Commentaries

Water Supply and Health in Developing Countries: Selective Primary Health Care Revisited

JOHN BRISCOE, PHD

Abstract: The inclusion of water supply and sanitation programs as a component of primary health care (PHC) has been questioned on the basis of calculations of the costs of these programs per infant death averted. In this paper the procedures used in these cost-effectiveness calculations are examined and found to be wanting. The calculations are misleading since gross rather than net costs have been used, and the health impact of these programs underestimated. It is also shown that the methodology used is biased against water supply and sanitation and other programs with multiple outputs.

The time constraints facing mothers in implementing PHC programs, as well as the contribution of improved water supplies in alleviating these constraints are outlined. Data are presented to show that, if poor women in developing countries were to choose the mix of activities to be included in PHC programs, improved water supplies would frequently constitute part of that mix. (*Am J Public Health* 1984; 74:1009–1013.)

Introduction

At the Alma Ata Conference in 1978, the concept of primary health care (PHC) was defined and the concept endorsed by all participating countries as key to the attainment of "Health for All." The Alma Ata definition of PHC was comprehensive, including in particular:

> "education concerning prevailing health problems and the methods for preventing and controlling them; promotion of food supply and proper nutrition; an adequate supply of safe water and basic sanitation; maternal and child health care, including family planning; immunization against the major infectious diseases, prevention and control of locally endemic diseases; appropriate treatment of common diseases and injuries; and provision of essential drugs".[1]

SPHC: A New Concept

Shortly after Alma Ata two biomedical scientists, Walsh and Warren, published a critique of this PHC concept and proposed an alternative "Selective Primary Health Care" (SPHC)[2] concept which has received widespread and generally favorable attention in the scientific and development communities.

The reasoning behind the concept of SPHC is simple. Because of limitations on the resources available to developing countries for implementing all components of the original PHC program, it is necessary to examine each possible item in the overall program individually, determine what the costs of implementing that component are, and what the effectiveness of the component is in reaching any particular objective such as reducing infant mortality. The components are then ranked in terms of cost-effectiveness, and the Selective Primary Health Care program designed to include the most cost-effective items within the overall budgetary constraints pertaining in any particular circumstances.

Address reprint requests to John Briscoe, PhD, Assistant Professor, Department of Environmental Sciences and Engineering, School of Public Health, University of North Carolina, Chapel Hill, NC 27514. This paper, submitted to the Journal September 30, 1983, was revised and accepted for publication March 5, 1984.

The SPHC package emerging from the cost-effectiveness calculations is almost exclusively medical, e.g., measles and diphtheria-pertussis-tetanus vaccinations, treatment for febrile malaria, oral rehydration for diarrhea in children, and tetanus toxoid in mothers. Biomedical research for the development of vaccines and therapies for major tropical diseases is also considered cost-effective. More systemic non-medical activities in general, and community water supply and sanitation programs in particular, are rejected as being non-cost-effective.

Subsequently, the SPHC approach in general, and the downgrading of water supply and sanitation, in particular, seem to have been accepted implicitly by many development agencies.[3,4] Just three years after the proclamation of the International Drinking Water Supply and Sanitation Decade by the United Nations General Assembly, the Decade is being pronounced "dead" in some quarters.[5]

Since the implications of the SPHC approach for a sector as traditionally important as that of water supply and sanitation are so drastic, it is imperative that the SPHC analysis be reviewed thoroughly to ensure that the methodology and data used are sound. The purpose of this paper is to conduct such a review, focusing on the specific example of community water supplies. First, the details of the cost-effectiveness calculations concerning water are reviewed, then the basis for choosing the measures of effectiveness is examined, and finally the applicability of the SPHC methodology examined for programs which fulfill multiple objectives is assessed.

Cost of Water Supply, Sanitation Programs per Infant Death Averted

The data used in the SPHC calculations for the capital costs of water supply and sanitation programs are based on recent and widely verified World Bank data. Aside from noting that in certain circumstances (such as tubewells in rural Bangladesh,[6] and ventilated improved pit latrines in Zimbabwe[7]), the per capita costs may be an order of magnitude lower, there is no basis for disagreement with the cost data used.

