health agencies must adopt new organizational structures, to redefine their basic priorities and core functions, and to develop new forms of co-operation in order to meet the health challenges of the next century. This may well include the abandonment of the previous programmes and methods of health care delivery (Werner et al. 1997).

**Consolidating on global gains in child health through prevention**

It is undeniable that disease-specific interventions and social programmes arising from the concerted efforts of international agencies, governments and community organizations have contributed significantly to global health gains. For example, eight out of ten children in the world now receive vaccinations against the five major childhood diseases (WHO 1995a). Globally, between 1980 and 1993 infant mortality fell by 25%, whilst overall life expectancy increased by more than four years to 65 years. Nevertheless, in 1993 alone, more than 12 million children under the age of five died, despite the number of children dying from vaccine-preventable diseases decreasing by 1.3 million as compared with the 1985 statistic (WHO 1995a). Still, up to 2.4 million deaths among children under five are due to vaccine-preventable diseases. The application of such disease-specific interventions as ORT and immunization is important, but the advances made by these laudable technologies continue to be marred by adverse environmental health and socio-economic conditions that undermine any real sustainable progress in this area.

In order to promote real change, environmental health and social actions targeting the root causes of childhood diseases must be fully incorporated into current child health care programmes. Failure to adopt this strategy means that children saved from specific diseases will have their lives threatened by other lethal conditions arising from poor environmental and social conditions. For example, when vaccination for smallpox became available in the early 19th Century, smallpox deaths, which occurred mostly among children, fell precipitously, but the overall mortality rate remained relatively unaffected as deaths from diarrhoea and related conditions
UNICEF combines improved management of childhood illnesses (IMCI) programme of the WHO and one of the most cost-effective public health actions of recent years: integrated management of childhood illness is the key to achieving the critical link between health and economic development and international agencies, but for the strategy to make a significant and sustainable impact on child health, it must include improvements in health systems needed to allow effective integrated case management to the five major causes of infant and child mortality – diarrhoea, malaria, malnutrition, acute respiratory infection and measles (WHO 1996a).

There is a general consensus (World Bank 1993) that integrated approaches to child health promotion offer the greatest benefits since the causes of morbidity and mortality among children are multiple and inter-related. The 1993 World Development Report, ‘Investing in Health’, marked the World Bank’s most unequivocal recognition of the relationship between health and economic development and asserts that integrated management of childhood illness is one of the most cost-effective public health actions of recent years (World Bank 1993). The integrated management of childhood illnesses (IMCI) programme of the WHO and UNICEF combines improved management of childhood illnesses with aspects of nutrition, immunization and related programmes. Its main objectives include:

- the improvement of the case management skills of health staff through the provision of locally adapted guidelines on the integrated management of childhood illness, and through activities to promote the use of those guidelines;
- improvements in health systems needed to allow effective management of childhood illness; and
- the improvement of family and community practices.

The current emphasis on an integrated case management approach to child health promotion may have advantages for international agencies, but for the strategy to make a significant and sustainable impact on child health, it must include social and environmental improvements. Available evidence (WHO 1995a) shows that for most parts of the developing world, a significant proportion of the problems of ill-health and disease are closely linked to both environmental conditions and poverty. The problems confronting Tanzania, for example, are similar to those in many other developing countries – high incidence of infectious and parasitic diseases, low nutritional levels, and problems relating to pregnancy and child birth (Klouda 1987). There is acceptance (WHO 1995a) that the primary cause of these problems is poverty exacerbated by inadequate food intake, low educational levels, lack of safe drinking water and poor environmental conditions which adversely affect health. The brunt of the problem is borne by infants and children under the age of five, who, although constituting about 18% of the population, account for 63% of all deaths (Klouda 1987).

