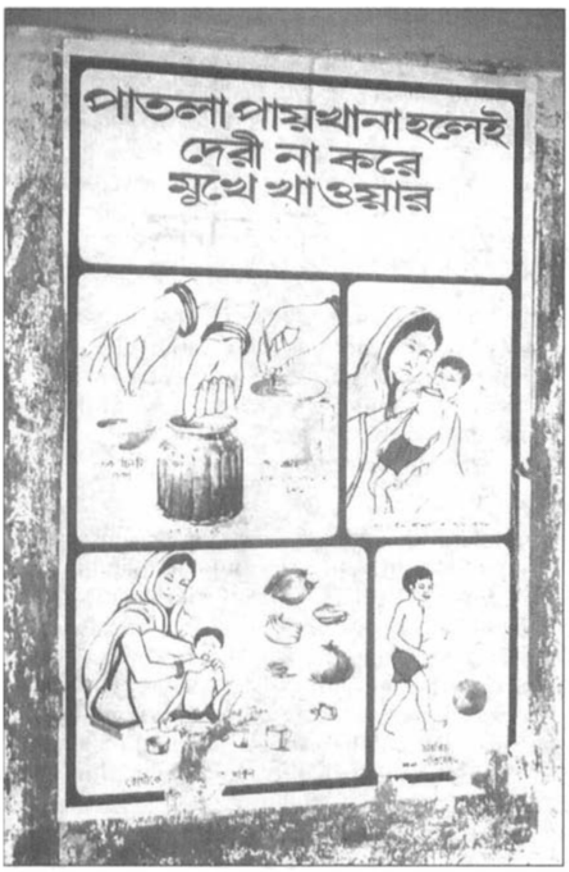
No half measures — sustaining health from water and sanitation systems

by Steven A. Esrey

Without improved hygiene and sanitation, the cleanest water in the world won't prevent children dying from diarrhoea. Just the latest theory? Steven Esrey presents some hard evidence on health.

HEALTH IMPROVEMENTS ARE often cited as a rationale for investing in water and sanitation. Many donors justify investments in water and sanitation from health budgets. Health benefits are also cited as a measure of success or outcome of water and sanitation improvements. Many projects are evaluated by health indicators. These differences, rationale and outcome, are not trivial differences. For example, people demand water for convenience; improvements provide this by bringing piped supplies closer, and offering more water for a variety of uses. Donors provide funds for water to improve health. Is convenience achieved, or health improved; and are both sustained? If the rationale and the outcome are not considered together, it is unlikely that both objectives can be achieved, much less sustained.



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A Bangladeshi health poster promotes ORS.

Why 'do' water and sanitation? There are many other reasons for investing in water and sanitation besides the obvious linkages with health. They are basic human needs and rights; the economic benefits, including waste reuse, increased tourism through a hygienic environment, and the savings on disease care; plus increased dignity, convenience, and quality of life are all valid objectives.

Nevertheless, the same question should be asked if sustainability is important. For example, is human dignity the reason for investing in water and sanitation? Or is human dignity the result expected from investing in water and sanitation?

Health benefits

Three types of information indicate that there are substantial health benefits to be gained from improvements in water and sanitation: theoretical, historical, and epidemiological. Theory, backed up by empirical evidence, suggests that, as pathogen exposure is reduced, so is disease. A healthy adult or child may become exposed to pathogens and, if the load is sufficient, will become sick. If the disease is severe enough, death is inevitable.

This progression of events, shown in Figure 1, also highlights three points of intervention: primary, secondary, and tertiary. In the case of diarrhoea, a tertiary intervention would be oral rehydration (ORS). ORS will prevent the death of a child if he already has diarrhoea. ORS also treats diarrhoea. Tertiary interventions are not intended to reduce exposure to pathogens, and do not have an impact on the subsequent severity of disease, except that early diagnosis can help make a tertiary intervention effective in preventing death. In a similar vein, secondary interventions are not concerned with the amount of exposure, but try to prevent or reduce disease severity.

