Technical Note

The Cost Effectiveness of Selected Child Survival and Maternal Health Interventions in the Haitian Context: A Synthesis of Literature Reviews

Submitted to:

USAID/Haiti

and

Policy and Sector Reform Division
Office of Health and Nutrition
Center for Population, Health and Nutrition
Bureau for Global Programs, Field Support and Research
Agency for International Development

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1.0 PURPOSE

The purpose of this paper is to summarize what is currently known about the cost effectiveness of selected child survival and maternal health interventions. The nine interventions studied were identified by USAID/Haiti for possible inclusion in a new integrated Family Health Project. Three of the interventions (as indicated belows) were being supported under the existing USAID Child Survival Project; the remaining interventions were identified by USAID/Haiti as candidates for possible inclusion in the new project. The nine interventions are:

- Safe water supply and sanitation services
- Malaria prophylaxis for pregnant women
- Social marketing of oral rehydration salts
- Iodine supplementation
- Vitamin A supplementation (included in the current project)
- Deworming of children
- Filariasis treatment
- Immunization (included in the current project)
- Growth monitoring and promotion (included in the current project)

The HFS Project was asked to review the literature on the cost effectiveness of each of the above interventions in an international context, including the implications of any possible synergies among the interventions. HFS was also asked to review the literature on the most cost-effective way to deliver the intervention (e.g., vitamin A supplementation versus fortification). In some cases, the definition of the intervention itself effectively narrowed the range of alternative approaches (e.g., social marketing of oral rehydration salts). Although the study was intended to focus on the international experience with the selected interventions, an attempt was made to relate this information to the Haitian context and to whatever comparable information was available for Haiti.
2.0 METHODOLOGY

2.1 Cost Effectiveness Analysis

The overall objective of the study was to provide USAID/Haiti with information it could use to identify the most cost-effective package of health interventions to include in a new health project. In principle, the most cost-effective package of interventions should produce the maximum health impact from limited project funds. The cost effectiveness methodology used here is similar to that used by the World Bank in its *World Development Report 1993*. Where available, the measure of cost effectiveness used is cost per disability-adjusted life year (DALY) gained.\(^1\) Interventions (and specific service delivery approaches) with the lowest cost per DALY are those which provide the best "value for money." Given a budget constraint (i.e., an estimate of the total resources available to a project) and a list of possible interventions, ranked from lowest to highest according to their cost per DALY, one would presumably work down the list, selecting additional interventions until the budget is exhausted. Under certain conditions (not always satisfied, as discussed below), the resulting package of interventions would constitute the most cost-effective project.\(^2\)

Although the simple ranking of interventions by cost per DALY may yield the most cost-effective project in some cases, there are at least four circumstances under which it may not do so:

- When the cost effectiveness of one intervention is affected by the presence or absence of another intervention in the project
- When the marginal cost effectiveness of an intervention is not constant
- When the effects of an intervention produce savings to the health system in the form of reduced consumption of other services

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\(^1\) The disability-adjusted life year (DALY) is a measure of the combined mortality and morbidity effects of a health intervention. In the case of mortality, the DALY measure reflects the expected gain in years of life associated with the intervention. An intervention which saves a child's life therefore results in more DALYs gained than one which saves an adult's life. In some applications (e.g., the 1993 *World Development Report*) a year of life is weighted according to age (e.g., a year of a working age adult's life is weighted more heavily than that of either a young child or a retired person), and future years of life gained are discounted compared to current years of life. In the case of morbidities, the DALY measure reflects the judgment of experts concerning the percentage of total incapacity which is restored by the intervention.

\(^2\) Two related questions, i.e., "Is the project itself optimal in size?" and "Does it provide a comparable return to alternative uses of the same funds (e.g., an education project or a microenterprise project)?" cannot be answered through cost-effectiveness analysis. The technique of benefit cost analysis must be used for this purpose. Benefit-cost analysis involves attaching a monetary value to a DALY, so that the project's outcomes (its benefits) can be compared to those of other projects, using monetary value as a common yardstick.
When some or all of the costs of an intervention can be recovered through user fees, or when demand for the intervention is so weak that incentives must be paid to users.

When the cost effectiveness of two interventions is not independent, we say that they are synergistic. Synergies can occur with respect to cost and/or effectiveness. For example, there may be cost synergies between immunization programs and vitamin A supplementation if the two interventions can be combined into a single outreach activity. Effectiveness synergies may be either positive or negative, depending on whether the inclusion of one intervention raises or lowers the effectiveness of another intervention. Water and sanitation services and health education are an example of two health interventions with positive effectiveness synergies. Numerous studies have demonstrated that the health impact of water and sanitation programs is enhanced when they are combined with health education programs, which emphasize the importance of correct use of sanitation facilities. Conversely, many of the messages conveyed by a health education program (e.g., washing one's hands, using safe water, using sanitation facilities) can be practiced more easily in the presence of water and sanitation services. However, there are also examples of negative effectiveness synergies between health interventions. A program to distribute oral rehydrations salts (ORS) and a water supply and sanitation program provide an example of possibly negative synergies. The marginal effectiveness of an ORS intervention might be reduced in the presence of a successful water and sanitation intervention since the latter would reduce the incidence of diarrhea.

When the marginal cost effectiveness of interventions is not constant, the task of selecting interventions becomes more complicated. Under these conditions, project design involves not only the selection of the most cost-effective interventions but also the determination of the optimal scale for each selected intervention. Immunizations provide a case in point. It has been argued that the cost effectiveness of immunization programs increases at low levels of immunization coverage, as the fixed costs of programs (e.g., administrative overhead, training, IEC) are spread over a greater base, but that it eventually begins to decrease at high rates of coverage (e.g., above 80 percent), beyond which the marginal cost of increasing coverage by each percentage point begins to rise and the marginal gains in reduced mortality begin to decline. Under these conditions, a project designer should consider not only whether to support an immunization program but also needs to select the optimal coverage rate to target. Similarly, a number of other health interventions have cost effectiveness ratios which are high when applied to limited geographical areas (e.g., malaria prophylaxis administered in high-prevalence areas) or to limited target populations (e.g., pregnant women, school-age children) but which decline as the interventions are administered over a wider area or to broader population groups. Under these conditions, project design involves not only the selection of the most cost-effective interventions but also the determination of the optimal scale for each selected intervention.
circumstances, the design of a cost-effective project involves not only identifying the correct package of interventions but also identifying the appropriate target areas and populations.

The methodology of cost effectiveness analysis compares a set of interventions on the basis of the resources used to produce one or more health outcomes. Many preventive health interventions, and some curative interventions, not only improve health outcomes (e.g., reduce mortality and/or morbidity) but also yield cost savings to the health system in the form of reduced costs for curative care. Immunizations are a good example. Not only do they lower mortality and morbidity, but immunizations also avert curative care costs for patients who would otherwise have become ill with the disease if not immunized. ORT is another example. Not only does it reduce mortality from diarrhea by permitting broad access to earlier treatment, but it also reduces the cost of treating severe diarrhea cases in hospitals and other health facilities. Other interventions considered here which present similar cost savings include safe water supply and sanitation services and malaria prophylaxis for pregnant women. In the case of such interventions, perhaps "net cost per DALY gained" would be a preferred cost-effectiveness measure, where net costs are defined as the cost of the intervention itself less the cost savings it produces for the rest of the health sector.

