## Chlorinating well water with liquid bleach was not an effective water disinfection strategy in Guinea-Bissau

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In late 1994. a cholera epidemic due to toxigenic *Vibrio cholerae* serogroup O1. serotype Ogawa, biotype E1 Tor caused 15,296 cases and 285 deaths in Guinea-Bissau. West Africa; three-quarters of the cases occurred in the city of Bissau (WHO 1995. Rodrigues et al. 1997). Early in the epidemic. toxigenic *V cholerae* O1 was cultured from two shallow wells in Bissau (Fereirra 1994). In response, the Ministry of Health disinfected approximately 3000 of the city's shallow wells with liquid bleach (sodium hypochlorite). Each well was measured and then chlorinated once with a dose of bleach estimated to bring the total chlorine concentration to 30 mg/L. and the well was closed for one day.

We were unaware of published data on the field-effectiveness of this intervention. To determine the duration of an qdequate residual chlorine level [RCL] (defined by the World Health Organization as > 0.2 mg/L (WHO 1996)) in well water after chlorination. We analyzed samples from 10 consecutive wells chlorinated in the city of Bissau. Using the DPD colorimetric methlod (PermaChem. Hach Company. Loveland. Colorado). we measured RCLs just before and 5 minutes after chlorination, and then each morning thereafter until no chlorine could be detected. Morning RCLs were assumed to reflect the minimum level of the preceding 24 hours. To characterize well owners' perceptions of the intervention, we asked how long they thought the chlorination would protect the water.

As per the chlorination protocol, no water was used from the wells for the first 14 hours after chlorination: however, normal use was allowed after the wells were reopened. Among the 10 wells tested, one had an adequate RCL for 6 days, three had an adequate RCL for one day and six never achieved an adequate RCL (Table 1). To evaluate reproducibility, we retested the first four wells after repeat chlorination: well 1 had an adequate RCL for at least 3 days. wells 2 and 3 had an adequate RCL for 2 days, and well 4 never achieved an adequate RCL. In summary, after chlorination and waiting one day, adequate RCLs were achieved in only four of ten wells and lasted a median of only one day in those four wells. This contrasts sharply with the perceived duration of protection. Six well owners responded that after chlorination, the water would be safe for a period ranging from 2 weeks to 6 months; four well owners could not say how long they thought the protection would last.

TABLE 1.Daily residual chlorine levels (in milligrams/liter) of well water after a single dose of liquid bleach (sodium hypochlorite). Bissau. Guinea-Bissau. December 1994										
		Days after chlorination								Owners perceive
Well #	5 min. post chlorination	0 (well closed)	1	2	3	4	5	6	7	protection

1	>3.50	>3.50	>3.50	2.00	1.00	0.50	0.45	0.20	0.00	No response
2	>3.50	>3.50	2.10	0.00						No response
3	Missing	2.10	0.30	0.00						2 months
4	4.00	0.70	0.00							No response
5	16.00	8.50	3.60	0.00						No response
6	0.70	0.30	0.00							45 days
7	18.00	0.80	0.00							3 months
8	30.00	0.45	0.00							2 weeks
9	7.50	0.90	0.00							6 months
10	0.40	0.00								25 days

None of the wells had detectable residual chlorine levels immediately before chlorination. Bold areas indicate days when the wells were open for use and residual chlorine levels were >=0.2 mg/L.

Chlorination with a single 'shock' dose has been recommended as a means of disinfecting contaminated wells, and ongoing chlorination has been recommended for keeping well water safe in areas where aquifers are contaminated (WHO 1996). In our investigation, the duration of an adequate RCL after a single, large dose of liquid bleach was short-lived and variable. Furthermore, it left the mistaken impression among well owners that the well water would be safe to drink for weeks or months. These results suggest that 'shock' well chlorination may not be an effective intervention for disinfecting water and that a systematic study is needed which compares the effectiveness of 'shock' well chlorination to other more reliable strategies such as point-of-use chlorination (Quick et al. 1996).

## References

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