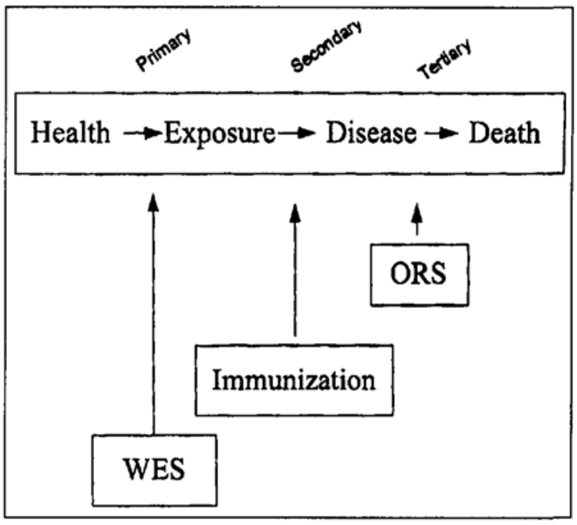


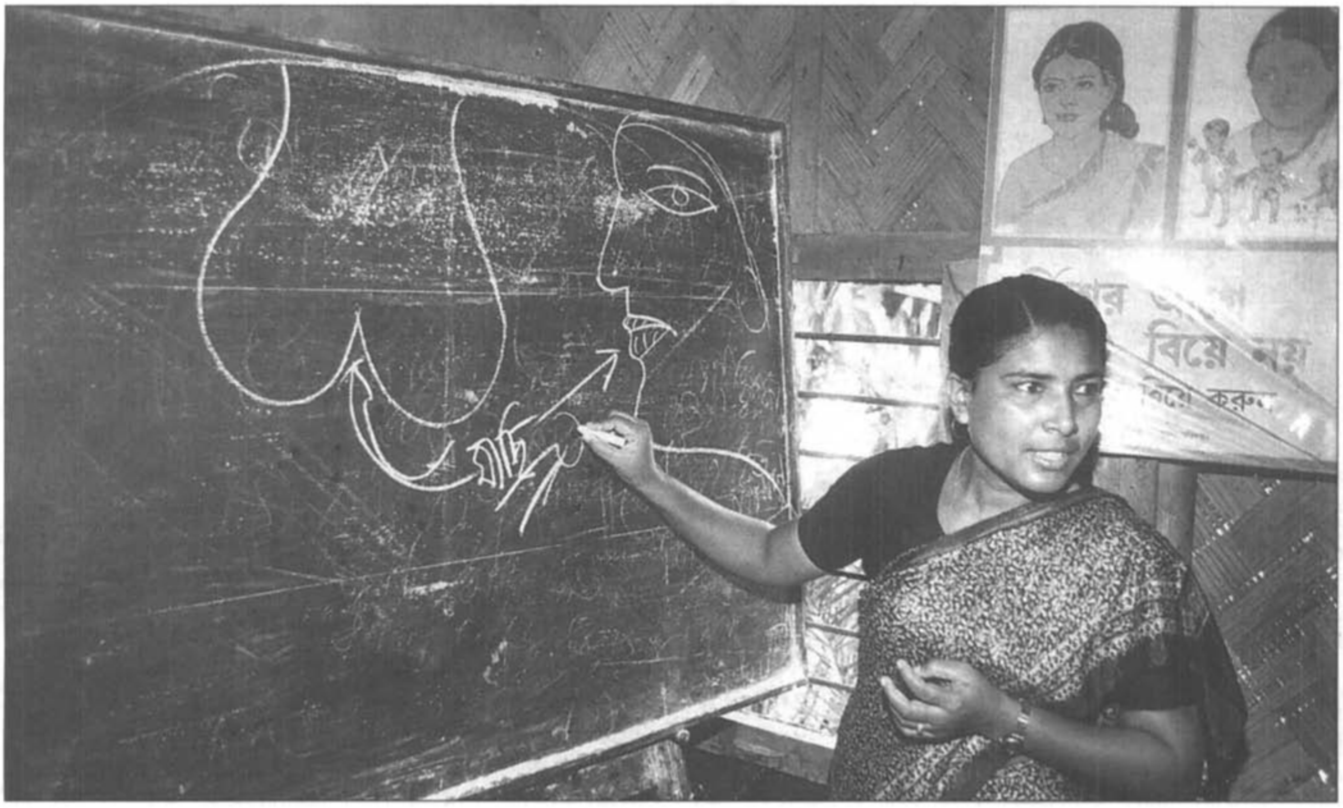
Figure 1. Intervention points to prevent and treat disease.