The methodology of cost effectiveness analysis does not reflect the demand for the intervention in question. Due to lack of information or the presence of externalities (i.e., a divergence between private and social benefits and costs), the demand for certain interventions may not parallel their cost effectiveness. For example, consumers may so value certain marginally cost-effective interventions that they are willing to pay a significant proportion of the costs of the intervention. Safe water supply and sanitation services is a frequently cited example. In such cases, it may be useful to have cost-effectiveness measures reflect this willingness to pay, since in such cases the amount of public investment required per unit of health effect may be lower. A "net public cost per DALY gained" measure which reflects public sector costs less private revenue collected through user fees may be used in such cases. The same measure may also be used where consumers are not willing to consume a service at zero cost, so that incentives are needed, at least initially. Again, a "net public cost per DALY gained" measure which includes incentives may provide a better indicator of the intervention's cost to the public sector, and hence of its sustainability.

2.2 Procedures and Data Sources

This paper is a synthesis of a set of nine background papers, each of which provides the following information on one of the above interventions: (1) background information on the need for the intervention in Haiti; (2) alternative service delivery approaches available for the intervention; (3) the cost and cost effectiveness of the intervention; (4) synergies of the intervention with other child survival and maternal health interventions; and (5) Haitian experience with the intervention. The nine background papers are listed separately in the bibliography of this paper.

The approach used in all the background papers was to begin with general sources (e.g., World Bank, 1993a; Jamison, Mosley, Measham and Bobadilla, 1993), adding more recently published material, and then proceeding to review carefully the key articles on which the more general sources were based. This approach was designed to ensure not only that the principal work on a given intervention was included but also to provide some insight into the reliability of the specific information on which the general reviews are based. We found fairly good information on the health effectiveness of most
interventions, but cost data were limited and of uneven quality. Most of the information on possible synergies between interventions was speculative or anecdotal. Although there was extensive information from USAID and other sources concerning previous interventions in Haiti, the review surprisingly turned up little general information on health conditions and problems in Haiti. We suspect that the absence of such information reflects a dearth of health data for Haiti. The first DHS in Haiti, for example, has not yet been published.

The present synthesis includes the following sections:

▲ **Description of Interventions, Service Delivery Approaches and Health Effects.** Discusses the need for each health intervention in Haiti, identifying its potential health and non-health effects. Identifies the alternative service delivery approaches available for each intervention (in the case of some interventions considered, e.g., social marketing of ORS, the service delivery approach is already defined).

▲ **Cost Effectiveness of Alternative Interventions.** Presents the available information on the cost and effectiveness of the available interventions and service delivery approaches. Evaluates the reliability of these estimates and identifies factors which might affect the intervention’s cost effectiveness in the Haitian context.

▲ **Synergies.** Discusses possible synergies between the nine interventions considered in the review, as well as with other child survival and maternal health interventions. Evaluates the reliability of the information on synergies and discusses Haitian factors which might affect these synergies.

▲ **Haitian Experience.** Describes previous experience with the intervention in Haiti; and reports any available information on the impact, cost effectiveness and sustainability of previous attempts to use these interventions.

▲ **Conclusions and Recommendations.** Provides overall conclusions and recommends appropriate actions.

A consolidated list of the references used in all of the background papers is included in the bibliography.
3.0 RATIONALE AND INTERVENTIONS

The various health interventions and their principal effects are summarized in Exhibit 1.

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Alternative Service Delivery Approaches</th>
<th>Health Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe Water Supply</td>
<td>House connection (urban)</td>
<td>Mortality and morbidity from diarrhea, infectious and parasitic diseases</td>
</tr>
<tr>
<td></td>
<td>Public tap (urban)</td>
<td></td>
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<tr>
<td></td>
<td>Community standposts (rural)</td>
<td></td>
</tr>
<tr>
<td>Sanitation</td>
<td>Sewerage (urban)</td>
<td>Mortality and morbidity from diarrhea, infectious and parasitic diseases</td>
</tr>
<tr>
<td></td>
<td>Other urban</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pit latrines (rural)</td>
<td></td>
</tr>
<tr>
<td>Malaria Prophylaxis of Pregnant Women</td>
<td>Chemoprophylaxis Impregnated bed nets</td>
<td>Mortality and morbidity from malaria infection</td>
</tr>
<tr>
<td>Social Marketing of Oral Rehydration Salts</td>
<td>(At the request of USAID/Haiti, the study did not consider other approaches to distributing ORS)</td>
<td>Mortality from diarrhea</td>
</tr>
<tr>
<td>Iodine Supplementation</td>
<td>Supplementation Fortification</td>
<td>Mental retardation Infant/child mortality</td>
</tr>
<tr>
<td></td>
<td>Fortification</td>
<td>Nutritional status</td>
</tr>
<tr>
<td>Vitamin A Supplementation</td>
<td>Supplementation Fortification</td>
<td>Blindness Infant/child mortality</td>
</tr>
<tr>
<td>Deworming of Children</td>
<td>Mass treatment Selective treatment</td>
<td>Nutritional status School performance Labor productivity</td>
</tr>
<tr>
<td>Filariasis Treatment</td>
<td>Mass treatment Selective treatment</td>
<td>Adult morbidity Labor productivity</td>
</tr>
<tr>
<td>Immunization</td>
<td>Routine services Accelerated strategies</td>
<td>Infant/child mortality</td>
</tr>
<tr>
<td>Growth Monitoring and Promotion</td>
<td>Clinic-based Community-based</td>
<td>Infant/child mortality Nutritional status School performance Labor productivity</td>
</tr>
</tbody>
</table>

Water Supply and Sanitation (WS&S). The principal health effect of safe water supply and sanitation (WS&S) services is a reduction in the incidence of diarrhea. Other effects include reduced infection with parasitic, infectious and skin diseases (e.g., schistosomiasis, guinea worm, amoebiasis, scabies, trachoma). The principal non-health effect of safe WS&S is time savings of family members involved.
in the collection of water. Diarrhea is a leading cause of death among children under 5 years of age in Haiti. Only 29 (12) percent of the rural population had access to safe water (sanitation) in 1989. A variety of specific interventions (technologies) are available to provide safe WS&S. However, the most popular technologies are, in the case of safe water supply, house connections and public taps in urban areas and community standposts in rural areas; and in the case of sanitation, sewerage connections in urban areas and pit latrines in rural areas.

Malaria Prophylaxis for Pregnant Women. Haiti is the only Caribbean island where malaria remains a health problem. Pregnant women are extremely susceptible to malaria, which can produce oedema, hypoglycemia and anemia. Although there are no Haiti-specific data, maternal mortality due to cerebral malaria is approximately 40 percent, or about twice that of other populations. Malaria is also associated with premature births and neonatal mortality. Non-health effects include reduced productivity, with each bout of malaria resulting in from 5-20 days of disability. Although malaria eradication was attempted for many years, more cost-effective interventions currently available include prophylactic chemotherapy in high-risk groups and the use of permethrin- or pyrethroid-impregnated bed nets. Chemoprophylaxis using chloroquine can be administered cost effectively as part of a prenatal care program.