In most urban and rural areas for instance, the abiding problems of lack of access to safe water, poor domestic hygiene, dependence on low-grade fuels for cooking and heating, and unregulated offensive trades continue to impact on the health and well-being of children (WHO 1995b). Rapid urbanization brings additional risks, including those associated with poor housing conditions and exposure to pesticides. Ample literature exists on the impact of such environmental and social factors on child health (Satterthwaite et al. 1996), but appropriate methodologies for assessing, prioritizing and mitigating their impacts are yet to be widely incorporated into current strategies for promoting child health. Hence, international health agencies and policy-makers may continue to define and tackle child health issues too narrowly, paying minimal attention to the role of household and community environmental health factors, and to primary prevention activities.

This paper now presents a brief discourse on childhood diarrhoea and explores specific environmental health issues that underpin its proliferation in less developed countries. Such a discussion is necessary to facilitate the planning of a systematic and effective agenda for environmental health education, communication, information exchange, and the creation of effective partnerships between international agencies and national health systems, individuals, community groups, and local businesses. The essence of the arguments advanced is that by implementing a range of cost-effective environmental health measures aimed at promoting the health and well-being of infants and children in developing countries, real sustainable improvements can be achieved.

Prevalence of childhood diarrhoea

Infections in children and the attendant malnutrition contribute significantly to the 13 million deaths worldwide that occur annually among infants and children under the age of five (Mortajemi et al. 1993). Global epidemiological data shows that diarrhoea is the commonest cause of childhood morbidity and has the greatest negative impact on child health and development (Mortajemi et al. 1993). Tackling such a serious public health challenge requires a commitment to cost-effective and sustainable strategies. In this regard, ORT is among several technologies that have benefitted the developing world (Perry 1997), rather than high technology. But in spite of this, diarrhoeal diseases are still...
Aetiology of childhood diarrhoea

It is traditionally believed (Mortajemi et al. 1993) that diarrhoea in infants and children results mainly from lack of potable water supply and inadequate sanitation. For this reason, much of the efforts of governments and international development agencies have been targeted towards the improvement of water supply and sanitation, supplemented by the promotion of breast-feeding. In the 1980s, a systematic review of interventions for the control of childhood diarrhoea was undertaken under the auspices of the diarrhoeal diseases control programme of the World Health Organisation (Esrey and Feachem 1989). After a careful evaluation of data on food hygiene practices, Esrey and Feachem (1989) concluded that a well-planned programme of research was urgently required.

Recent evidence suggests that weaning foods prepared in unhygienic conditions are often highly contaminated with diarrhoea pathogens, and are a major cause of diarrhoea and associated malnutrition (Hendricks and Badruddin 1994; Mortajemi et al. 1993; Henry et al. 1990; Imong et al. 1989). The complex relationship between diarrhoeal diseases and malnutrition has been extensively researched (Tomkins and Watson 1989) and there is an acceptance that infectious diseases can affect children’s growth once weaning is initiated (Mata 1971, 1978). Infections can lead to a reduction in a child’s food intake due to anorexia, and because of cultural practices in some countries, parents may exacerbate the situation by withholding or substituting certain foods during illness (Ekanem and Akitoye 1990). Thus, a poor food intake, loss of nutrients from vomiting, diarrhoea, malabsorption, and fever over an extended period leads to nutritional deficiencies with serious consequences for the growth and immune system of infants and children (Mortajemi et al. 1993). An infant whose resistance is suppressed becomes vulnerable to other diseases and is subsequently victim to a vicious cycle of malnutrition and infection (WHO 1990a). The complexity and interrelatedness of this problem highlights the limitations of the current approaches to diarrhoeal disease control that emphasize therapeutic remedies at the neglect of the crucial link between diarrhoea, socio-cultural, environmental and economic factors.

Childhood diarrhoea has a complex epidemiology. For this reason, studies on the subject have often been confounded by the number of influencing factors, including sanitation, poverty and education (Hendricks and Badruddin 1994). One common limitation of these studies is their micro-focused approach of examining only one or at most, a few variables at a time. Consequently, researchers often attribute disproportionate weights to the few factors considered in such studies. More significantly, the analyses seldom include an examination of the mechanisms by which the hypothesized factors influence diarrhoea and child health. For example, while it is generally accepted that a mother’s education is inversely associated with the development of diarrhoea in children (Molbak et al. 1997), the pathways by which education exercises this effect have remained largely speculative, with limited research.