Immunization — against measles, for example — prevents disease and, consequently, death, while effectively treating exposure. Primary interventions work in much the same way, except that they are intended to prevent people from being exposed to pathogens in the first place.

Sanitation, hygiene, and clean water prevent exposure to pathogens, thereby preventing disease and death. As such, a primary intervention treats health. Thus, water and sanitation are healthcare, while immunization and ORS are disease-care interventions.

No way in

In the same vein, sanitation, hygiene, and safe water can be considered as primary, secondary, and tertiary barriers between the health and exposure linkages. Sanitation is the primary barrier to prevent pathogens from gaining access to the environment. Put



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We have transmission — only a multiplicity of efforts will prevent people from ingesting disease-causing pathogens.

another way, without sanitation, the environment is exposed to pathogens. Hands, food, objects, soil, and water are contaminated. Effective secondary barriers are needed to prevent the continued transmission of pathogens, thus, hygiene practices such as handwashing, better food-handling, keeping the living and cooking areas of the home clean, good personal hygiene, and making water safe, can be effective interventions to prevent humans from ingesting pathogens. Attempts to improve one hygiene area — for example, safe water — do not reduce transmission through food, soil, objects, and hands. Thus, a multiplicity of efforts are required to reduce the transmission of pathogens. Single hygiene efforts are unlikely to reduce diseases unless the pathogens are transmitted through only one route.

Historical evidence indicates that preventive measures have effectively reduced the incidence of disease and death caused by a number of killing ldiseases. The reasons for these preventive measures include better water and sanitation conditions, better and more varied diets, increased education, and a greater understanding of the germ theory of disease. The improvements in water and sanitation included better sewage disposal, higher-quality water, and more water made available for people to keep themselves and their environments clean. Thus, the improvements in water and sanitation could not be ascribed to any one component of the improvements. This raises the question, if only one condition was improved, would the improvements in health or life expectancy have occurred?

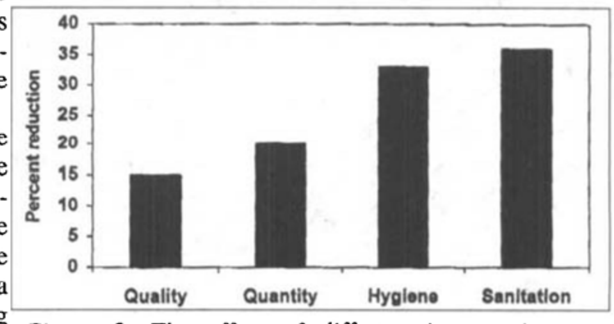

Figure 2. The effect of different interventions on the reduction of diarrhoea.

