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Setting Priorities, Targeting Subsidies among Water, Sanitation, and Preventive Health Interventions in Developing Countries

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Summary. — The paper challenges the conventional wisdom that water and sanitation improvements and other preventive health interventions are always a wise economic investment. Costs and benefits are presented for six water, sanitation, and health programs—handwashing, sanitation, point-of-use filtration and chlorination, insecticide-treated bed nets, and cholera vaccination. Model parameters are specified for a range of conditions that are plausible for locations in developing countries. We find that the parameter values needed for such cost–benefit calculations are not available for setting global priorities. We reflect on the implications of our findings for more "evidence-based" planning of public health and development interventions.

Key words — benefit–cost analysis, health, water and sanitation, technological adoption, Monte Carlo analysis

1. INTRODUCTION

Economists who do not work in water and sanitation and hygiene (WASH) and other preventive health interventions in developing countries will likely be surprised at the current policy debates in this sector. Professionals in these fields are wrestling with three related puzzles that outside observers might well expect to have been resolved long ago.

First, although the health benefits from use of preventive health goods and services are purported to be high, demand for them is usually very low among households in developing countries. Preventive health interventions which require single or occasional uptake, such as insecticide-impregnated mosquito nets (bed nets) and vaccines, have been shown to be effective in saving lives and reducing general morbidity, as well as cost effective, yet household demand for these interventions has been found to be consistently low and price elastic (Kremer, Leino, Miguel, & Zwane, 2009; Whittington, 2010). Some of these technologies (e.g., home-based water chlorination and bed nets) have been around for decades, yet market penetration has been very slow (in sharp contrast to cell phones), perhaps because these interventions also involve significant disamenities (taste and odor problems, discomfort or inconvenience in use, etc.). On the other hand, household demand for piped water services in developing countries is very inelastic (Nauges & Whittington, 2009), even though the health benefits from these services in developing countries are ambiguous and controversial (Bennett, 2010; Cairncross *et al.*, 2010; Fewtrell *et al.*, 2005; Waddington & Snilstveit, 2009). This may be because households value the time savings and privacy the services provide. [1]

A second puzzle relates to experts' differing positions on the importance of user fees for preventive services and products. Public health professionals and development economists generally support free or heavily subsidized improved water and sanitation services and other preventive health interventions, such as vaccinations, bed nets, and point-of-use water treatments, on the basis of economic, financial, and moral arguments. On economic grounds they make the Pigovian case that positive externalities from such health interventions justify public subsidies (Pigou, 1932). On financial grounds they argue that because demand is so price elastic, the revenues generated by user fees do not justify the costs of administration and collection. On moral grounds they argue that both water and health are basic human rights: user fees would prevent the poorest households from accessing services. The fact that penetration and/or sustained usage of many of these preventive health interventions often remains low despite free or highly subsidized provision has not led proponents of free services to reconsider these arguments (Cairncross, Shordt,

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Zacharia, & Govindan, 2005; Pattanayak *et al.*, 2009; Waddington & Snilstveit, 2009).

On the other hand, professionals in the water and sanitation sector tend to insist on the need for user charges for both network and nonnetwork water and sanitation technologies. They argue that user charges achieve the financial goal of cost recovery, the economic-efficiency goal of delivering appropriate amounts of water and preventing water wastage, and the political goal of creating a sense of ownership in the capital facilities and management decisions (Rogers, De Silva, & Bhatia, 2002). The consensus that user charges are important in this sector may also be due to what Howells (1996) has termed "tacit knowledge," that is, long experience of trying without great success to provide services with no user charges.

A third puzzle is that in contrast to public health professionals, governments in developing countries often may support large subsidies for piped water and sanitation infrastructure at the expense of other, supposedly more beneficial health improvements. Ramsey pricing would suggest that if revenues need to be raised to finance piped water services and nonnetwork water and sanitation interventions, as well as other public health interventions, prices should be increased on piped water services (the price inelastic good) in order to cross-subsidize the nonnetwork services such as point-of-use treatment (the price elastic good) (Ramsey, 1927). But what actually occurs is the precise opposite. Governments of developing countries are typically extremely reluctant to price piped water services at anything close to the true costs of service, much less to extract from them extra revenues to finance nonnetwork services, even those with demonstrated positive public health outcomes (Cairncross, 2003). Governments provide massive subsidies for piped water and sewer services (which tend to be disproportionately captured by upper- and middle-income households), while nonnetwork public health interventions receive little funding (Evans, 1999). In fact donors attempting to subsidize vaccination, bed nets, and point-of-use water treatment are often concerned that national and regional governments may try to divert funds earmarked for these preventive health services toward other uses, or that donor financial support will simply become a substitute for government budget allocations for preventive health activities.