The role of food contamination in infant and child diarrhoea

Studies investigating the role of food hygiene in childhood diarrhoea have been comprehensively reviewed by Mortajemi et al. (1993). Evidence from this review and others (Esrey and Feachem 1989) suggests that over 70% of all cases of diarrhoea in children under the age of five is attributable to food contamination. Although there is acceptance that most diarrhoea in children, as in adults, results from ingestion of food and drink contaminated with diarrhoeal disease pathogens, there has been an apparent neglect of the role of food hygiene in child health and development.

To appreciate the significance of food hygiene practices in the epidemiology of childhood diarrhoea, it is germane to consider a number of facts. Normally, breast milk is the main source of nourishment for infants during their first months of life. During this period, dependence on breast milk reduces their exposure to food-borne pathogens, and also protects them against diarrhoea through the anti-infective properties of breast milk. Between the ages of four to six months, however, weaning commences and children are exposed to food-borne pathogens. A study of 454 children in Nigeria (Blum et al. 1990) shows that infants aged between 6–12 months suffer the highest incidence of diarrhoea, and this age range coincides with the usual weaning period. This evidence corroborates earlier findings by Osuhor and Etta (1980) which showed that hospital attendance for diarrhoea among children aged 3–4 years was only one-quarter to one-fifth of that for those aged 1–2 years.

Studies comparing diarrhoea mortality among exclusively breast-fed, partly breast-fed, and non-breast-fed children (Victora et al. 1987; Molbak et al. 1994) demonstrate reductions in mortality associated with breast-feeding. However, much of the reduction in diarrhoea mortality in breast-fed children could well have resulted from their limited exposure to contaminated weaning foods (Butz et al. 1984). There is evidence to suggest that the effect of breast-feeding on child survival tends to diminish under conditions of improved environmental health and socio-economic development. For example, analysis by UNICEF (1985) shows that the infant mortality rate decreases with socio-economic development, whether or not breast-feeding is maintained. This debate does not, however, call for the neglect of breast-feeding promotion, but suggests the need for priority emphasis on environmentally sound interventions, coupled with economic stability and social equity (Stanton 1994), to ensure sustainable improvements in child health. It also reinforces the issues addressed in the previous section, stressing the need for research to be conducted examining more variables, e.g. environmental, social, and economic, to demonstrate the effects on childhood diarrhoea.

This argument also takes account of the changing role of women in contemporary societies. The role of the mother in virtually all parts of the globe goes far beyond child care to...
include engagement in businesses, in academics, agriculture and other enterprises. It has been shown (Visness and Kennedy 1997) that returning to work is often associated with early weaning among women who breast-feed. Women’s participation in paid labour increases their economic power, and therefore, contributes to child survival, acting through nutrition, access to health care, and housing. Furthermore, their ability to make rational decisions about fertility will be strengthened (Ehiri 1996). Breast-feeding and related measures have an important role in promoting child health, but strategies which actively seek to reduce the risk of diarrhoea through mitigation of the environmental and social root causes of the disease should receive equal, if not priority attention in any integrated approach to its management.

A range of studies (Mortajemi et al. 1991) provides information about environmental health factors that contribute to the proliferation of diarrhoea disease pathogens, and contamination of weaning foods. These include for example:

- improper disposal of excreta
- unsafe water supplies
- inadequate basic sanitation and hygiene
- exposure of foods to flies and other vermin
- undercooking
- inadequate re-heating
- inadequate storage of foods
- cross-contamination
- use of left-overs.

Similarly, the manner in which poor social conditions adversely influence attitudes and practices towards food hygiene has been described (Mortajemi et al. 1993). In situations where poverty is rife, priority is often given to the low price of food, rather than to quality or safety issues. Households living under conditions where fuel for cooking is lacking may adopt food preparation practices that encourage contamination. In order to save fuel for instance, food, is sometimes insufficiently cooked, may be prepared in larger quantities than needed for one meal, and then stored (often at ambient temperatures) until required. Epidemiological evidence shows that this single practice contributes to most cases of food contamination (Bryan 1988; Davey 1985; Roberts 1982). Likewise, to cope with the shortage of fuel for cooking, foods may be served cold or without adequate re-heating.