Social Marketing of Oral Rehydration Salts (ORS). Dehydration is a severe complication of diarrhea and is responsible for approximately 70 percent of diarrheal deaths. Infants and small children are particularly at risk. When properly prepared and employed, oral rehydration salts (ORS) can successfully rehydrate 90-95 percent of cases of acute watery diarrhea. ORS can be distributed by health clinics or commercially through social marketing. Two advantages of social marketing are that some costs are recovered and that modern marketing and communications techniques can be used to strengthen health education. Bangladesh, Nicaragua, Honduras, The Gambia and Egypt all have successful ORS social marketing programs. However, the fact that ORS does not cure diarrhea makes it difficult to "sell" to both health professionals and to the public.

Iodine Supplementation. Iodine deficiency disorders range in severity and clinical manifestations. Women, children and the unborn are at greatest risk of severe and irreversible consequences. Extreme iodine deficiency results in cretinism, which is a form of mental retardation. Non-health effects include reduced productivity. Interventions include supplementation (i.e., pills, capsules, injections of iodized oil) and fortification (i.e., addition of potassium iodate to salt or sodium iodide to water).

Vitamin A Supplementation. In its most severe forms (i.e., xerophthalmia, keratomalacia), vitamin A deficiency results in blindness and, in combination with protein-calorie malnutrition, even death. Vitamin A deficiency is an important health problem in Haiti, particularly among pre-school-age children and pregnant women. Interventions include supplementation, through the administration of vitamin A capsules at 6-monthly intervals, and fortification of selected foods. Supplementation can be easily integrated into immunization programs.

Deworming of Children. Approximately 20 varieties of helminths (worms) infect humans, and it has been estimated that one-third of the world's population is infected with helminths at any given time. The most heavily affected population is school-age children. Many of those infected are asymptomatic, and morbidity rather than mortality is the primary consequence of helminth infections. In the case of children, reduced school attendance and impaired learning are important non-health effects. Roundworms, tapeworms, hookworms, schistosomes, and filariae are all endemic in Haiti. Interventions include water and sanitation, vector control, and chemoprophylaxis. Today, effective single-dose anti-helminthics of low toxicity are available for treatment of many types of infection. They can be used
simultaneously, with minimal side effects, and are considered to be the most cost-effective interventions, particularly for high-risk populations. Control of disease in most heavily infected groups also reduces infection rates in the general population. However, retreatment is required in most cases because chemoprophylaxis does not address the source of infections. Sample surveys can be used to determine infection rates in a community prior to administering mass chemoprophylaxis.

**Filariasis Treatment.** Filariasis is a chronic disease, becoming more debilitating as the mosquito-transmitted worms mature, leading eventually to elephantiasis in most cases. Traditional forms of chemotherapy, using DEC, require twelve doses and are often accompanied by severe side effects. Consequently, they have experienced low compliance rates in many settings. Use of the experimental drug ivermectin (which is also effective against a number of other worms) is an appealing alternative treatment. Though somewhat less effective than DEC, it can be administered in one dose and is much less likely to be accompanied by serious side effects. Mass school- and community-based programs are feasible using ivermectin. Mass chemotherapy can also be administered at low doses over long periods, either using pills or medicated table salt. Environmental sanitation measures, such as reducing breeding sites, are also effective. The use of impregnated bed nets, as with malaria, may also be an effective preventive measure against filariasis.

**Immunization.** Immunization programs in most developing countries provide protection against the following six diseases: measles, tetanus, pertussis, tuberculosis, diphtheria and polio. Of these, measles alone typically accounts for over half of infant/child mortality due to vaccine-preventable diseases, followed by neonatal tetanus and pertussis. Immunization coverage rates in Haiti are still very low, i.e., for measles and pertussis (DPT), 31 and 41 percent respectively in 1990, and for tetanus, 23 percent in 1988. Although there are a number of technical issues and choices involved with immunization (e.g., timing, choice of vaccine), most immunizations are highly effective in reducing disease incidence (BCG vaccination against tuberculosis is the exception). The two main approaches to delivering immunizations are routine strategies, using regular health services (including outreach), and accelerated strategies, such as mass campaigns. Both strategies have been employed in Haiti.

**Growth Monitoring and Promotion (GMP).** Haiti is considered to have the most serious problem of protein-energy malnutrition (PEM) in the Western hemisphere. The consequences of severe PEM include increased mortality and morbidity, poor school performance, reduced productivity and increased risk of chronic health problems. Growth monitoring and promotion (GMP) is an intervention which involves the continual monitoring of a child’s development with the help of growth charts, accompanied by appropriate services (e.g., treatment for infections, food supplements, nutrition education) in cases where children are not found to be gaining adequate weight over time.
4.0 COST EFFECTIVENESS OF ALTERNATIVE INTERVENTIONS

Exhibit 2 reports available estimates of the cost of the nine interventions considered in this paper. In some cases (e.g., water supply and sanitation, immunization) estimates are available for many countries. In other cases (e.g., malaria prophylaxis for pregnant women, filariasis treatment) there are few cost estimates available. Moreover, the available cost estimates differ substantially from one another, both in quality and in the definitions of cost used. In some cases, for example, cost estimates include both recurrent and capital costs; in others, they reflect only recurrent costs. Units also differ (e.g., per capita, per episode, per person-year-of-protection), making it difficult to compare the cost estimates across interventions and, in some cases, even across countries for the same intervention. Exhibit 3 reports available estimates of the cost effectiveness of the nine interventions. As with the cost estimates, they vary widely in scope and quality. Where possible, cost per DALY estimates are provided; in some cases, however, the cost effectiveness estimates refer to other measures of effectiveness (e.g., disease cases averted, deaths averted). The individual background papers from which the estimates reported in Exhibits 2 and 3 were obtained considered both the reliability of the cost and cost-effectiveness estimates for each intervention and factors which might affect the cost effectiveness of the intervention in the Haitian setting. We summarize this information below (including the mention of comparable Haiti-specific estimates where available):

Water Supply and Sanitation (WS&S). The basic source of cost information for WS&S is a study by Esrey, Feachem and Hughes (1985), which reviewed 87 country studies. This source is used by Martines, Phillips, and Feachem (1993), who conclude that the median cost of WS&S projects is $14 per capita in rural areas and $46 per capita in urban areas. However, as noted by Cairncross, Hardoy and Satterthwaite (1990), the cost in a particular country setting depends on the availability of water. In countries where water is scarce, the per capita cost may be as much as five times what it is in areas of abundant water. The World Bank (1993a) estimates that WS&S has the potential to reduce the worldwide burden of diarrheal and intestinal diseases (e.g., parasites) by 40 percent and 30 percent respectively, averting the loss of 40 million Disability-Adjusted Life Years (DALYs) annually. Similarly, Esrey, Feachem and Hughes (1985) found that well-designed WS&S projects had the capacity to reduce mortality and morbidity by 35-50 percent. A review of 84 studies by the USAID-funded Water and Sanitation for Health (WASH) project found that the median reduction in mortality was 60 percent. Based on these and other studies, and using the Walsh and Warren (1979) model, Jamison et al. (1993) conclude that the cost per death averted with WS&S projects is $3,600-4,300 (no estimates of cost per DALY are available).