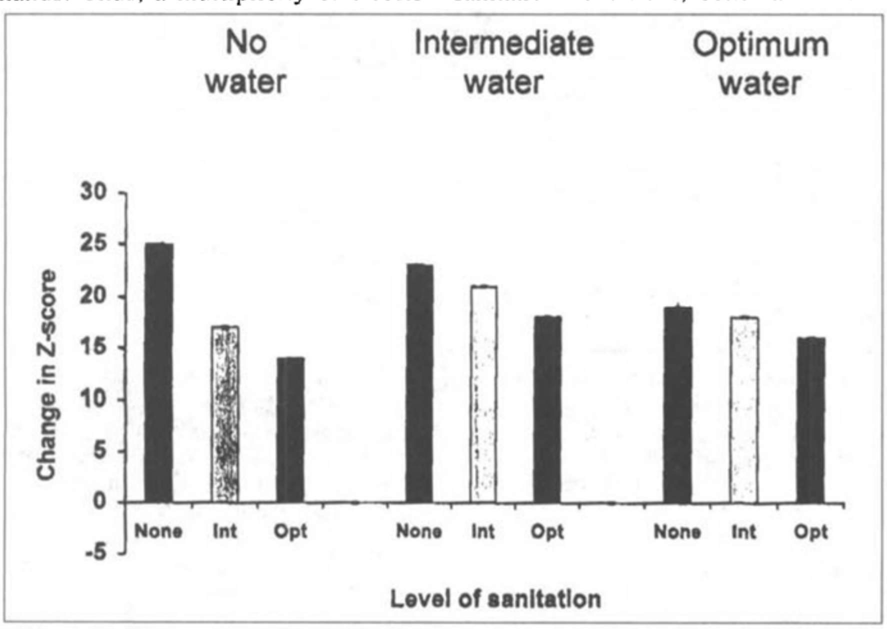

Figure 3. Water, sanitation and diarrhoea among 4888 urban children aged between 3 and 36 months of age, in 18 countries.

Analysing the evidence

Recent epidemiologic studies have helped to separate out the external influences — such as education — from water and sanitation improvements, as well as the influence of one component of better water and sanitation, for example, safe water, from another (such as more water).

Two types of analysis have been

Innovative emptying — improving slum sanitation in Kibera by Madeleen Wegelin-Schuringa, J. Gitonga, and T. Kodo

Kibera is the largest, low-income urban area in Kenya's capital, Nairobi. Covering 225 hectares, it is home to an estimated population of 470 000. The land belongs to the State, and temporary occupation licences are obtained through the municipal authorities. Yet the area is considered illegally squatted, and there are no public services available. The vast majority (98 per cent) of the residents are tenants who depend on their landlords to provide latrines. Most homes consist of a large number of rooms crammed into a compound, leaving little space for infrastructure facilities. Most people obtain their water through Kibera's estimated 500 water kiosks, usually privately owned, or managed by water committees, who sell the water for between one and three shillings per 20-litre container (about six times the price for water at individual connections). The price of water and the restricted hours of supply result in a level of water-use which endangers personal and environmental hygiene.

Madeleen Wegelin-Schuringa

A Kibera latrine drains into the natural drainage channel.

Kibera has no solid-waste collection system and garbage litters the streets. Wastewater is simply allowed to drain away through the roads, and natural drains have formed. Excreta disposal is principally down to traditional pit latrines. Although, in theory, almost all families have access to a pit latrine, actual access is limited; one latrine may serve up to 200 people. Apart from the insufficient number, the main problem with the latrines is emptying the full pits, and space to dig new pits is often not available.

Although the sheer number of people living in Kibera would indicate the need for some form of reduced-cost sewerage to improve sanitation conditions, the scarcity and cost of water — and the fact that people use solid materials (paper, corncobs, and leaves) for anal cleansing — more or less preclude any option for a system using water.

Since landlords already spend funds on digging pits and constructing latrines, it seems advisable to concentrate on options to upgrade the existing types of latrines. People are unlikely to be willing to spend funds on improvement, however, if the main problem — the difficulties of emptying the pits — is not dealt with simultaneously.

Since 1990, the Kenyan NGO, Kenya Water for Health Organization, has been operating a mini vacuum tanker service in the area, dumping the sludge in the sewer running through Kibera. The service was not sustainable: capital costs were high, badly maintained roads caused frequent breakdowns, and there were problems with the local authorities over the management of the service. Moreover, the tanker was unable to serve all homes as many can only be reached by footpath. The manual pit-emptying technology (MAPET), developed and operational in Dar es Salaam[1], could have been a suitable alternative if there had been space to dig a pit for the sludge on the compound (the Dar es Salaam method), or if Kibera was situated on flat ground. Manually pushing a full tank to dump the sludge in one of the four manholes is not possible due to the distances and the sloping ground.