In cost-effectiveness calculations, however, it is the *net* rather that the *gross* cost which should be used. In the case

TABLE 1—The Quantities of Water Used and Expenditures on Water in Lima, Peru

Quality of Service	Quantities Used (liters per capita per day)	Monthly Household Expenditures on Water (soles)*
Poor (vendors)	23	105
Medium (standpipe)	78	22
Good (house connection)	152	35

*At the time of the study (1972), the exchange rate was: 1 US dollar = 43 soles.

TABLE 2—The Effect of Water Supply and Sanitation Programs in 24 Non-Intervention Studies[13]

Parameter Affected	Number of Studies	Per Cent Reduction in Diarrheal Diseases (median)
Water quality	6	30
Water availability through standpipes	11	34
Quality and availability	4	40
Excreta disposal	8	40

of water supplies, this makes an enormous difference, since many poor people (particularly in urban areas) already pay substantial amounts of money for poor quality water supplies. A well documented but by no means unique case is that of Lima, Peru,[8] the results of which are summarized on Table 1.

Table 1 shows that improvements in the quality of water supply service in urban areas may be associated not with an *increase* but a *reduction* in the monetary costs of the supply, a finding by no means unique to Lima. One of the most experienced water supply engineers in the world has found this phenomenon to be virtually universal in developing countries and has concluded that "if daily expenditures made to a water carrier were invested instead in a proper piped supply, far more economical and better water service could be provided."[9]

In terms of a cost-effectiveness analysis then, the net economic cost of such water supply improvements may be much smaller than the gross cost of the project, since much, or often all, of the costs can be covered by redirecting expenditures which are already being made by the population for an inferior water supply service. Since the Third World is urbanizing rapidly, since similar willingness-to-pay is often demonstrated by rural inhabitants,[10] and since those urban dwellers (i.e., the poor) who pay high costs for poor water supplies are also those urban dwellers with the highest incidences of disease, this phenomenon is of major importance in terms of improving health through the investment of relatively few outside resources.

Turning to the effectiveness half of the cost-effectiveness calculations, an assessment of the likely impact of water supply and sanitation programs on health is far more problematic than the assessment of the effects of other components of PHC which operate more directly on the causes of disease. Thus while it is a relatively straightforward (although not trivial) task to calculate the effects of a tetanus or measles vaccine on death rates, a similar assessment of the effects of a water supply and sanitation program is fraught with methodological problems,[11] and great caution should be exercised in interpreting the results of such studies.[12]

In the SPHC analysis of the cost-effectiveness of community water supplies, only a small sample of the large number of available impact studies was examined and universal conclusions were drawn which are not supported by a more comprehensive and searching assessment of the literature. From the few studies used in the SPHC analysis, it was concluded that water supplied through public standpipes would effect only a very small reduction (about 5 per cent) in the incidence of diarrheal diseases. A recent, comprehensive review of the literature on the health effects of water supply and sanitation programs,[13] however, reveals that the impact of these programs is typically an order of magnitude greater (Table 2).

It is evident then that the figures used for both the cost and the effectiveness parts of the cost-effectiveness calculations for water supply and sanitation programs are seriously in error.

Criteria Used for Assessing the Effectiveness of Health Programs

What are the Objectives and Who Decides on These?—Health is a multi-faceted concept. At the most elementary level it is possible to categorize by diagnosis and severity of effect (degree of disability and death), and by age group affected (infant, child, or adult). A fundamental difficulty in comparing different health programs is that typically different programs affect different facets of health. One program, for example, may affect infant mortality only, while another might affect infection, disease, disability, and mortality in all age groups.

Decision theory offers only some simple concepts in suggesting how to analyze trade-offs between programs which affect different facets of health in this way. With reference to Figure 1, decision theory tells us only that, if outcome 1 and outcome 2 are both desirable, and if the costs of the programs represented on the diagram are equal, then program B is always preferable to program A and program C is always preferable to program A (a concept known as "Pareto optimality"). Decision theory tells us explicitly that, if we are unable to reduce outcome 1 and outcome 2 to a common measure (such as dollars), then the only way of resolving whether program B is preferable to program C is to submit the choice to decision makers and have them tell us which program is preferable.

