# An Environmental Survey of Drinking Water in Kampala, Uganda, During a Typhoid Fever Outbreak

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**Background:** In 2015, a typhoid fever outbreak began in downtown Kampala and spread into adjacent districts. Ground water was suspected, but unconfirmed, as the source of the outbreak. In response, an environmental survey of improved and unimproved drinking water sources was conducted in areas in the city with high case numbers.

**Methods:** A total of 122 samples were collected from 12 different water types and tested for *E. coli*, free chlorine, and conductivity. An additional 37 samples from seven water types and 16 paired large volume (20 L) samples were also collected and tested for the presence of *S.* Typhi.

**Results:** *E. coli* was detected in 60% of kaveras (i.e., drinking water sold in plastic bags) and in 80% of refilled water bottles; free chlorine was not detected in either water type. Elevated conductivity readings suggest that kaveras and refilled water bottles likely contained ground water, as opposed to treated water supplied by the Kampala water utility and licensed vendors. Most jerry cans (68%) contained *E. coli* and most free chlorine residuals were well below the WHO recommendation. All unprotected springs and wells and more than 60% of protected springs contained *E. coli*. Water samples collected from the water utility were found to have acceptable free chlorine levels and no detectable *E. coli*. While *S*. Typhi was not detected in water samples collected for this investigation, *Salmonella* spp. were detected in four unprotected springs, one protected spring, and one refilled water bottle.

**Conclusions:** These data, in conjunction with *E. coli* data, provide clear evidence that unprotected and protected springs and unlicensed vended water represented a risk for typhoid transmission. Despite the high incidence of typhoid fever globally, relatively few outbreak investigations incorporate drinking water testing. Results from prompt drinking water quality investigations might help identify contaminated sources, which could lead to rapid interventions.