Some form of removal system between the mini vacuum tanker and the MAPET will be the most suitable option for Kibera. Such a system is being developed now, and will be tried out in Kibera during 1996. Once a reliable emptying service is functioning, landlords have proved to be willing to improve their latrines, mainly through the construction of a Sanplat. Moreover, the traditional depth of the pits (currently 10 to 20 ft) could be reduced, making a pit latrine cheaper. This may induce landlords to construct more latrines for their tenants if they are willing to make space available in the compound.

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As one latrine pit fills up, a new one is dug.

1. Muller, Maria S., and Jaap Rijnsburger, 'MAPET: An appropriate latrine-emptying technology', *Waterlines*, Vol. 13, No.1.

completed. The first, in 1991, was a review of all epidemiologic studies.[1] Based on this review, the relative reduction in diarrhoea was estimated from improvements in safe water, increases in the amount of water, better hygiene practices, and improved sanitation (Figure 2). The greatest improvements were achieved through sanitation and hygiene: a 35 per cent reduction in diarrhoea. Increases in the amount of water were associated with a reduction in diarrhoea of about 20 per cent, while safe water was associated with only a 15 per cent reduction in diarrhoea. This suggests that sanitation acts as a successful primary barrier to reduce the environmental exposure of pathogens, and better hygiene acts as an additional, secondary barrier to reduce their transmission further.

The question of why safe water has less of an effect — perhaps only a marginal effect — on diarrhoea than improved sanitation or better hygiene goes against traditional thinking. A recent review of water-borne outbreaks[2] indicates that many outbreaks of the pathogens associated with diarrhoea are, in fact, not water-borne. While cholera was reported to be predominantly water-borne, a recent analysis of cholera outbreaks suggests that, for every water-borne outbreak, there are two non water-borne outbreaks. Less than 50 per cent of outbreaks from common diarrhoeal pathogens (Shigella, E. Coli, and Campylobacter) are water-borne.

A recent study examined the joint effect of water and sanitation on incidents of diarrhoea and the nutritional status of children aged between three and 36 months.[3] Three types of water and three types of sanitation systems were examined: unimproved, intermediate, and optimum. Unimproved systems included ponds, lakes, and traditional water sources and fields for sanitation. Intermediate water usually indicated a communal tap, while intermediate sanitation was predominantly a pit latrine. Optimum water was classed as a supply on the premises or in the dwelling, while optimum sanitation included pourflush toilets or sewage connections.

The analysis included nearly 17 000 children — two-thirds of whom lived in rural areas — from eight countries in three continents. The results on diarrhoea among urban children for the nine different water and sanitation options are shown in Figure 3. The highest rates of diarrhoea were found among children without improved sanitation, *regardless of the type of water supply found.* The effect of sanitation was largest when there was no improved water, an 11 per cent difference in the prevalence of diarrhoea between unimproved and intermediate sanitation in the absence of improved water. This was equivalent to a 44 per cent reduction in diarrhoea prevalence. The difference in diarrhoea prevalence for intermediate water compared to unimproved water, in the absence of improved sanitation, was 2 per cent, or the equivalent of an 8 per cent reduction in diarrhoea. Similar findings were found when nutritional status was examined. Water had a minor effect, while improved sanitation had a substantial effect on nutritional status, both height and weight.

Complementary improvements

The effects of improved water and sanitation were greatest when improvements occurred together; a finding that is backed up by other studies. As a general rule, sanitation improvements have the greatest effect when improved water is available, and vice versa. In addition, the effect of water and environmental sanitation (WES) interventions may be enhanced when other external factors come into play, including higher education and higher incomes. Efforts to reduce disease and improve health, therefore, can be maximized by seeking linkages with other programmes.

Besides reductions in diarrhoea, improvements in water and sanitation also reduce the prevalence and severity of other diseases, such as guinea-worm, intestinal parasites, and skin diseases. Improvements in nutritional status, including a reduction in the prevalence of stunted and wasted children, as well as saving in energy expended, have also been reported.