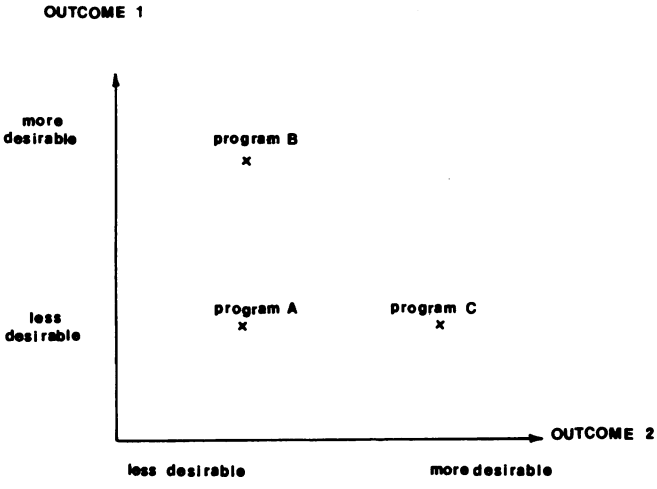

FIGURE 1—The Choice of Programs with Multiple Outcomes

It is immediately apparent then that in attempting to compare different health programs two questions are of fundamental importance, namely: what are the outcomes which will be considered?; and who will be the judges of the trade-offs between these outcomes?

A first concern with the procedure followed in the SPHC calculations is the choice of criteria and the consistency in applying these to the components of PHC. For the most part, the SPHC approach considers reductions in infant mortality to be the unique criterion of interest, thus comparing, for example, the cost per infant death averted through water supply programs, immunization programs, and oral therapy programs. In the case of certain health programs, such as an onchocerciasis control program, however, the objective of the program is obviously not averting infant deaths and so, correctly, in the SPHC calculations the onchocerciasis program is not compared to other programs on the basis of the number of infant deaths averted.

The case of water supply and sanitation is rather more complex, for while infant death reduction is *one* outcome, it is by no means the *only* outcome. Just as it would be incorrect to compare an onchocerciasis program with an oral rehydration program on the basis of infant deaths averted, so the only consistent procedure would be to not use the criterion of "infant deaths averted" to compare a program with multiple impacts (such as a water program) with a program the sole purpose of which is to avert infant deaths (such as an oral rehydration therapy program). In the SPHC analysis, however, water supply and sanitation programs are compared with programs aimed specifically at reducing infant mortality and, not surprisingly, it is concluded that the programs which affect only infant mortality are more effective than programs which have multiple impacts. As Berman has pointed out in a review of the SPHC methodology, "cost-effectiveness comparisons tend to undervalue interventions which provide important outcomes other than the one being considered" and are thus "particularly inappropriate where programs produce a broad mix of benefits."[14]

Trade-offs between different outcomes cannot be considered in isolation from the decision as to who will make such trade-offs. Where different criteria of effectiveness are used, the ranking of alternative programs on a cost-effectiveness basis will generally differ. For example, in the case of cholera, whereas rehydration therapy has been shown to be less costly and more effective in saving lives than has immunization, if morbidity reduction becomes the objective, the results of a cost-effectiveness analysis would be reversed.[15]

Rather than proposing an alternate set of objectives to those used in the SPHC approach, we suggest that it is more appropriate to follow the counsel of John Grant, who argued that primary health care and other development programs should follow "the principle of inherent need and interest," in which "projects in a village should grow out of its own needs and interests, and not be superimposed,"[16] and argue that the trade-offs between the outputs of PHC programs be done in light of the expressed needs of the families involved. In assessing actual practices, however, attention has to be given to the fact that families, like villages, are not division-free entities; it is therefore necessary to go one step further and ask whose interests in the family should be given greater weight. In the following sections, we suggest that the group whose needs are most important in terms of the health of the community in general and young children in particular are mothers. The constraints faced by mothers in implementing health care programs are assessed, and the contributions of water supply programs to lifting these constraints are evaluated.

Women as the Front-Line Health Care Workers: Some Constraints

The core elements of PHC programs—such as breast-feeding, supplementary feeding, oral rehydration therapy, and household hygiene—involve the mother as the front-line health worker. Indeed, the objective of PHC programs may be described as the improvement of "mothering, the poorly-defined but crucial interactions between mother and child that form the principal determinants of health, growth and development."[17]

To carry out the complex and demanding task being set for her by PHC programs, the mother faces four principal constraints: technology, knowledge, resources, and time. One way of visualizing PHC programs is that these programs are aimed at relieving the mother of one or more of these constraints so that she may become a more effective mother.

