

Microbial health risks in KwaZulu-Natal (South Africa) drinking water

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Abstract In KwaZulu-Natal (South Africa) 56.5% of the population is rural and 61% have inadequate sanitation infrastructure or water supply. The remaining inhabitants are served by a reticulated water and sewage infrastructure with modern purification processes and monitoring, effectively eliminating water-borne infection and disease. Those using rivers, springs, dams or boreholes for ablutions and drinking water are exposed to a wide range of pathogens. The health service provision to treat diarrhoeal disease alone costs the province approximately 2% of its GDP. Endemic diseases are caused by enteropathic *Escherichia coli*, *Salmonella typhi*, *Shigella*, hepatitis A, rota-viruses, amoeba (amoebic dysentery), *Cryptosporidium* and *Giardia*. Bilharzia (a major risk to people using low-lying water bodies for recreation) and internal parasites (e.g. *Ascaris*) occur while a cholera outbreak is anticipated from Mozambique. Education programmes are being employed to inform people of water sanitation methods while raw and treated drinking water is monitored for pathogens, often using indicator organisms. A formal Control of Diarrhoeal Diseases Programme is being developed to address these problems in an integrated and co-ordinated manner. The reticulated water supply and sewage networks are constantly expanding and services are being expanded to service outlying communities.

INTRODUCTION

KwaZulu-Natal is the seventh largest of South Africa's nine provinces. It is the most densely populated province with 20.3% of the country's population of nearly 38 million. This may be ascribed to its high rainfall in a relatively arid land. In total, 56.5% of its population is rural, whereas 61% lack access to adequate sanitation facilities or an adequate potable water supply. Throughout South Africa more than 12 million people (30% of the population) do not have access to an adequate potable water supply, whereas nearly 21 million (53.8% of the population) lack basic sanitation (Department of Water Affairs and Forestry, 1996). This problem is one of quality rather than quantity, and the remainder of the population has access to a reticulated water and sewage infrastructure, serviced by modern purification processes and monitoring. This effectively eliminates the risk of infection and diseases from this source.

Diarrhoeal diseases are of the greatest concern. Conservative health economic analyses have shown that these diseases cost the province US\$211 million per annum

in health service provision, which equates to about 2% of its GDP. No costing of loss of productivity, morbidity or mortality was considered in these calculations. Every year in South Africa 43 thousand people die of, and 3 million people have to be treated for, diarrhoeal disease, costing the country around half a billion US dollars annually (Pegram *et al.*, 1998).

This study highlights the reasons for the high incidence of water-borne diseases in KwaZulu-Natal, their causes, and steps taken to remedy the situation.

DEMOGRAPHIC AND GEOGRAPHIC INFORMATION

KwaZulu-Natal is bordered by the Drakensberg (a 3000 m high mountain range) in the west and the sea to the east, with hilly tribal (Zulu), nature reserve and farmland in between. Most of the rural population lives in villages, many of which are inaccessible by road. Water often must be carried great distances from rivers or other raw water supplies. The same rivers are used for ablutions and the washing of clothes. The cities (Durban and Pietermaritzburg) and smaller towns are populated by relatively affluent homeowners, served with reticulated water and sanitation supply systems maintained to international standards, and shack-dwellers (migrants from rural areas or other African countries) who rely upon raw water or communal taps for their water supply. Sanitation varies from the most primitive to cheap but well designed "outhouses". Umgeni Water and Mhlathuzi Water are the two water boards committed to raising water and sanitation standards throughout the province, as are the government and city health departments and the Department of Water Affairs and Forestry.

CAUSES OF THE WATER-BORNE DISEASES

The diseases currently of greatest concern from the standpoint of socio-economic cost are those associated with symptomatic diarrhoea. Several diseases currently occur endemically, including those caused by the enteropathic bacteria *E. coli*, *S. typhi* and *Shigella*. In 1995–1996 a *Shigella dysenteriae* type 1 epidemic in KwaZulu-Natal resulted in thousands of observed cases and many hundreds of deaths (Rollins, 1996). This organism causes a particularly virulent form of dysentery and recently emerged as an epidemic throughout KwaZulu-Natal and the Eastern Cape. Cases were also being reported in the other provinces (Pegram *et al.*, 1998). A cholera outbreak is anticipated soon from Mozambique (on the KwaZulu-Natal border) and steps are being taken to minimize its effect. Hepatitis A and rota-viruses are the most significant water-borne viral pathogens while amoebic dysentery is also prevalent. *Cryptosporidium* and *Giardia* have also been detected.