The literature is in agreement that it is very difficult to obtain reliable estimates of the cost effectiveness of WS&S projects, due to a variety of factors, including: paucity of relevant data, the multiple health and non-health outcomes involved, variations in disease prevalence, number of alternative technologies, and inconsistencies across studies in the methodologies used to measure cost effectiveness. Another important factor to consider is the extent to which costs can be recovered with suitable user fees, in which case the relevant measure should be net cost effectiveness, rather than gross cost effectiveness, as mentioned above.

With respect to Haitian factors, the available reviews suggest that the cost effectiveness of WS&S interventions can be adversely affected by inappropriate choice of technology, unfavorable environmental conditions, poor operation and maintenance, failure to generate or sustain community participation,
persistently poor hygienic practices, high rates of water wastage, and inadequate cost recovery—all conditions present in Haiti.

### EXHIBIT 2
**COST ESTIMATES OF HEALTH INTERVENTIONS**

<table>
<thead>
<tr>
<th>INTERVENTION</th>
<th>COST</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safe Water Supply</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>House connection (urban)</td>
<td>$200 per capita</td>
<td>World Bank (1993)</td>
</tr>
<tr>
<td></td>
<td>$200 per capita</td>
<td>Water International (1991)</td>
</tr>
<tr>
<td></td>
<td>$120 per capita</td>
<td>Cairncross <em>et al.</em> (1990)</td>
</tr>
<tr>
<td></td>
<td>$20 per capita</td>
<td>Esrey, Feachem &amp; Hughes (1985)</td>
</tr>
<tr>
<td>Public tap (urban)</td>
<td>$100 per capita</td>
<td>Water International (1991)</td>
</tr>
<tr>
<td></td>
<td>$60 per capita</td>
<td>Cairncross <em>et al.</em> (1990)</td>
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<tr>
<td></td>
<td>$31 per capita</td>
<td>Esrey, Feachem &amp; Hughes (1985)</td>
</tr>
<tr>
<td>Community standposts (rural)</td>
<td>$15 per capita</td>
<td>World Bank (1993)</td>
</tr>
<tr>
<td></td>
<td>$30 per capita</td>
<td>Water International (1991)</td>
</tr>
<tr>
<td></td>
<td>$9.50 per capita</td>
<td>Okun (1988)</td>
</tr>
<tr>
<td></td>
<td>$10 per capita</td>
<td>Esrey, Feachem &amp; Hughes (1985)</td>
</tr>
<tr>
<td></td>
<td>20-26 per capita</td>
<td>Walsh &amp; Warren (1979)</td>
</tr>
<tr>
<td><strong>Sanitation</strong></td>
<td></td>
<td></td>
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<tr>
<td>Sewerage (urban)</td>
<td>$350 per capita</td>
<td>Water International (1991)</td>
</tr>
<tr>
<td></td>
<td>$26 per capita</td>
<td>Esrey, Feachem &amp; Hughes (1985)</td>
</tr>
<tr>
<td></td>
<td>$26 per capita</td>
<td>Kalbermatten, Julius &amp; Gunnerson (1982)</td>
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<tr>
<td>Other (urban)</td>
<td>$25 per capita</td>
<td>Water International (1991)</td>
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<td></td>
<td>$11 per capita</td>
<td>Esrey, Feachem &amp; Hughes (1985)</td>
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<td></td>
<td>$10-14 per capita</td>
<td>Kalbermatten, Julius &amp; Gunnerson (1982)</td>
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<td></td>
<td>$23 per capita</td>
<td>Walsh &amp; Warren (1979)</td>
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<td>Pit latrine (rural)</td>
<td>$20 per capita</td>
<td>Water International (1991)</td>
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<td></td>
<td>2.50 per capita</td>
<td>Okun (1988)</td>
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<td></td>
<td>$4 per capita</td>
<td>Esrey, Feachem &amp; Hughes (1985)</td>
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<td>$3 per capita</td>
<td>Kalbermatten, Julius &amp; Gunnerson (1982)</td>
</tr>
<tr>
<td></td>
<td>4-5 per capita</td>
<td>Walsh &amp; Warren (1979)</td>
</tr>
</tbody>
</table>
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### COST ESTIMATES OF HEALTH INTERVENTIONS

<table>
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<tr>
<th>INTERVENTION</th>
<th>COST</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Malaria Prophylaxis of Pregnant Women</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemoprophylaxis</td>
<td>$ 1.20 per compliant woman</td>
<td>Hellitzer-Allen <em>et al.</em> (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 0.60 per capita</td>
<td>Shepherd, Etling &amp; Sauerborn (1991)</td>
</tr>
<tr>
<td>Impregnated Bed Nets</td>
<td>SIS 3.85 per capita</td>
<td>Kere &amp; Kere (1992)</td>
</tr>
<tr>
<td>Combined (Chemoprophylaxis and bed nets)</td>
<td>$ 0.62 per capita</td>
<td>Shepard, Etling and Sauerborn (1991)</td>
</tr>
<tr>
<td><strong>Oral Rehydration Therapy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORT Treatment</td>
<td>$ 0.70-9.66 per episode</td>
<td>Martines, Phillips and Feachem (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 1.00 per episode</td>
<td>UNICEF (1987)</td>
</tr>
<tr>
<td></td>
<td>$ 0.70-4.57 per episode</td>
<td>Lerman, Shepard &amp; Cash (1985)</td>
</tr>
<tr>
<td><strong>Social Marketing of ORS</strong></td>
<td>NA (but ORS social marketing program in Bangladesh reports covering all product costs and most marketing costs)</td>
<td>PSI (1993)</td>
</tr>
<tr>
<td><strong>Iodine Supplementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplements</td>
<td>$ 0.14-0.46 per person-year of protection (PYP)</td>
<td>Jamison <em>et al.</em> (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 0.07-0.09 per PYP</td>
<td>Stanbury &amp; Hetzel (1980)</td>
</tr>
<tr>
<td></td>
<td>$ 0.20 - 0.50 per PYP</td>
<td>Levinson (1991)</td>
</tr>
<tr>
<td>Salt fortification</td>
<td>$ 0.04 per PYP</td>
<td>Jamison <em>et al.</em> (1993), Levinson (1991)</td>
</tr>
<tr>
<td></td>
<td>$ 0.01 per PYP</td>
<td>Stanbury &amp; Hetzel (1980)</td>
</tr>
<tr>
<td>Water fortification</td>
<td>$ 0.04 per PYP</td>
<td>Jamison <em>et al.</em> (1993)</td>
</tr>
</tbody>
</table>
### EXHIBIT 2
COST ESTIMATES OF HEALTH INTERVENTIONS