The SPHC method focuses largely on the first of these four constraints, technology. While there is no doubt that technological advances, such as improved vaccination programs and oral rehydration therapy, open new vistas in terms of the potential for child health in developing countries, the provision of improved technology alone is insufficient, for usually the effective implementation of such technology requires simultaneous inputs of knowledge, resources, and time on the part of the mother.

A recent workshop on "Women in Poverty"[18] examined these and other constraints which limit the involvement of women in the development process. Studies in many developing countries showed that women work extremely hard (an average of 10–11 hours per day of active home and market production) and are often extremely poor (especially in female-headed households which constitute a large [15 per cent to 35 per cent] and growing proportion of total households).[18] The workshop concluded that, for poor women in developing countries "saving time *is* development, for time saved from humdrum tasks is time to invest in human capital," and that priority should be given to "technologies that reduce the time women and children spend fetching wood and water and preparing food."[18]

This general finding on the severity of time constraints on mothers is particularly important in PHC, for many of the principal components of PHC are time-intensive activities. For instance:

- *Breast-feeding*—Studies throughout the world have shown that where women work outside of the home, they do not have the time available to breast-feed their babies, with the result that the inputs of knowledge and technology provided by the breast-feeding promotion programs cannot be translated into improved child-rearing practices.[18]
- *Oral Rehydration Therapy*—In the words of a definitive recent review of oral therapy, "continually giving a sick infant large volumes of liquid by spoon or cup is time-consuming, tiring and inconvenient, (and) for an overburdened mother with other children plus household and farm work to do, ORT may require the commitment of more time and energy than she can easily provide."[20]
- *Clinic-based Supplementary Feeding and Other Programs*—Studies throughout the developing world have shown that clinic attendance drops off dramatically as the distance to a clinic increases[21] and that women in the labor force are frequently unable to avail themselves of clinic-based programs because of the constraints on their time.[22]

• *Food Preparation and Storage*—Recent longitudinal studies in Bangladesh[23] and the Gambia[24] have documented the vital role of food contamination on the transmission of diarrheal diseases, an effect which becomes particularly marked when great demands are made on the time of the mother. In the Gambia, for instance, at the peak diarrheal transmission season, "feeding of small children is particularly haphazard . . . infants may be left in the compound in the care of young nursemaids with a supply of porridge or gruel for the next 8 or 9 hours, and food for the evening meal is sometimes stored overnight."[24]

In sum, the great demands placed on the time of Third World mothers constitute a serious barrier to the implementation of PHC, with these constraints often being particularly acute at those times of the year when children have most need of additional health care[25] and in low-income families where the incidence of illness is greatest.[26]

Time Required for Water Collection

The impact of the installation of a convenient village water supply system on the time spent by women and children in carrying water has been documented throughout the world.[27] To give just a few of many examples: in the lowlands of Lesotho, 30 per cent of families spend over 160 minutes per day collecting water[28]; as a result of improved water supplies in the Zaina scheme in Kenya about 100 minutes per household per day are saved from the water-collecting activity[29]; in East Africa rural families spend up to 264 minute per day carrying water[30]; in East Nigeria families spend up to 300 minutes per day collecting water.[28] Studies in Asia (e.g., the Philippines[22] and Thailand[10]) have also documented the substantial amount of time spent in collecting water in many areas.

Felt Needs of Low-income Women

It is clear, then, that a major constraint on poor women's "discretionary activities" (including child care) is the enormous demand made on their time for the performance of repetitive time-consuming tasks, and that in many rural communities the fetching and carrying of water is one of the most important of these tedious tasks. What do the low-income women of the Third World have to say about this when they are asked about these trade-offs, when they are treated, as Halfdan Mahler would have, as subjects and not just as objects in the development process?

