

Microbial quality of drinking water from groundtanks and tankers at source and point-of-use in eThekweni Municipality, South Africa, and its relationship to health outcomes

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ABSTRACT

Drinking water quality was investigated at source and corresponding point-of-use in 2 peri-urban areas receiving drinking water either by communal water tanker or by delivery directly from the distribution system to household-based groundtanks with taps. Water quality variables measured were heterotrophic bacteria, total coliforms, *E. coli*, conductivity, turbidity, pH, and total and residual chlorine. Water quality data were analysed together with an existing epidemiological database to investigate links between microbial quality of drinking water, household demographics, health outcomes, socio-economic status, hygiene and sanitation practices. Groundtank households had better quality drinking water than households using storage containers filled from communal tankers. Uncovered storage containers had the poorest microbial water quality among all storage containers. All stored water did not meet drinking water standards, although mains water did. Households with children under 5 years and using open-topped containers had the poorest water quality overall. Households with groundtanks had the best water quality at point-of-use, but did not have the lowest occurrence of health effects. Although groundtanks were supplied together with urine diversion (UD) toilets and hygiene education, groundtank households showed overall poorer hygiene practices than tanker-supplied households, and some groundtank households with UD toilets preferred to continue using open defecation. Households that practised open defecation had higher levels of *E. coli* in their drinking water and higher rates of adverse health outcomes. Poorer socio-economic standing and lower educational standard were associated with poorer water quality, poorer hygiene practices and higher rates of diarrhoea and vomiting.

Keywords: drinking water; point of use; water quality; water quantity; hygiene; sanitation

INTRODUCTION

South Africa has large areas that lack adequate supplies of potable water and sanitation. A lack of infrastructure, coupled with rapid population growth in rural and peri-urban areas, is a major contributing factor to this problem. Where improved drinking water has been provided to such communities, water is often stored in the home prior to use. Here, 'improved water source' is defined as at least 20 l of water per capita per day from a protected source which is piped into a yard, dwelling or standpipe and which is no further than 200 m away from the user's dwelling. It thus often still involves collection and storage of water prior to use. Microbial contamination of water during storage, collection and transportation is of concern since contamination may result in water that is unsafe for human consumption (Jagals et al., 1997, 2004; WHO, 2005).

The responsibility for supplying the city of Durban (South Africa) and its surrounding areas with drinking water rests with eThekweni Municipality. Since rural and peri-urban areas in Durban often lie outside the waterborne sewerage network, the Municipality initiated a programme to provide sanitation

to these areas via urine diversion (UD) toilets, coupled with the provision of drinking water by groundtanks, along with health and hygiene education. Groundtanks are 200 l closed containers which are filled from mains once daily. The tanks are fitted with a tap for dispensing water. In settlements which have not yet been serviced under this programme, sanitation provision is by pit latrines or open defecation is practised. Treated drinking water is provided to such areas via standpipes or mobile water tankers (KwaZulu-Natal Municipalities, 2008).

Water provision via standpipes and mobile water tankers requires users to collect, transport and store water prior to use, whilst groundtanks themselves serve as a storage container. In the case of standpipes and mobile water tankers, water is collected, transported to and stored in households in either open-top or closed-top portable storage containers. Numerous studies have demonstrated the deterioration in microbiological quality of drinking water as it moves from source to point-of-use (Moyo et al., 2004; Trevett et al., 2005; Gundry et al., 2006; Onabulo et al., 2011), leaving the water unsafe for human consumption (Momba et al., 2003; Moyo et al., 2004; Trevett et al., 2005; Gundry et al., 2006). Factors thought to contribute to deterioration in water quality include poor hygiene and sanitation practices; the use of contaminated transport and storage containers; insertion of contaminated hands and utensils into water; contact of water with particulate matter, animals and insects as a result of

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