While conditions in the tropics make refrigerated storage of perishable foods a necessity, only few families can afford such facilities. A study of environmental problems and the urban household in Accra, Ghana (Benneh et al. 1993), shows that only about 40% of the study sample had refrigerators for storage of perishable and leftover foods. This phenomenon exists in many developing countries and highlights the need for research on the benefits of traditional methods of weaning food preservation and preparation including fermentation. In many African countries it is customary to give infants fermented cereal products such as akamu/ogi (Nigeria) and ugi (Tanzania, Uganda and Kenya). Fermentation is a process by which growth and survival of micro-organisms (including pathogens) are regulated by high acidity, competition for nutrients, and/or bacteriocins resulting from the metabolic activities of lactic acid bacteria or yeasts (FAO/WHO 1995).

There is acceptance that fermentation is helpful in improving the hygienic quality of foods, especially where socio-cultural and economic constraints hinder heating or the refrigeration of foods (WHO 1995c), hence the use of fermented products is currently being promoted as part of the efforts to ensure the safety of weaning food. However, some food-borne disease outbreaks have been traced to fermented foods, and to inappropriate application of this technology (WHO 1996b). A number of measures for the improvement of fermentation as a household technology for improving food safety have, therefore, been recommended by a joint FAO/WHO workshop (FAO/WHO 1995).

The prevalence of houseflies, other vectors and vermin associated with poor sewage and refuse disposal also plays a significant role in food contamination, and therefore, the epidemiology of childhood diarrhoea, the chain of transmission being largely unchecked owing to the abiding presence of open refuse dumps that characterize many streets. Consequently, the greatest problem facing most local environmental health departments in the developing world is the lack of resources for the effective management of sewage and refuse. This is at the heart of most of the problems of preventable diseases that abound in the developing world. There is acceptance that excreta is the primary source of diarrhoeal disease pathogens (Winblad 1993).

Contamination of food and water occurs through:

- surface run-off washing human excrement to sources of water supply and agricultural lands, and onto vegetables and crops
- flies and other vermin, as a result of their feeding habits, and rodents gnawing on foods after contact with excreta, and
- hands of food handlers, and of children crawling or playing in polluted environs.

In spite of considerable awareness of the importance of the above connections, and of the need to implement appropriate environmental health interventions, there is an abiding medical emphasis from both international agencies and developing countries on the secondary prevention of diarrhoea through case management, using measures applied after the disease has occurred, notably ORT, and the promotion of appropriate feeding during and after diarrhoea episodes. While the effectiveness of these measures is not disputed (Monte et al. 1997), the fact remains that their primary objective is to promote recovery and survival and not to prevent the onset of diarrhoea episodes. Broader prevention strategies are, therefore, urgently needed to reduce the estimated annual thousand million episodes and the 3.3 million diarrhoea-related deaths that occur among children under five years of age (Bern et al. 1992).

A comprehensive review of potential interventions for control of diarrhoeal diseases was instigated by the WHO in
1982 (Feachem et al. 1983). Eighteen interventions were identified, evaluated and classified into three categories, according to their effectiveness and feasibility (Feachem 1986). The cost-effectiveness of seven interventions identified as having high effectiveness and reasonably strong feasibility was also evaluated (Phillips et al. 1987; Martines et al. 1993).

