

Are there health hazards from disinfection byproducts in humanitarian water? Findings from a MSF water treatment plant, Palorinya, Uganda

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Introduction

During 2017, MSF operated a surface water treatment plant (SWTP) in Palorinya settlement, Northern Uganda, that provided ~1.2 million litres of safe water each day to 150000 South Sudanese refugees. As is typical in humanitarian operations, the SWTP used chlorination to disinfect water and protect against recontamination. Concerns however have been raised about disinfection by-products (DBPs) including trihalomethanes (THMs), which may be linked to cancer and other adverse outcomes. We are not aware of any investigations into DBPs in emergency water supplies. Therefore, we investigated DBP levels at the Palorinya SWTP, and aimed to determine if health hazards may exist.

Methods

Recently, simple techniques for measuring DBPs at field level have become available, such as the colorimetric THM Plus test kit (Hach). We used this test (previously validated with reference to standard instrumental techniques) at the Palorinya SWTP during a three-week period in Aug-Sept 2017. During this time, chlorination at the SWTP targeted 1.5 mg/L free residual chlorine at plant output prior to water trucking in order to achieve 0.8-1.0 mg/L at tapstands. We sampled 26 unique parcels of water in which we observed DBP/THM levels at 30 minutes and 24 hours post-chlorination (the latter to simulate what beneficiaries consume). We compared mean DBP measurements to the WHO maximum allowable concentration for chloroform of 300ppb, using t-tests, to assess whether observed DBP/THM levels were hazardous or not.

Ethics

This innovation project did not involve human participants or their data; the MSF Ethics Framework for Innovation was used to help identify and mitigate potential harms. It was conducted with permission from Sidney Wong, Operational Centre Amsterdam, MSF.

Results

Mean DBP/THM levels after 24 hours were below the WHO limit of 300ppb for both standard treatment (water clarified via coagulation-flocculation before being chlorinated in separate tanks: 85.1ppb; 95%CI 70.9-99.1; $p < 0.0001$), and for rapid treatment (water simultaneously clarified and chlorinated in the same tank: 218.0ppb; 95%CI 151.2-284.8; $p < 0.02$).

Conclusion

We found no evidence of a DBP-related health hazard when raw surface water is chlorinated to control pathogens at the Palorinya SWTP. This site may represent a “worst case scenario”, as it used marshy Nile River water during the rainy season when organic DBP precursors are expected to be elevated. In order to better understand potential DBP/THM hazards for emergency water supplies, MSF and other agencies should monitor DBP/THM levels at SWTPs using the Hach THM Plus test-kit, which we found to be suitable for humanitarian field settings. In the immediate stages of an emergency however, providing safe chlorinated water regardless of possible longer-term health hazards must remain the priority.

Conflicts of interest

None declared.