<table>
<thead>
<tr>
<th>INTERVENTION</th>
<th>COST</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vitamin A Supplementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplements</td>
<td>$ 0.42 per person-year of protection (PYP)</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 0.46-0.68 per PYP in Haiti</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 0.40-0.70 per PYP</td>
<td>Levinson (1991)</td>
</tr>
<tr>
<td>Fortification</td>
<td>$ 0.14 per PYP</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 0.15 per PYP</td>
<td>Levinson (1991)</td>
</tr>
<tr>
<td></td>
<td>$ 0.07 per capita</td>
<td>Berg &amp; Brems (1986)</td>
</tr>
<tr>
<td><strong>Deworming of Children</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>$ 0.80 - 1.80 per child treated (school-based program)</td>
<td>Warren et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 0.36 - 1.62 per person treated (annual costs in a 5-year ascariasis control program)</td>
<td>Guyatt, Bundy, and Evans (1993)</td>
</tr>
<tr>
<td></td>
<td>$ 1.45 - 2.91 per person protected in a schistosomiasis control program in St. Lucia</td>
<td>Barlow and Grobar (1985)</td>
</tr>
<tr>
<td><strong>Filariaeis Treatment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>$251.96 per case-year prevented (mass treatment + indoor spraying)</td>
<td>Rao (1980)</td>
</tr>
<tr>
<td></td>
<td>$13/64 (selective treatment + indoor spraying)</td>
<td>Rao (1980)</td>
</tr>
<tr>
<td>INTERVENTION</td>
<td>COST</td>
<td>SOURCE</td>
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<td>-------------------</td>
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</tr>
<tr>
<td><strong>Immunization</strong></td>
<td></td>
<td></td>
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<tr>
<td>Fixed facilities</td>
<td>$11.20 per fully immunized child (FIC)</td>
<td>Brenzel (1990)</td>
</tr>
<tr>
<td></td>
<td>$0.89 per dose</td>
<td>Brenzel (1990)</td>
</tr>
<tr>
<td>Outreach</td>
<td>$10.60 per FIC</td>
<td>Brenzel (1990)</td>
</tr>
<tr>
<td></td>
<td>$1.36 per dose</td>
<td>Brenzel (1990)</td>
</tr>
<tr>
<td>Campaigns</td>
<td>$15.60 per FIC</td>
<td>Brenzel (1990)</td>
</tr>
<tr>
<td></td>
<td>$1.64 per dose</td>
<td>Brenzel (1990)</td>
</tr>
<tr>
<td><strong>Growth Monitoring</strong></td>
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<tr>
<td>Community-based</td>
<td>$8.00 - 11.00 per child per year</td>
<td>Levinson (1991)</td>
</tr>
<tr>
<td></td>
<td>$2.00 - 20.00 per child</td>
<td>Yee and Zerfas (1987)</td>
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<tr>
<td></td>
<td>$23.17 per beneficiary per year</td>
<td>USAID (1988)</td>
</tr>
<tr>
<td></td>
<td>$8.09 per beneficiary per year ($12.00 including feeding)</td>
<td>Griffiths (1985)</td>
</tr>
<tr>
<td></td>
<td>$3.94 per beneficiary per year (pilot, $2.05 if expanded)</td>
<td>Griffiths (1985)</td>
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<td></td>
<td>$4.00-5.00</td>
<td>Griffiths (1985)</td>
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</tbody>
</table>

**Malaria Prophylaxis for Pregnant Women.** There is very little information about the cost of programs providing chemoprophylaxis to pregnant women. However, it is clear that chemoprophylaxis is only cost effective when compliance is high. The one available study in Malawi found that the cost per compliant woman could be brought down from $1.67 to $1.20 by administering a better-tasting coated form of chloroquine. Only one study is available on the cost of treated bed nets ($3.85 per capita in the Solomon Islands), and another study in The Gambia provides an estimate of the cost of a combined chemoprophylaxis and impregnated bed net intervention ($0.62 per capita). Generally speaking, estimates of the cost to avert a case of malaria vary widely from one country to another (from $2.10 to $259 in one study), as well as estimates of cost per DALY gained ($2.80 to $255). Some traditional Haitian
beliefs may reduce the cost effectiveness of chemoprophylaxis (e.g., the belief that chloroquine induces abortion or that fevers have supernatural causes).

**Oral Rehydration Therapy.** A review of seven studies on the cost effectiveness of ORT programs found that the cost per treatment ranged from $0.70 to $9.66. Other studies have produced similar ranges of estimates. Part of the observed difference in the estimates across countries can be explained by levels of GNP per capita as well as levels of health services involved. A social marketing program in Bangladesh, which distributed more than 25 million ORS packets, reportedly generated sufficient revenue to cover all product costs and most marketing costs. There are very few studies of the cost effectiveness of field-based ORT programs (Martines, Phillips, and Feachem, 1993), and there are no cost effectiveness estimates for ORS social marketing programs. One study produced estimates of cost per death averted (varying between $50 and $20,000) based on hypothetical values of the cost per episode treated (varying between $0.50 and $10.00) and the proportion of cases treated which prevented a death (varying between 0.05 percent and 1.00 percent). Estimates in the range of $50-$1,000 per death averted would appear most appropriate for Haiti. The World Bank (1993a) estimates that the "integrated management of the sick child" (which includes ORT) has a cost of $30-50 per DALY gained.

**Iodine Supplementation.** Cost estimates for iodized oil prophylaxis from the Central African Republic, Peru, Zaire and Indonesia are in the range of $0.07 to $0.46 per person year of protection. Fortification cost estimates are generally lower, in the range of $0.01 to $0.04 per capita, and are the preferred intervention where feasible. Cost-effectiveness estimates are available, in the case of supplements, for programs targeted to reproductive-age women only ($1,250 per death averted, $18.90 per DALY gained) and to the general population ($4.650 per death averted, $37.00 per DALY gained) and for fortification ($1,000 per death averted, $7.50 per DALY gained). However, country-specific factors (e.g., prevalence of iodine deficiency) clearly affect the estimates of cost effectiveness.

**Vitamin A Supplementation.** Estimates of the cost of providing vitamin A supplements typically range from $0.40 to $0.70 per person-year-of-protection (PYP). In Haiti, the cost of providing vitamin A supplements in the form of capsules has been estimated to be $0.46-0.68 per PYP. The cost of fortification is typically about one-third that of providing supplements to the general population. However, success with fortification requires that the population at risk be able to afford the fortified food. Additionally, particularly where deficiencies are concentrated in certain sub-groups of the population, targeting supplements to high-risk populations (e.g., pregnant women, children) through existing prenatal or immunization programs may be a cost-effective alternative to fortification. Estimates of the cost effectiveness of vitamin A supplements given to children under 5 ($325 per death averted, $9.30 per DALY gained) compare quite favorably to estimates of the cost effectiveness of fortification for the total population ($1,000 per death averted, $29.00 per DALY gained). There is no information on the cost effectiveness of vitamin A supplementation in Haiti.

**Deworming of Children.** There are few (if any) actual cost or cost effectiveness estimates for the deworming of school-age children. Estimates of the annual cost of treating school-age children in a hypothetical 10-year program range from $0.80 to $1.80; estimates of the cost per DALY gained range from $6 to $33. Deworming of school-age children is believed to be cost-effective because: (1) infection rates are highest in this age group; (2) school-age children are most at risk for growth and developmental effects of helminthic infections; (3) the school setting is convenient for treatment and follow-up testing and evaluation; and (4) treatment of school-age children reduces the risk of adult infection. Prescott (1987) has shown that several factors affect the cost effectiveness of deworming in a given setting.
including: (1) the treatment strategy (mass versus selective treatment); (2) compliance rates; (3) costs of treatment; and (4) rates of infection.