Recent work supported by the UK Department for International Development (DFID) has highlighted the potential benefits of food hygiene promotion as part of a programme of improving weaning practices (Monte et al. 1997). Food hygiene refers to those practices involved in the preparation, handling, and storage of food known or expected to reduce the transmission of enteric pathogens (Esrey and Feachem 1989). Considering the role of food contamination in the epidemiology of childhood diarrhoea, food hygiene education and promotion should receive priority attention in the efforts to promote child health. Mothers and care-givers need to be effectively educated in the ways to protect infants and children from food-borne hazards, especially in situations where the risk of food contamination is increased by prevailing environmental and social factors. It is argued that in spite of the various risks of contamination a polluted environment (including contaminated water and lack of sanitation) poses for food, the hygienic quality of prepared foods can be assured if basic food hygiene principles are observed (WHO 1993a). For this reason, appropriate food hygiene education programmes, well adapted to the socio-cultural conditions of the target groups, should be designed and integrated with water and sanitation programmes (WHO 1990b). It is felt that the development of such an educational intervention should be based on data obtained through a combination of approaches, including the following:

1) The evaluation of socio-cultural, environmental and behavioural variables which influence the epidemiology of childhood diarrhoea, using a triangulation of ethnographic, survey and observational methods that explore the viewpoints of mothers and care-givers (Monte et al. 1997). This approach is indispensable if the disease control message is to effect behaviour change.

2) The identification of critical control points (CCPs) in the preparation, handling, storage and serving of children's foods in homes, using the hazard analyses critical control point (HACCP) approach. This method yields useful information on points of actual or potential contamination of weaning foods, and on food mishandling and other faulty procedures, both quickly and relatively cheaply, while taking into consideration local habits and culture (Abdulsalam and Kaferstein 1994). HACCP involves the identification of hazards associated with any stage of food production, processing, packaging, preparation or service; the assessment of related risks and their severity; and the determination of steps where control can be applied for the achievement of safety.

An HACCP study of weaning foods will involve a number of stages:

a) determining the extent of contamination of raw foods and ingredients;
b) watching preparation, handling and storage practices;
c) measuring, as appropriate, time–temperature exposures during cooking and storage, and the pH and/or water activity of certain foods;
d) sampling and testing foods at appropriate stages of preparation to ascertain sources and modes of contamination, survival and growth/concentration/attenuation;
e) conducting challenge studies, if necessary, to provide further confirmation of hazards (Bryan 1995).

Although the HACCP concept was originally developed for use in food-processing plants (The Pillsbury Company 1973), it is applicable for food preparation in homes (WHO 1997, 1993b; Codex 1993; Bryan 1992), and can be applied to ensure the safety of weaning foods. The strategy can be used to identify food-borne hazards (microbial, physical, and chemical), to assess related risks, and to facilitate the design of effective preventive mechanisms (Moy et al. 1997). It considers not only the food and methods of preparation, but also the peculiar socio-economic conditions of the environment in which the food is prepared, as well as the cultural factors that influence potentially risky behaviours. Because it can facilitate systematic identification of potential hazards and specific preventive actions, it helps to clarify the distinction between control measures related to aesthetics and those critical to food safety. It therefore provides guidance on the selection of education priorities, so that time and resources are not wasted on general superficial improvements. The strategy can also be used to further investigate the benefits and hazards of fermentation and other household technologies for improving food safety.

The usefulness of HACCP research in the promotion of hygiene of weaning foods lies not in the establishment of new risk factors, but in the determination of points in the food preparation–handling–serving chain which are critical to safety (i.e. the critical control points), thus facilitating appropriate targeting of educational messages, and of prevention efforts and resources. There are those who argue that there is presently enough information on risk factors for diarrhea in children (Monte et al. 1997). However, the problem of establishing which factors constitute priorities for intervention has yet to be fully resolved. Application of the HACCP strategy in the design of weaning food hygiene promotion interventions has the potential to contribute significantly in this regard, thus facilitating a more pragmatic preventative approach rather than curative remedies applied after the disease has occurred (Ehiri 1995).

Conclusion
The foregoing discussion indicates that the factors which influence child health in developing countries are more significantly influenced by social equity, political stability, and improvement in household and community environmental health than by specific medical interventions (Werner et al. 1997). Therefore, a rational approach to improving public health in these countries needs to address the socio-political and economic dimensions, through a well-planned programme of collaboration between governments and agencies, and with a clear definition of functions and activities.
The idea of using HACCP data to inform food safety education is of paramount importance in situations of extreme poverty, and where adequate food-borne disease surveillance may be lacking (Ehiri 1995). Thus, in addition to other social and environmental interventions (e.g. water and sanitation), data generated can be used to inform health and social authorities, train public health personnel, and design culturally appropriate food hygiene promotion interventions (Michanie and Bryan 1987). As Abdulsalam and Kaferstein (1994) observe, this approach has the potential for promoting food hygiene in primary health care, but has yet to be fully exploited.

