Comment on "Reliability of a Commercial Kit to Test Groundwater for Arsenic in Bangladesh"

In a recent publication, "Reliability of a commercial kit to test groundwater for arsenic in Bangladesh" (*1*) regarding the effectiveness of the Hach EZ arsenic kit (product 2822800), Van Geen et al. remarked "Clearly the Hach kit should continue to be used to test wells throughout Bangladesh and other countries affected by elevated arsenic in groundwater". They studied only 799 wells in a 25-sq-km study area, when in Bangladesh there are 8−10 million wells (*2*) and more than two-thirds of the geographical area (140 000 sq km) is arsenic-affected. It has been reported (*3*) that the reliability of a kit depends on concentration distribution in the survey area and there is a short-range variability (over 1 km or so) of arsenic concentration in Bangladesh. Notably, out of the total 4.95 million tubewells tested in Bangladesh, 2.36 million were tested by the Hach kit in 147 upazillas in a study employing more than 54 000 field team members in 2002−2003 (*4*). The rest were tested by other kits; among them BAMWSP alone tested 0.67 million tubewells by using a Merck kit. The authors should have employed several groups across Bangladesh and analyzed (by Hach kit) a couple of hundred samples at least from each of the geomorphological regions of Bangladesh. They should have checked the efficiency of other kits widely in use in other countries before giving a global clearance to the Hach kit.

The authors reported, despite having actua1 concentrations >50 μg/L, 12% (n = 799) of the tested wells were analyzed to be safe (<50 μg/L) by the Hach kit. Extrapolating, with 12% of 2.36 million tubewells tested by Hach kit reported as safe, about 0.283 million reportedly safe ones may be actually unsafe (>50 μg/L). On average, 24 people use one tubewell in Bangladesh (*5*). So 0.283 million × 24 (6.8) million people may drink contaminated water considering it safe. In the opinion of van Geen et al., the inconsistencies in the Hach kit mainly underestimate in the range 50−100 μg/L. Analyzing by FI-HG-AAS technique, we found 31% of 52 000 samples from different parts of Bangladesh (*5*) were contaminated (>50 μg/L). Among the contaminated samples, 27% contained arsenic between 50 and 100 μg/L (unpublished data, D.C.). So a good percentage of unsafe tubewells (>50 μg/L) could have been misclassified as safe by Hach kit.

Various factors act behind erroneous field kit measurement. van Geen et al. stated "...field workers feeling pressed for time because of the need to complete a certain number of tests within the day" is one of them. Elaborating, Erickson (*6*) noted "BAMWSP worked out an agreement with the World Bank, which financed a U.S. $50 million loan for the effort, to complete screening and mitigation of wells in 147 upazillas or subdistricts, in Bangladesh by June 2003. According to Rosenboom, the work had not even begun as of past October, and BAMWSP has asked the World Bank for a second extension". BAMWSP subcontracted the World Bank Project to different groups based on the number of households in an Upazilla. While working, field team members found that the actual number of households was more than they were asked to cover and they were denied any additional money.

In an evaluation survey (1998−2001) we dealt with three then widely used field kits (NIPSOM, GPL, and Merck) analyzing 2866 samples from hand tubewells already colored red or green from 60 villages of 20 police stations in 10 districts of Bangladesh (*7*). We observed from field experience in Bangladesh and West Bengal that, due to repeated subcontracting to inexperienced, ill-qualified persons/groups, the overall quality of work suffers a lot. NAMIC Bangladesh informed (*4*) "To conduct the survey efficiently, training was given at three levels. BAMWSP provided training to master trainers. Master trainers provided training to Regional Project management team, NGOs, Upazilla coordinators, and field mobilizers, and then they provided training to the Field Team members." So there remains ample scope for dilution of "expertise" in the mid-steps of this "top down" approach. Our experience in the BAMWSP−World Bank project [names of their field workers: Jharna, Harun Rasid, Sahina, Muffazul, Md. Khorsed Alam] in Bangladesh is narrated below.

Date, 25th June 2001; Village, Disaband; Union, Khiladi; P.S, Laksham, Comilla. Field workers told Jubeida Begum (F/40) that her tubewell was arsenic-contaminated and she had arsenical skin lesions. We tested her tubewell water and the results showed that it contained less than 10 μg/L of arsenic. Our dermatologist could not detect arsenical skin lesions on her.

This is one of many examples.

There are some technical constraints of Hach or any other field kit, as follows: (1) The authors stated that the sulfides trap in the Hach kit could jeopardize the result by "wetting test strips" and advocated its removal since Bangladesh water does not have sulfide problems. However, a recent report (*8*) shows areas in Pakistan (e.g., Sargodha) with reducing groundwater where anoxic compounds such as dissolved iron, hydrogen sulfide, or methane are found. (2) There have been EPA-funded efforts (*6*) at developing mercury- and/or lead-free arsenic test kits to overcome environmental hazards associated with disposal of used test strips. In most cases the used test strips are thrown near the test site. (3) Conceding that the Hach kit in its present form may be inadequate for accurate measurement, van Geen et al. advocated increase of reaction time from 20 to 40 min, when already 2.36 million hand tubewells have already been measured by the Hach kit. (4) Recent reports (*9*, *10*) suggest harmful effects of arsine gas generated during field kit testing.

The paper also suffers from some minor discrepancies as detailed below.

The press release from Hach (*11*) regarding method of using Hach EZ arsenic kit mentioned the 70 μg/L reference point on the scale, which the authors missed in the methods section.

Reference 6 (*7*) of van Geen's paper mostly featured our group's work in Bangladesh not on West Bengal.

The authors mentioned that in West Bengal "the current government policy is to test only community wells while the vast majority of existing wells remain untested." This is not supported by any reference.

The authors opined that a long-term solution lies in "community wells that tap deep aquifers that are low in As", suggesting a drilling depth between 50 and 200 m. In West Bengal many tubewells installed by PHED to depths around 100 m (*12*), although initially safe, became contaminated over time.

On the basis of two experiences in Cambodia with the Hach kit−one "good" and another "bad", Dave Polya (*13*) expressed his concerns about (i) lack of precision; (ii) criticality of training of and implementation by field operators, and (iii) the amount of information lost in using field kits rather than laboratory ICP or AA analysis. The South East Asia Regional Director of WHO commented, "We are now at a stage to support the development of standardized laboratory testing of arsenic" (*14*).

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An endorsement such as that given by van Geen et al. may send the wrong signal as a nice advertisement for the manufacturer. In fact, a salesman (*15*) for Hach Company came to us and boasted that the superiority of their kit has been vindicated by a recent publication in an ACS journal. Though we understand the pertinence of evaluating test kits, considering the urgent need to screen millions of tubewells in Bangladesh, any kind of premeditated judgment on the basis of a small subset of a total database (799 wells make up only 0.008% of the total 10 million tubewells in Bangladesh) can have long-term implications on arsenic screening as well as mitigation programs

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