Bilharzia (a major risk to people using low-lying water bodies for recreational purposes) and internal parasites (e.g. *Ascaris*) are also very prevalent. Poisoning also occurs due to the use of contaminated containers (e.g. by paraffin) for water storage.

The above organisms enter the watercourses from direct faecal pollution, land runoff through badly positioned pit latrines or fractured sewer pipes. The most dangerous period is that immediately following heavy rainfall.

METHODS EMPLOYED FOR WATER TREATMENT

Sophisticated ozonation or chlorination, flocculation, clarification and filtration are used in the reticulated drinking water supply systems, whereas activated sludge and related processes are used for wastewater purification in developed areas (Umgeni Water, 1998). Rural or urban communities without access to reticulated water supply systems resort to the boiling of water, and/or the addition of bleach or chlorine/flocculent tablets to raw water. Intensive programmes to educate people on the risks of water-borne infection are being employed. However, the inaccessibility of many communities and the occasional outbreak of violence hamper the efforts of health workers to distribute this information in susceptible areas.

MONITORING OF WATER SUPPLIES AND WATER-BORNE DISEASES

Treated drinking water is tested on a daily basis for the presence of coliforms, *Escherichia coli* and coliphages (none permissible). Total plate counts must contain less than 100 micro-organisms per 100 ml. Raw water is also tested daily for these organisms before purification commences and alternate sources are used if they are found to be too heavily contaminated. Alternatively, a pre-chlorination step is added or a different draw-off level from a dam used. *Cryptosporidium* and *Giardia* are monitored on a monthly basis.

Effluents from sewage works are monitored weekly for *E. coli* and faecal coliforms, as are designated sampling points on the rivers and dams. The Control of Diarrhoeal Diseases Programme monitors incidents of diarrhoeal diseases using paediatricians, pharmacists, nurses, environmental health officers and doctors at clinics and hospitals throughout the province. This allows prior warning of any disease that threatens to become an epidemic. The results are submitted to the Durban Health Department on a monthly basis for evaluation.

Enteric pathogens are monitored, using a provincial parasite control programme, and related to altitude. These pathogens are more prevalent at lower than higher lying areas.

METHODS USED TO COMBAT WATER-BORNE PATHOGENS

The focus is on supplying as many people as possible with adequate clean water for drinking and sanitation purposes. This is accomplished by treatment of raw water to standards complying, at a minimum, with those of the World Health Organization. However, in the short term, this is not a practical solution. Education of people about the hazards of using untreated water is currently being implemented. Comprehensive pamphlets and posters indicating suitable general hygiene practices and household water purification methods have been made available in both official languages of the province, and are supported by graphic depiction of the methods to be used. The pamphlets are distributed to those most likely to contract water-borne diseases. This information is also relayed via radio, clinic staff and environmental health officers.

Information on the siting of boreholes and water extraction points is also available in pamphlet form.

Health care workers are supplied with treatment protocols for the various water-borne diseases and primary school children are being treated *en mass* for internal parasites according to altitude-based criteria.

CONCLUSIONS

Although South Africa, including KwaZulu–Natal, is in dire straits with respect to the supply of adequate safe drinking water and sanitation, the problem is slowly being overcome by the extension of existing reticulation networks and tapping into the safest water supplies in less accessible areas. Here suitable rural sanitation systems are also being installed.

In the short term, however, education programmes are in place to teach the importance and methods of sanitation and household water purification.

The spread of disease is monitored through the Control of Diarrhoeal Disease Programme, whereas water monitoring of treated drinking and surface water in some areas is monitored routinely for indicator organisms. Further testing is conducted when required.

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