Discussion below addresses what we believe is one underlying reason for all three of these puzzles: the high uncertainty (for given sites) and inherent variability (across sites) in the economic costs and benefits of water and sanitation and hygiene and preventive health interventions in developing countries. We report on an analysis of the variation in costs and benefits of six different interventions (promotion of handwashing and improved hygiene; "total sanitation" campaigns, designed to curb open-air defecation; biosand water filters; point-of-use chlorination of drinking water; insecticide-treated bed nets; and cholera vaccination), and show that ...

(1) At the median parameter values in the benefit–cost model, all six interventions deliver positive net benefits, but the magnitude of the net benefits to a household from all of the six interventions is relatively modest.

(2) There are many combinations of parameter values that yield a benefit–cost ratio (BCR) that is less than 1 for all six interventions. (For the median assumptions about uptake and usage, anywhere from 20% to 55% of simulation outcomes have costs that outweigh benefits depending on the intervention.)

(3) Given the heterogeneity in benefit–cost outcomes from the model simulations, developing a priority ranking of water and sanitation and hygiene and preventive health interventions—and setting cross-sectoral investment priorities—is much more complicated than commonly appreciated.

Our findings challenge the conventional wisdom in the water and sanitation and public health sectors that the economic case for such interventions is overwhelming and noncontroversial. We also find reasons to agree with researchers who have expressed skepticism about the confidence that health sector professionals sometimes place in new innovations in service delivery and technology and in rigorous program evaluation methods such as randomized controlled trials, for finding "evidence-based" solutions to these policy puzzles (Deaton, 2010). To illustrate this point we show the limited utility of zeroing in on a better estimate of any single parameter in the benefit–cost calculation, given the multitude of factors that are relevant. We also demonstrate that global estimates of the costs and benefits of such interventions are of very limited worth given the heterogeneity one can expect to find across target locations in developing countries. Our results also have implications for recent debates about the role that pricing can play in allocating public health goods and services in developing countries (Ashraf, Berry, & Shapiro, 2010; Cohen & Dupas, 2010).

In Section 2 of the paper we show why benefit–cost and cost-effectiveness calculations in the water and sanitation and hygiene and preventive health fields are fraught with uncertainty. Section 3 presents our benefit–cost model and discusses the assumptions made. In Section 4 we briefly describe the six interventions and the specific assumptions made to estimate the costs and benefits of each. Section 5 presents the results of our benefit–cost calculations and sensitivity analyses. Section 6 discusses some of the implications of these findings.

2. BACKGROUND

The desire to establish investment priorities in water and sanitation and hygiene and preventive health initiatives is understandable, virtually universal, and not new. Budgets to support such interventions are limited, and government agencies and donors want to allocate available financial resources so as to do the most good. But a strong desire to set global funding priorities does not make the task easy. Priority-setting analyses have adopted two main analytical approaches: cost-effectiveness analysis (CEA) and benefit–cost analysis (BCA). Centralized planning institutions have always struggled to improve the quality and availability of the information needed for such calculations. The kinds of information required to implement CEA and BCA differ somewhat, but both require up-to-date, site-specific data that have proven extremely difficult to obtain.

The problem that global planners in these sectors confront is conceptually not very different from that faced by economic planners in the former Soviet Union: how can a central planning office procure accurate, reliable information from the field to set production and investment targets? To address this question, water and sanitation and hygiene and preventive health professionals working for donor organizations confront two further major hurdles. First, even if the needed data are obtained, they are nonstationary; that is, one cannot assume that parameter estimates will remain constant over time. For example, when climate change, demographics, migration patterns, and economic growth are changing baseline conditions, studies of the burden of disease incidence or case fatality rates may quickly become out of date.