Water Quality Interventions to Prevent Diarrhoea: Cost and Cost-Effectiveness

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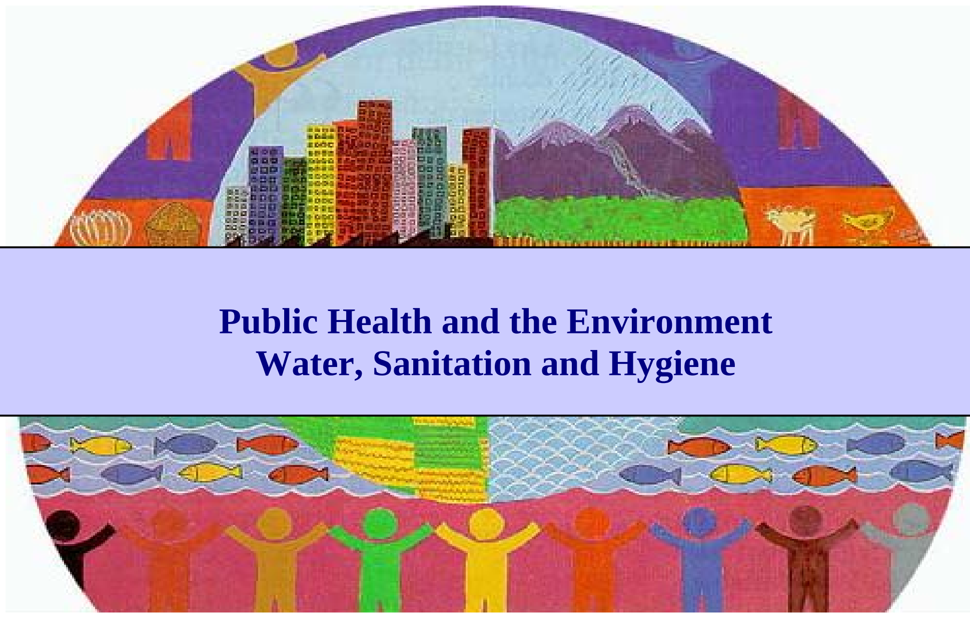

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EXECUTIVE SUMMARY

Diarrhoeal disease kills an estimated 1.8 million people each year, and accounts for 17% of deaths of children under 5 years of age in developing countries. Ninety-four percent of this disease burden is attributable to the environment, including risks associated with unsafe water, lack of sanitation and poor hygiene. While piped-in water supplies are an important long-term goal, the WHO and UNICEF acknowledge that it is unlikely to meet the MDG target of halving the proportion of the people without sustainable access to safe drinking water and basic sanitation by 2015. As a result, they and others are seeking alternative interventions that can deliver the health gains of safe drinking water at lower cost. Among the candidates are conventional source- and a variety of household-based water treatment interventions.

Building on our recent Cochrane review of the effectiveness of water quality interventions to prevent diarrhoea (38 trials, 21 countries, more than 53,000 subjects), we collected cost information from 28 country programmes and computed the cost-effectiveness of conventional improvements of water quality at the source (well, borehole, communal stand post) and four interventions to improve water quality at the household level (chlorination, filtration, solar disinfection and combined flocculation/disinfection). We then employed the generalized cost-effectiveness analysis (CEA) methodology developed by the WHO under its CHOICE project in order to assess the cost-effectiveness of these interventions in 10 WHO epidemiological sub-regions with lower levels of improved water and sanitation coverage. For each intervention, we report the cost-effectiveness ratios (cost per disability adjusted life year (DALY) averted) (CER) and a range of CERs based on the upper and lower estimates of their effectiveness and costs. We also estimated health cost savings from implementing the interventions, though the CERs are reported on a gross cost basis exclusive of such savings.