**Filaria Treatment.** The effectiveness of chemotherapy is limited by compliance rates, which have been low in the past. The problem of low compliance rates has been addressed by the substitution of selective treatment (involving prior screening) in some settings. However, mass chemotherapy in highly endemic areas (i.e. urban and peri-urban slums), using ivermectin, would appear to be a more cost-effective approach. The most cost-effective service delivery approaches probably involve integrating filariasis treatment into existing maternal/child health programs and into school-based anti-helminthic treatment programs. The use of community-based health workers to treat filariasis is also a promising alternative in Haiti. Unfortunately, there is little information on either the costs or cost effectiveness of filariasis treatment programs. However, one would expect the cost of chemotherapy to be similar to that of other anti-helminthic interventions. Its effectiveness, due to variations in compliance, would depend on the type of drug used (DEC or ivermectin). Given that its principal health effects are chronic (i.e., there is no mortality effect on children), with the greatest effects being felt among older adults (and therefore quite sensitive to any discounting), it is unlikely that filariasis treatment compares favorably on a cost per DALY gained basis to a number of alternative interventions, such as immunization and vitamin A supplementation.

**Immunization.** A review of costs of EPI programs in eight countries in Africa and Asia yielded estimates of the cost per fully immunized child ranging from $4.47 to $19.48. Costs tend to vary according to the delivery strategy employed, with the highest costs observed in connection with mass immunization campaigns. For example, one study in Haiti compared the cost per dose for all immunizations given at fixed facilities ($0.89) and at rally posts ($0.95) to those given during National Vaccination Days ($1.64). The cost effectiveness of fully immunizing children is estimated to be $25 per DALY gained. Tetanus immunization is generally most cost effective ($110 per death averted, $2-10 per DALY gained). In one project in Haiti, targeted to the entire population, the estimated cost per death averted was $115 (in 1989 dollars), with a benefit-cost ratio of nine. Since studies indicate that immunization costs tend to decline with coverage rates up to 80 percent, the fact that Haiti's coverage is presently low suggests that unit costs could be expected to decline.

**Growth Monitoring and Promotion (GMP).** Few estimates of the cost of GMP are available, due partly to the fact that GMP is often combined with other preventive health interventions. Estimates of the annual cost per beneficiary in a few community-based GMP programs range between $4.00 and $26.00. In the Iringa project, the cost per death averted was estimated to be $2,560 and the cost per DALY gained, $82. No other cost-effectiveness estimates for GMP are available. Moreover, some available studies cast doubt on the effectiveness of growth monitoring as an intervention. An important issue is whether growth monitoring itself contributes any independent effect to integrated packages of treatment, food supplements and nutrition education. It has also been questioned whether screening itself is cost effective in high prevalence areas. However, GMP may be relatively cost effective in Haiti due to the high prevalence of severe PEM.
<table>
<thead>
<tr>
<th>INTERVENTION</th>
<th>COST EFFECTIVENESS</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Supply and Sanitation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>$3,600 - 4,300 per infant/child death averted</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td><strong>Malaria Prophylaxis of Pregnant Women</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemoprophylaxis</td>
<td>$2.10 - $259 per case averted</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$1.09-10.87 per case averted (depending on the compliance rate)</td>
<td>Hellitzer-Allen et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$2.80 - $255 per DALY gained (benefit-cost ratios of 2.4 to 146)</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td>Bed nets</td>
<td>Benefit-cost ratio of 1.77</td>
<td>Shepard, Ettling &amp; Sauerborn (1991)</td>
</tr>
<tr>
<td><strong>Oral Rehydration Therapy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic-based ORT</td>
<td>$100 - 500 per death averted (hypothetical; assumes treatment costs range from $1.00-5.00 per episode and that 1 percent of cases treated avert a death)</td>
<td>Martines, Phillips, and Feachem (1993)</td>
</tr>
<tr>
<td>Integrated management of the sick child (includes ORT)</td>
<td>$30 - 50 per DALY gained</td>
<td>World Bank (1993a)</td>
</tr>
<tr>
<td><strong>Iodine Supplementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women of reproductive ages only</td>
<td>$1,250 per death averted</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$18.90 per DALY gained</td>
<td></td>
</tr>
<tr>
<td>All persons under 60</td>
<td>$4,650 per death averted</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$37.00 per DALY gained</td>
<td></td>
</tr>
<tr>
<td>Fortification</td>
<td>$1,000 per death averted</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td></td>
<td>$7.50 per DALY gained</td>
<td></td>
</tr>
</tbody>
</table>
# Exhibit 3

## Cost Effectiveness of Health Interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Cost Effectiveness</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A Supplementation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supplements (children under 5 years of age)</td>
<td>$325 per death averted $9.30 per DALY gained</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td>Fortification</td>
<td>$1,000 per death averted $29.00 per DALY gained</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td>Deworming of Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-based chemotherapy (intestinal helminths and schistosomiasis)</td>
<td>$6 - $33 per DALY gained (hypothetical)</td>
<td>Warren et al. (1993)</td>
</tr>
<tr>
<td>Chemotherapy (ascariasis)</td>
<td>$2.82 - 27.88 per disease case prevented (hypothetical effectiveness, actual cost data)</td>
<td>Guyatt, Bundy, and Evans (1993)</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>Benefit cost ratio of 1.7</td>
<td>Barlow and Grobar (1985)</td>
</tr>
<tr>
<td>Ascariasis</td>
<td>Benefit cost ratio of 6.4</td>
<td>Barlow and Grobar (1985)</td>
</tr>
<tr>
<td>Filariasis Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemotherapy</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Immunization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Immunization</td>
<td>$25 per DALY gained</td>
<td>World Bank (1993)</td>
</tr>
<tr>
<td>Measles</td>
<td>$462-561 per death averted $10-19 per DALY gained</td>
<td>World Bank (1993)</td>
</tr>
<tr>
<td>Tetanus</td>
<td>$110 per death averted $2-10 per DALY gained $115 per death averted Benefit-cost ratio of 9</td>
<td>Jamison et al. (1993) Berggren (1974)</td>
</tr>
<tr>
<td>DPT/Polio</td>
<td>$670-1,600 per death averted $20-42 per DALY gained</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>$7 per DALY gained</td>
<td>Jamison et al. (1993)</td>
</tr>
<tr>
<td>Growth Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community-based programs</td>
<td>$2,560 per death averted $87 per DALY gained</td>
<td>Pinstrup-Andersen et al. (1993)</td>
</tr>
</tbody>
</table>
5.0 SYNERGIES

Synergies include both cost and effectiveness synergies, as discussed above. The synergies between the interventions reviewed in the present study are summarized in Exhibit 4.

5.1 Cost Synergies

The present study found evidence of cost synergies with respect to the following interventions:

- The cost of Vitamin A and iodine supplements will be lower for children of immunizable ages (e.g., under one or two years of age) if these two interventions can be integrated into an existing immunization program, and lower for women of child-bearing ages if they can be integrated into a prenatal care program.

- Iodinization of water, as an approach to providing iodine supplements, is only technically feasible where WS&S projects have been carried out.