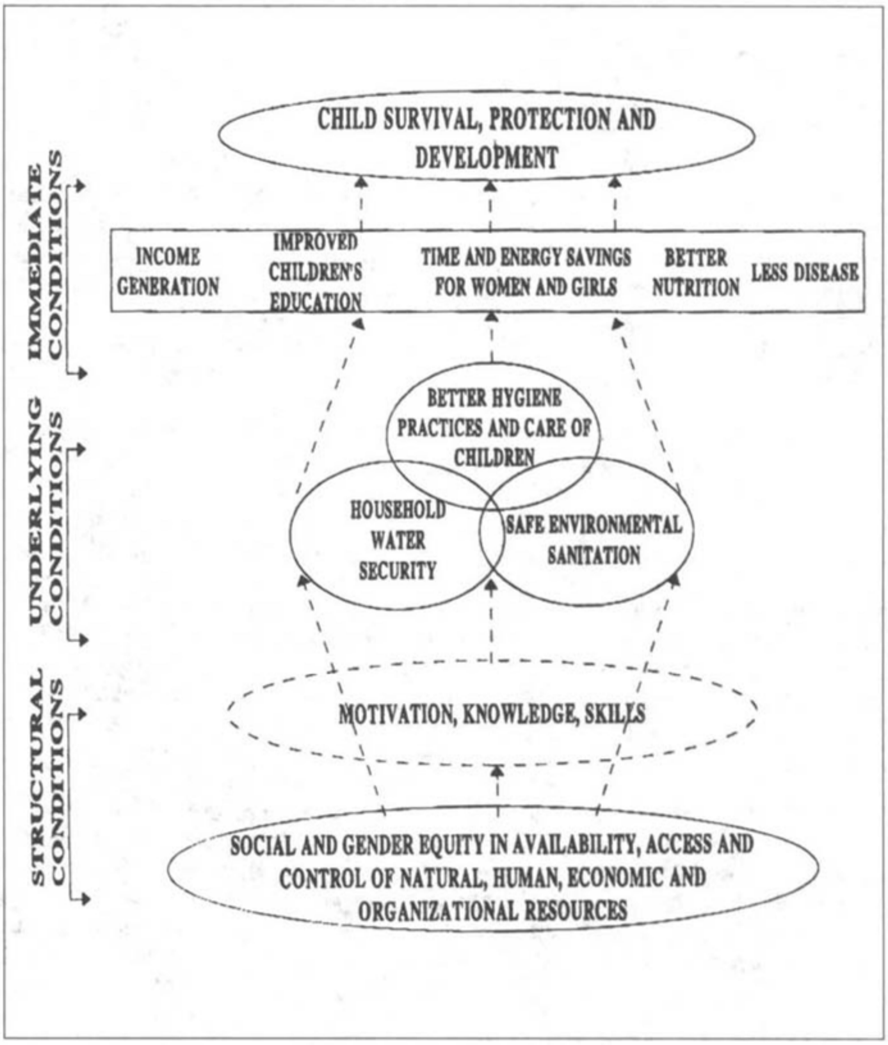

Figure 4. Conceptual model for water and sanitation programme development.

Unicef's WES Programme

These impacts helped form the basis for the conceptual framework for Unicef's Water and Environmental Sanitation (WES) Programme (Figure 4). Briefly, the objectives of Unicef programmes are child survival, protection, and development. The WES contributions are safe environmental sanitation, better hygiene practices and maternal care, and household water security. These programme interventions, which should be integrated to maximize impact, are mediated through less disease, better nutrition, less time and energy spent in collecting water, better education for children, and greater income-potential as a result of water and sanitation improvements. All of the mediating factors are well-documented.

The lower half of Figure 4 indicates the conditions necessary to secure household water security, better hygiene and maternal care, and safer environmental sanitation at the community level. These are, primarily, greater equity in the access to and control of available resources. Yet, access to, and the control of, resources will not provide sustainable resources unless people are empowered to act for themselves, including their participation in the design, implementation, and evaluation of WES interventions.

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