Among all water quality interventions, household-based chlorination is the most cost-effective. Solar disinfection is only slightly less cost-effective, owing to its almost identical cost but lower overall effectiveness. Conventional source-based interventions have a mean cost per DALY averted of about twice that of chlorination and solar disinfection. Household-based ceramic filters have a higher cost, but yield the largest health impact; they thus represent an opportunity to avert more DALYs with additional investment. Combined flocculation-disinfection was strongly dominated (i.e., higher cost and lower effectiveness) by all other interventions except under an assumption in which it can be implemented at its minimum cost. By way of example, in the Africa-E region (see page 17 for a listing of countries in each WHO Sub-Region), the cost per DALY averted is US$53 for household chlorination, US$61 for household solar disinfection, US$123 for source-based interventions, US$142 for household ceramic filtration and US$472 for household flocculation/disinfection. An "expansion path" on a cost-effectiveness plane which plots each of the interventions under investigation by cost and effectiveness would begin with household-based chlorination and end with household-based filtration, the other interventions being dominated by these two approaches.

Direct cost offsets, even if limited to the WHO estimates of health cost savings, more than offset the costs implementing most water quality interventions. This means that governments, who are chiefly incurring such costs, would reduce their overall outlays by investing in the implementation of such interventions rather than in the treatment of cases of diarrhoeal disease. As a cost-effectiveness rather than cost-benefit analysis, this study also omits the economic value of other benefits (including time savings) that have been shown to ensue from improvements in water supplies. Insofar as this CEA is based on effectiveness data which concerns only the prevention of diarrhoeal diseases, it does not address diseases such as typhoid, hepatitis A and E and polio that may be transmitted by the ingestion of unsafe water but whose pathology does not consist of diarrhoea. Moreover, because the systematic review on which the effectiveness data in this CEA was based was limited to endemic diarrhoea, the impact of such interventions on epidemic diarrhoea will not be included in the DALYs averted. In these respects, this CEA understates the true cost-effectiveness of such interventions.

1. INTRODUCTION

1.1 Background and Rationale

Diarrhoeal diseases kill an estimated 1.8 million people each year (WHO 2005). Among children under five years in developing countries, diarrhoea accounts for 17% of all deaths (United Nations 2006). Oral rehydration therapy has dramatically decreased the mortality associated with diarrhoea, but has had little effect on morbidity estimated to be approximately 4 billion cases per year (Kosek 2003). With continued high attack rates, diarrhoeal disease is also an enormous economic burden, resulting in significant direct costs to the health sector and patients for treatment as well as in lost time at school, work and other productive activities (Mulligan 2005).

The infectious agents associated with diarrhoeal disease are transmitted chiefly through the faecal-oral route (Black 2001). An estimated 94% of the diarrhoeal burden of disease is attributable to the environment, and associated with risk factors such as unsafe drinking water, lack of sanitation and poor hygiene (Prüss-Üstün & Corvalán 2006). While conventional interventions to improve water supplies at the source (point of distribution) have long been recognized as effective in preventing diarrhoea (Esrey 1985, 1991), more recent reviews have shown household-based (point-of-use) interventions to be significantly more effective than those at the source (Fewtrell 2005; Clasen 2006). As a result, there is increasing interest in such household-based interventions.

However, the extent to which such interventions are ultimately deployed to reduce the burden of disease will not be determined on their effectiveness alone. It will also depend on their cost. With limited resources, particularly in developing countries, governments are forced to allocate health expenditures to an array of public health challenges. NGOs must do the same in order to satisfy donors of the responsible use of their funds. Even interventions such as insecticide-treated nets that have shown the potential for commercial or quasi-commercial (e.g., social marketing) distribution often require public expenditures to promote basic health messages, awareness of the intervention, and continued and appropriate use. The use of purely commercial products that also have a health impact, such as soap or insecticide treated nets, is also effectively rationed by the cost that consumers can afford to pay for it.

While public sector decisions on health expenditures are often based on political commitments or other expediencies, economic efficiency, by definition, requires that resources be directed to their most productive use. In the health context, such allocative efficiency means “assessing which intervention will produce greatest health gains for a given investment of resources, and focusing on that activity” (Witter 2000). This implies more than cost; the lowest cost intervention is seldom the most effective. Thus, economic evaluation is normally a function of both the cost of the intervention and the return on that cost, measured either in terms of overall economic benefits (a “cost-benefit analysis” or CBA) or in the realization of a social objective, such as the prevention of disease (a “cost-effectiveness analysis” or