- Anti-helminthic chemotherapy using invermectin is effective against a wide array of helminths, including those which cause filariasis.

- Impregnated bed nets provide protection against both malaria and filariasis.

- Malaria prophylaxis for pregnant women can be provided at lower cost in the presence of effective prenatal care programs. In this case, the additional cost of malaria prophylaxis ought to be limited to the cost of the medication (chloroquine), training of health workers, and health education materials. Compliance can also be monitored (e.g., using urinanalysis) at relatively low cost in prenatal care programs.

- The cost of a social marketing of ORS program may be lower in the presence of a strong social marketing program for other commodities, such as contraceptives, to the extent that some of the skills and experience gained is transferable.

5.2 Effectiveness Synergies

There were a few positive effectiveness synergies found between the interventions reviewed in this study:

- Growth monitoring, to the extent that it requires periodic contacts with the health system, has been shown to boost coverage rates for immunization, the administration of vitamin A or iodine supplements, and other preventive measures.
There may be positive effectiveness synergy between ivermectin and ABZ (another anti-helminthic), such that administering both drugs in combination may enhance the effectiveness of ivermectin against filariasis.

The long-run effectiveness of deworming of children and filariasis treatment is inversely related to rates of reinfection, which are reduced by sanitation programs. On the other hand, by reducing the incidence of filariasis, sanitation programs reduce the short-run benefits from treating filariasis and other helminth-caused diseases. Although these relationships are complex, one possibility is that deworming and filariasis treatment might be particularly cost effective immediately following sanitation projects, since under these conditions one might encounter both high rates of previous infection and low rates of subsequent reinfection.

At the same time the study cited evidence of negative synergies among several of the interventions studied:

- ORT programs reduce mortality (but not morbidity) from many of the diseases caused by the absence of safe water and sanitation services. Accordingly, where effective ORT programs exist, the cost effectiveness of WS&S may be reduced. Conversely, where WS&S projects have been successfully carried out, the cost effectiveness of ORT may be lower. In some cases, both interventions may be cost effective in combination; however, a choice between the two—where that appears to be appropriate—ought to be determined by local conditions.

- Vitamin A supplementation may have a negative effectiveness synergy with measles immunization. Mortality from measles has been found to be higher in populations with vitamin A deficiency. Conversely, the risk of blindness from vitamin A deficiency appears to be heightened in association with measles.4

- ORS and measles immunization may also have a negative effectiveness synergy, since diarrhea is a common cause of mortality in children infected with measles. However, it has been suggested that ORT is unlikely to be effective in the case of the severe diarrhea which occurs with measles, so that there may be no synergistic relationship between these two interventions (i.e., their effects may well be additive).

- There may be negative effectiveness synergy between measles immunization and growth monitoring. Mortality rates from measles are higher in malnourished children, suggesting that the effectiveness of measles immunization may be lower in the presence of an effective growth monitoring program. Conversely, since measles infection is often a precipitating cause of severe malnutrition, the effects of a growth monitoring program may be somewhat lower in populations with high rates of measles vaccination coverage.

4 Again, it is important to distinguish between the concepts of mutual reinforcement (both of these interventions are mutually reinforcing) and synergy (independence of effects).
There may be negative effectiveness synergy between growth monitoring and ORT. Where ORT is practiced effectively, diarrheal disease would have less adverse impact on nutritional status and, consequently, the cost effectiveness of growth monitoring might be lower. On the other hand, there are probably positive synergies between growth monitoring and deworming of children. Children identified as falling behind nutritionally can be given deworming medicines.

The present study also underlines the importance of strong health education programs in order to obtain maximum effectiveness from all of the interventions considered. Although health education is not, strictly speaking, one of the interventions considered, it has strong positive synergies with some of the interventions studied. For example, a number of studies have found that the most successful WS&S projects occur in the presence of effective health education programs. In the absence of health education, the intended beneficiaries of WS&S projects do not make effective use of sanitation facilities in particular. Similarly, health education is important in raising compliance rates for malaria prophylaxis among pregnant women and in encouraging the use of ORS.

A negative synergy was found to exist between malaria prophylaxis for pregnant women and iron supplements to treat anemia, i.e., another intervention not considered in the present study. Some studies have shown that parenteral administration of iron supplements has been followed by increased frequency and intensity of malaria. In addition, because it decreases the prevalence of anemia, malaria prophylaxis reduces the cost effectiveness of iron supplementation, with which it therefore also has a negative synergy.
EXHIBIT 4
SYNERGIES BETWEEN INTERVENTIONS STUDIED
(Cost Synergies are indicated above the diagonal; effectiveness synergies are indicated below the diagonal)

<table>
<thead>
<tr>
<th>Safe Water Supply</th>
<th>Sanitation</th>
<th>Malaria Prophylaxis</th>
<th>Social Marketing of ORS</th>
<th>Iodine Supplementation</th>
<th>Vitamin A Supplementation</th>
<th>Deworming of Children</th>
<th>Filariasis Treatment</th>
<th>Immunization</th>
<th>Growth Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe Water Supply</td>
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<tr>
<td>Sanitation</td>
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<tr>
<td>Malaria Prophylaxis</td>
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<tr>
<td>Social Marketing of Oral Rehydration Salts (ORS)</td>
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<tr>
<td>Iodine Supplementation</td>
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<td>+</td>
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<tr>
<td>Vitamin A Supplementation</td>
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<td>+</td>
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</tr>
<tr>
<td>Deworming of Children</td>
<td>+</td>
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+ (-) indicates a positive (negative) synergy between two interventions.
6.0 HAITIAN EXPERIENCE

As mentioned above, the current USAID Child Survival Project includes three of the nine interventions considered in the present study, i.e., immunization, vitamin A supplementation, and growth monitoring. In addition, both water supply and sanitation and the social marketing of ORS have been supported by previous projects. This previous experience is summarized below:

Water Supply & Sanitation. USAID has implemented WS&S projects throughout Haiti since 1975, the largest of which have been implemented by CARE. Water systems have been mostly drilled wells and slow gravity systems. International donors have financed small systems in over 100 communities and the expansion of systems in seven towns. Locally available materials have been used, and some projects have included food-for-work components. Approaches to sustainability have included training community members and assessing nominal user fees. Both Church World Service (CHS) and CARE encountered a number of problems in their WS&S projects in Haiti, including poor community participation, poor agency coordination, poor management and supervision, inadequately trained personnel, and limited ability to collect user fees.

Malaria Prophylaxis for Pregnant Women. USAID and other donors have supported a number of projects over the years in Haiti intended to control and treat malaria. Although these efforts led initially to decreases in malaria prevalence, they may also have contributed to the development of chloroquine-resistant strains. There have not been any projects which specifically targeted pregnant women.

Social Marketing of ORS. ORS has been distributed through clinic-based and outreach services in both the public and private sectors, as well as through community-based distribution in the private sector. An ORS social marketing program, funded by WHO, USAID and UNICEF, was initiated in 1983. Locally produced ORS packets, using WHO's formula, were marketed by grocery stores, medical facilities and pharmacies. ORS knowledge and use increased initially; however, use rates returned to pre-program levels when the project was terminated after one year. One obstacle to ORS use has been the attitude of health workers, who view it as a second-rate treatment. Due to inadequate health education, people expected ORS to cure diarrhea and were consequently disappointed by its inefficacy. Although some of these deficiencies have been addressed in subsequent projects, ORS continues to be unavailable in many rural areas.

