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What quality standards are appropriate for rural water supplies?

Editor:

The paper by Welch et al. entitled “Microbial quality of water in rural communities of Trinidad” (1) discussed aspects of water quality testing and expectations of safety of rural water supplies, and it affirmed similar observations of unpotability in developing countries that my colleagues and I described in a study in sub-Saharan Africa (2). The hazard of increased contamination of stored water supplies in the home must be emphasized (3).

Consumers expect that delivered water, whether by truck or pipe, and that is reported to be sanitized, should be free of total coliforms and *Escherichia coli*. That expectation is in line with guidelines published by the World Health Organization (4). Finding concentrations of these indicator bacteria in treated water supplies implies that treatment procedures are inadequate, quality control measures have lapsed, or a breach in the integrity of the delivery or distribution system has occurred after treatment, as well as that there is a possibility of postdelivery contamination.

Respectfully, I suggest that several assumptions by the authors beyond this observation miss the mark. Applying in rural areas the potability standards of the United States Environmental Protection Agency (EPA)—that is, an absence of microbial indicators—is a misleading, untenable, unrealistic, and unnecessary goal for water delivery schemes in many developing countries. Providing drinking water free of coliforms is an admirable and idealistic aspiration. However, EPA guidelines, while appropriate in locations with adequate resources, ought not to be applied to civil infrastructure in geographical settings where neither technical expertise nor resources are available to guarantee delivery of safe drinking water. In addition, the authors do not place in perspective the reality of developing countries, where people may not understand concepts of pathogenicity and most rural water “systems” rely on surface sources or shallow wells.

Our research, conducted in Lesotho in the early 1990s, was able to distinguish potability markers and engineered solutions that practically and realistically indicated whether a water supply was likely to be safe or to be potentially hazardous. Gravity-feed water system configurations that had been implemented by development projects in pre-

vious years generally provided water considered safe for human consumption if they were properly maintained. Total coliforms were present, while *E. coli* were usually absent. These systems had a protected intake at the surface source, connected by plastic pipe first to a sediment tank and then to either a plastic or corrugated metal storage tank with a tap. This clever construct required inexpensive and minimal technical knowledge to implement. These systems did not rely on chlorination or other mechanisms of disinfection to attain potability. The goal of the design was to protect the water source from human and/or animal fecal contamination

Ubiquitous in the environment, total coliforms represent a taxonomically diverse classification of bacteria, including *E. coli*. The source of coliform bacteria may be from fecal sources or biodegraded vegetable matter, with the latter not considered to be harmful or of sanitary significance to humans. To infer that water supplies are unsafe if coliforms as a class are present is an inaccurate application of water quality bacterial indicator screening tools. A more accurate screening tool, based specifically on the presence of *E. coli*, is the only logical indicator of potability in settings where disinfection is not a realistic option.

Some would undoubtedly argue that ignoring the public health needs of rural, disadvantaged villagers by not "protecting" their drinking water from coliforms is an unacceptable position and is based on a double standard. But, given the realities in many parts of the world, the aspiration of protecting water supplies through expensive, technical interventions is in large measure impossible and excessive. There is always a danger that an inability to comply with an unreasonable standard may paralyze any remedial efforts. Tempered goals are required. Implementing rational solutions based on local resources and capabilities is recommended (5). There need not be an expectation that water supplies are "sterile." Protecting a water source from fecal contamination is the key to a practical potability standard based on bacterial indicator quality control measures.

References

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Response

Editor:

Dr. Kravitz agrees with us that water delivered to peoples' homes ought to be free of total coliforms. Our finding that drinking water in rural Trinidad was contaminated in 55% of homes receiving pipe-borne water and in 88% of homes receiving truck-borne water must have alarmed Dr. Kravitz as much as it did us.

For water from untreated water supplies, we agree with Dr. Kravitz that fecal contamination is a sensible bacterial indicator of drinking water quality. This is why we displayed the percentages of samples contaminated with fecal coliforms and *E. coli*, in addition to total coliforms. Also, we went a step further and determined the frequency of virulence markers in the *E. coli* isolates, thereby elucidating the health risk to consumers of the water that less-specific methods had found to be contaminated.

Dr. Kravitz has objected to our application, in our discussion of our results, of the United States Environmental Protection Agency (EPA) standard of zero total coliforms. This may reflect the vast differences between his research setting in low-income Lesotho and the situation in middle-income Trinidad and Tobago, where the 1999 per capita GNP figures were, respectively, US\$ 550 and US\$ 4 390 (1). In Dr. Kravitz's experience of developing countries, "where people may not understand concepts of pathogenicity, most rural water systems rely on surface sources or shallow wells." We reported in our Trinidad study that only 19 of the 167 households (11.4%) drank water obtained directly from surface sources or wells. The vast majority of households consumed water from treated water supplies. Therefore, in Trinidad and Tobago the EPA standard of zero coliforms is not an "untenable, unrealistic, or unnecessary goal," as suggested by Dr.

Kravitz. Even for the minority of households in Trinidad that consume untreated water, the goal of zero coliforms is neither unrealistic nor unnecessary. Literacy rates in Trinidad and Tobago approach 100% and most households consuming untreated water could certainly be taught simple, low-cost methods of eliminating coliforms from their drinking water (2).

The infant mortality rate in the English-speaking Caribbean is more than double the rate in North America. A substantial portion of this excess mortality is due to intestinal infectious diseases, which are also a leading cause of death in children 1–4 years of age (3). Another compelling reason why the purity of the water supply is vital to Trinidad and Tobago is that the country has a thriving tourism component that could be adversely affected by outbreaks of communicable diseases.

Dr. Kravitz is concerned that setting stringent, “unreasonable” drinking water standards in developing countries may paralyze remedial efforts. Knowing that many of our samples were heavily contaminated with fecal coliforms, we categorized the samples as being “very poor” if fecal coliforms exceeded 20 per 100 mL. Even by this very conservative definition, the percentage of households with very poor drinking water quality ranged from 9% to 34%, depending on the town (Figure 2 in our article).

The information provided in that figure provides baseline data from which local authorities in Trinidad and Tobago can set medium-term targets for the progressive improvement of water supplies, as recommended by World Health Organization (WHO) guidelines (4). In recommending that developing countries set medium-term targets, however, the guidelines have not suggested that coliform-free water is a goal that is “untenable” or “unnecessary” for developing countries. Indeed, the WHO guidelines state that although the values

for bacteriological quality were developed for large water-supply systems, they are also applicable to community supplies (4). Medium-term targets are simply a means of determining whether the country is making progress towards providing a safe water supply.

Compared with Lesotho, Trinidad and Tobago has relatively well-developed infrastructure, a very literate population, a dependence on tourism, and substantial financial resources. It is not unreasonable for residents and tourists alike to expect stringent drinking water standards and high quality drinking water that does not pose a significant threat to their health.

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