In looking for answers to this question it bears repeating that societies, in general, and societies in developing countries, in particular, are typically sharply divided along class and sex lines. It has been argued that particular attention should be paid to the concerns of poor women, yet determining the concerns of this largely disenfranchised group is not simple, for two main reasons. First, the sexual division of labor is universal, with the time-consuming tasks performed by women seldom if ever being performed by men, and, second, "the decision-makers or leaders in the agencies and in the target communities are usually men and they communicate with other men and not with the women."[31] Thus, as has been documented for Kenya, [31] the reduction in time-consuming tasks like fetching and carrying water is a high priority need for rural women but is typically given low priority when the "village leaders" (men) are asked for their opinion.

Where surveys of community needs have taken account of such factors, throughout the developing world, water supply has ranked high on the list of expressed priorities.[10,32] In a recent review of the findings of surveys of low-income women in developing countries, water supply improvements were found to "rank right alongside the most basic human need (adequate food) in many (such) surveys."[26]

Discussion

Returning to the simple decision model outlined earlier, it is apparent that the cost-effectiveness calculations of the SPHC approach are fundamentally flawed when dealing with community water supplies. If appropriate procedures were to be used for determining the net costs of improved supplies, if all available information on health impact was to be considered, if impacts other than just improvements in infant mortality were to be included, and if poor women themselves were to be asked to weigh the relative benefits, then it is apparent that community water supplies would be high priority items in those (large) areas of the developing world where access to adequate water supplies is restricted. Not surprisingly, in many countries in which PHC programs have been successfully implemented,[33–36] improvements in water supply and sanitation have been an integral part of development policy.

REFERENCES

1. World Health Organization: Declaration of Alma Ata, Report on the International Conference on Primary Health Care, Alma Ata, USSR, September 6–12, 1978. Geneva: WHO, 1978.
2. Walsh JA, Warren KS: Selective primary health care: an interim strategy for disease control in developing countries. N Engl J Med 1979; 301:967–974.
3. US Agency for International Development: AID Policy: Health Assistance. Washington DC: USAID, 1982; 16 pp.
4. Grant JP: The State of the World's Children, New York, UNICEF, 1982; 12 pp.
5. Samstag T: Water crusade fails. *London Times* July 13, 1983.
6. US Agency for International Development: Aid Policy Paper: Domestic Water and Sanitation. Washington DC: USAID, 1982; 16 pp.
7. Morgan PR, DD Mara: Ventilated Improved Pit Latrines: Recent Developments in Zimbabwe. World Bank Technical Paper Number 3. Washington, DC: World Bank, 1982; 38 pp.
8. Adrianza BT, Graham GG: The High Cost of Being Poor: Water. Arch Environ Health 1974; 28:312–315.
9. Okun DA: Review of Drawers of Water. Econ Dev Cult Change 1975; 23:580–583.
10. US Agency for International Development: The Potable Water Project in Rural Thailand. Washington DC: USAID, 1980, 14 pp.
11. Blum D, Feachem RG: Measuring the impact of water supply and sanitation investments on diarrheal diseases: problems of methodology. Int J Epidemiol 1983; 12:357–365.
12. Briscoe J: Intervention studies and the definition of dominant transmission routes. Am J Epidemiol 1984; (in press).
13. Hughes JM: Potential impacts of improved water supply and excreta disposal on diarrheal disease morbidity: an assessment based on a review of published studies. Atlanta: CDC, 1983; 30 pp.
14. Berman PA: Selective primary health care: is efficient sufficient? Soc Sci Med 1982; 16:1054–1059.
15. Chen LC: Control of diarrheal diseases morbidity and mortality: some strategic issues. Am J Clin Nutr 1978; 31:2284–2291.
16. Grant JB: Health Care for the Community, Selected papers of Dr. John B. Grant. Baltimore: Johns Hopkins University Press, 1963.
17. Rohde JE: Preparing for the next round: convalescent care after acute infection. Am J Clin Nutr 1978; 31:2258–2268.
18. Birdsall N, Greevey WP: The Second Sex in the Third World: Is female poverty a development issue? Workshop on Women in Poverty. Washington, DC: International Center for Research on Women, 1978; 36 pp.
19. Popkin BM, FS Solon: Income, time, the working mother and child nutriture. J Troy Pediatrics and Environ Child Health 1976; 22:156–166.
20. Parker RL, Rinehart W, Piotrow T, Doucette L: Oral rehydration therapy for childhood diarrhea. Baltimore: Population Reports, 1980.
21. DeSweemer C: *In:* Koster FT: Resume of the discussion on health care interventions. Am J Clin Nutr 1978; 31:2274–2278.
22. Popkin BM: Time allocation of the mother and child nutrition. Ecol Food Nutr 1980; 9:1–14.
23. Black RE, Brown KH, Becker S, Alim ARMA, Merson MH: Contamination of weaning foods and transmission of enterotoxiganic *E. coli* diarrhea