Iodine Supplementation. Nothing is known about the Haitian experience in providing iodine supplementation, whether through supplements or fortification. However, the fact that Haiti has successfully included vitamin A supplements in its extended immunization program suggests that iodine supplementation would be feasible.

Vitamin A Supplementation. Beginning in 1989, the USAID-funded NOVA project supported the delivery of vitamin A supplements to children in two northwestern districts of Haiti. Vitamin A capsules were distributed at 243 rally posts (postes de rassemblement), as well as at home to children who did not attend the rally posts. This project also funded a study of the impact of vitamin A supplements on mortality and morbidity, but unfortunately the study has not yet been completed. Vitamin A supplements have also been distributed by the Ministry of Health, but there have been frequent stock-outs.
Deworming of Children. We could find no information about any Haitian experience with deworming interventions, apart from filariasis treatment programs (see discussion below).

Filariasis Treatment. There have not been any national-level efforts to control filariasis in Haiti. However, there have been a number of operations research studies conducted in the area surrounding the town of Leogane, 30 kilometers west of Port-au-Prince. These studies concern the short- and long-run effectiveness, as well as side effects, of alternative doses and regimens of DEC and ivermectin. No findings are yet available.

Immunization. Haiti's immunization program began in 1979 as a clinic-based program which gradually expanded to a variety of outreach mechanisms, including rally posts and mobile horse teams. Because coverage remained low, mass campaigns were initiated in 1988 (3) and 1989 (2). The campaigns were successful in raising coverage for all immunizations except tetanus toxoid. However, as noted above, campaigns have been found to be much less cost effective than other approaches. Major problems to overcome include overall low coverage rates, high drop-out rates, poor management (particularly in the public sector program), and low motivation on the part of public sector employees. The program is also heavily dependent on donor funding.

Growth Monitoring. Growth monitoring and promotion (GMP) activities, as part of integrated preventive health outreach services, have been conducted in Haiti since the early 1970s. USAID-funded GMP activities in the Cayes district of Haiti in the early 1980s were associated with higher immunization rates, greater use of ORS, and higher coverage of vitamin A supplementation. However, a PRICOR review of GMP activities in Haiti found that the quality of services provided was very poor, particularly in the areas of nutrition counseling and follow-up.
7.0 CONCLUSIONS AND RECOMMENDATIONS

The present study suggests that the most cost-effective package of child survival and maternal health interventions for Haiti would include:

- immunization;
- vitamin A supplementation for children of immunizable ages and women of child-bearing ages;
- social marketing of ORS; and
- iodine supplementation for children of immunizable ages and women of child-bearing ages.

The reasons for selecting this set of interventions are as follows:

- The cost per DALY gained for these interventions is generally quite favorable, i.e., $25 for full immunization, $9.30 for vitamin A supplementation, $30 - $50 for ORS, and $18.90 for iodine supplementation of women;
- All four of interventions have important positive cost synergies. Micronutrient supplements can be provided to children of immunizable ages (and to their mothers) as part of an enhanced immunization program. Mothers can be educated about the value and correct use of ORS to reinforce the social marketing program when their children are immunized (i.e., at the very ages at which diarrhea is most serious as a threat to survival).
- Immunization coverage rates are still very low in Haiti, suggesting that unit costs can be expected to fall until coverage rates rise to 80 percent or more;
- There is considerable experience in Haiti with three of the four proposed interventions (iodine supplementation is the exception).

The enhanced immunization program should be clinic-based, with a strong outreach component (i.e., use of rally posts), and should attempt to provide micronutrients to mothers as well as children. Campaigns and other accelerated strategies of service delivery should be used selectively, e.g., in areas which are not covered by the existing health infrastructure. The enhanced immunization program will also require a strong health education component.

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5 These cost savings should more than compensate for the possibility that the effects of measles immunization and vitamin A supplementation are less than additive (i.e., negative effectiveness synergies).
Malaria prophylaxis for pregnant women should be considered as well for possible inclusion in a new project, particularly if the existing prenatal care program were to be strengthened. In this case, there would be strong cost synergies between the provision of chloroquine and micronutrients (vitamin A, iodine) to pregnant women as part of a strengthened prenatal care program. There would also be effectiveness synergies between the prenatal program and the child survival interventions (i.e., immunization, micronutrients, and ORS).

The rationale for including the other interventions studied in a new project is less clear:

- Although currently supported by the ongoing Child Survival Project, growth monitoring has not been very effective in Haiti because it requires a strong health system to provide counseling and follow-up care. A new project would have to address these weaknesses before continued support for this intervention would be cost effective.

- Relatively little is known about the health effects of various helminthic infections, except that they are rarely life threatening. The deworming of school-age children may also be cost-effective; but it is unlikely that mass deworming would be cost-effective.

- Filariasis treatment, apart from its inclusion in a school-based program, is unlikely to be cost-effective. Its effects are chronic and are most severe among older age groups.

- Water Supply and Sanitation programs have not been uniformly successful in Haiti. Although potentially cost effective, particularly when combined with cost recovery and health education, WS&S programs require somewhat stronger institutional support than Haiti currently can provide.

This review has emphasized the value of a strong health education program to all of the interventions proposed for inclusion in a new project. It is our recommendation that Haiti’s health education program be strengthened through the new project.

An important objective of this study has been to assess the reliability of the available information on the cost effectiveness of the nine health interventions considered, including the applicability of the available findings to Haiti. Our findings with respect to these issues can be summarized as follows:

- Of the nine interventions studied, only two (water supply and sanitation and immunization) have benefited from careful and systematic efforts to measure costs and cost effectiveness. Given the breadth and complexity of water supply and sanitation projects, as well as their outcomes, only the estimates for immunization provide a fairly solid basis for decision-making.

- The literature indicates that the cost-effectiveness of all interventions should vary significantly according to individual country circumstances, including labor costs, managerial efficiency, available infrastructure, disease incidence, and other factors. Findings from other countries, even if technically sound, might therefore provide only a very crude indication of the cost effectiveness of an intervention in Haiti.
Much of the information on synergies is speculative and anecdotal in nature. There are few quantitative estimates of how synergies would affect the cost-effectiveness of a given combination of interventions. Moreover, the literature suggests that the synergies themselves would be country-specific.

In light of these observations, it would be appropriate to design a strong evaluation component into any new health project. Ideally, in order to generate the information needed for effective evaluation, the project would be phased into randomly selected intervention areas, collecting baseline and follow-up data on health outcomes and inputs in both the intervention and control areas. One particularly effective design would involve introducing interventions into a set of randomly selected clusters from a DHS survey (which would provide baseline data) in an initial phase, maintaining another set of clusters as "controls," but which would receive the intervention in subsequent phases. Since most interventions need to be phased in gradually in any case, and since random selection of the sites for the initial phase is an ethical solution to selecting sites for the first phase, such an evaluation design would be both ethical and practical.
BIBLIOGRAPHY

Background Papers:


Basic References:


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