Similarly, for real sustainable improvements in infant and child health to be achieved, it is essential that the growing pluralism amongst many international health and environmental agencies is quelled, and that a greater strategic and collaborative relationship is forged. The essential task of examining the roles of the international agencies, such as the World Bank and International Monetary Fund, has already commenced with a fundamental review of the functions and priorities of these organizations, including a commitment from Wolfensohn, the president of the World Bank, to concentrate more resources on lending and human development programmes. The current reform of health care provision by international agencies and nations is occurring within an economic context in which they are seeking to provide health care in the 21st Century, within financial constraints. Therefore, the requirement to provide effective health care becomes an abiding concern. The remedy to this problem resides in a fundamental shift in emphasis, as this paper has stressed, from curative to preventive health care supported by investment in the wider infrastructure.

Whilst not undermining the contributions of medicine to public health, medical care should underpin the health of a population or group only when prevention fails (Ashton and Seymour 1993). Reliance on the case management of specific diseases as a framework for health improvement in less developed countries is expensive, unsustainable, and will result in little real health benefits, if the underlying environmental and social causes are not addressed.

The importance of appropriate food safety education in the control of childhood diarrhoea has been clearly identified (WHO 1990b; Ehiri 1995; Ehiri and Morris 1996). Health education in food safety is likely to be more effective if designed and implemented, using appropriate data on critical control points in the preparation, handling, storage and serving of children’s foods, obtained using the HACCP approach in combination with socio-cultural, environmental and behavioural study of factors influencing food contamination and childhood diarrhoea. This approach is vital if the disease control message is to effect behaviour change and community involvement.

As this paper has argued, treating children with environmentally induced ailments, whilst at the same time tackling the causative environmental and social factors, is a most comprehensive and sustainable alternative. A number of real opportunities already exist for bringing environmental health actions for child survival into the forefront of the international development agenda. Current debates on sustainable development focused mainly on the preservation of the global resource base, and on the ways to reduce emission of greenhouse gases and the depletion of the ozone layer (World Resources Institute 1992, 1994; UNEP 1991), are rational and worthwhile, but to give real meaning to the imminent dangers to the health of children (now and in the future), debate must incorporate the development of appropriate means of tackling the myriad of household and community environmental health concerns that underlie diarrhoea and similar diseases which claim the lives of millions of children annually around the world.

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Biographies

Dr John Ehiri is a Research Fellow in the Centre for Occupational and Environmental Health, De Montfort University, Leicester, England. He is a Registered Environmental Health Officer in West Africa, where he has been involved in teaching and research in the fields of environmental health and public health policy for over 15 years. He obtained an MSc (Econ) in Health Planning and Development from the University of Wales, Swansea, and MPH and PhD from the University of Glasgow, Scotland, specializing in Public Health. He has published widely on the subjects of social and environmental factors in child health, and on the topic of hazard analysis critical control point (HACCP). Currently, he is Principal Investigator of a Thrasher funded research into the application of the HACCP system for the prevention and control of childhood diarrhoea in Imo State, Nigeria.

Julie Prowse, MA, BSc, RGN is a Senior Lecturer in Health Service Management and Comparative Health in the Department of Health & Continuing Professional Studies, De Montfort University, Leicester. She obtained a BSc from London University, and worked for a number years in the UK Health Service. She obtained an MA in Health Studies from the Nuffield Institute for Health Studies, University of Leeds. She has worked on a range of research projects, examining management issues, and has published on a number of topics ranging from audit to human resources management.

Correspondence: John E Ehiri, PhD, MPH, Centre for Occupational & Environmental Health, De Montfort University, Scraptoft Campus, Leicester, LE7 9SU, UK.