in children in rural Bangladesh. Trans Roy Soc Trop Med Hyg 1982; 76:259–264.
24. Rowland MGM, McCollum JPK: Malnutrition and gastroenteritis in the Gambia. Trans Roy Soc Trop Med Hyg 1977; 71-199–203.
25. Chen LC, Chowdhury AKA, Huffman SC: Seasonal dimensions of energy protein malnutrition in rural Bangladesh: the role of agriculture, dietary practices, and infection. Ecol Food Nutr 1979; 8:175–187.
26. Popkin BM: Some economic aspects of planning health interventions among malnourished populations. Am J Clin Nutr 1978; 31:2314–2323.
27. Saunders RJ, Warford JJ: Village Water Supply: Economics and Policy in the Developing World. Baltimore: Johns Hopkins University Press, 1976.
28. Feachem R, Burns E, Cairncross S, Cronin A, Cross P, Curtis D, Khan MK, Lamb D, Southall H: Water, Health and Development: An Interdisciplinary Evaluation. London: Tri-Med, 1978.
29. Carruthers ID: Impact and Economics of Community Water Supply: A Study of Rural Water Investment in Kenya. London: Agrarian Development Unit, Wye College, 1973.
30. White GF, Bradley DJ, White AN: Drawers of Water: Domestic Water Use in East Africa. Chicago: University of Chicago Press, 1972.
31. Elmendorf M: Women, Water and Waste: Beyond Access. Washington DC: WASH Project, 1982.
32. White AN: The role of the community in water supply and sanitation projects. *In:* The Impact of Interventions in Water Supply and Sanitation in Developing Countries. Washington DC: USAID, 1981.
33. Ratcliffe J: Social justice and the demographic transition: Lessons from India's Kerala State. Int J Health Serv 1978; 8:123–144.
34. Navarro V: Health services in Cuba: an initial appraisal. N Engl J Med 1972; 287:954–959.
35. Hsiang-Kuan C: China: The rural health service. *In:* Hetzel BS (ed): Basic Health Care in Developing Countries: An Epidemiological Perspective. Oxford: Oxford University Press, 1980.
36. Van Tin N: Mass prophylaxis on a national scale. *In:* Twenty Five Years of Health Work. Hanoi: Vietnamese Studies, No. 25, 1970.

ACKNOWLEDGMENT

An earlier draft of this paper was presented at the International Conference on Oral Rehydration Therapy, Washington DC, June 1983.

International Immunodeficiency-Cancer Registry Announcement

The international Immunodeficiency-Cancer Registry (ICR) at the University of Minnesota has requested professional journals to promote awareness of the registry in the medical community.

Established in 1973 and funded by the National Cancer Institute, ICR has experienced a lag in its full-time management due to funding difficulties. The registry reiterates its goals, which are to:

- serve as a clearinghouse for information and data on cases of cancer in naturally occurring immunodeficiency;
- facilitate the flow of information between clinicians and other experts in the field;
- serve as a resource of unique cancer cases and encourage research studies; and
- contribute to the scientific literature through analysis of cases in the registry.

The registry currently has more than 475 cases of cancer in several categories of naturally-occurring immunodeficiency, and is soliciting additional cases of cancer and pre-malignant lesions in patients with prior evidence of immunodeficiency. Financial reimbursement is available for registration of new cases.

This registry is a resource available to individuals in the biomedical community interested in the etiology and treatment of malignancies in immunodeficient persons. Direct inquiries to: Valerie Stoker, MPH Registrar, Alexandra H. Filipovich, MD, Principal Investigator, or John H. Kersey, MD, Co-Investigator, Box 610 Mayo, University of Minnesota, Minneapolis, MN 55455. Tel: (612) 376-2174 (24 hours a day)