

Faecal coliform densities and water quality criteria in three coastal recreational lakes in the SW Cape, South Africa

WR Harding

Scientific Services Branch, Cape Town City Council, PO Box 1694, Cape Town 8000, South Africa

Abstract

The risk of contracting swimming-associated diseases in surface waters is currently poorly defined in the absence of epidemiological data. Site-specific and population factors, such as immunity or resistance to pathogens, complicate the universal application of a particular guideline to different lakes utilised for aquatic recreation. Data sets, covering 8 to 10 years of faecal coliform densities in 3 anthropogenically-impacted lakes in South Africa, are presented. Other hindrances to contact recreation such as dense phytoplankton populations or submerged macrophyte growth are not considered. Application of the European Community (EC) and South African National Committee for Oceanographic Research (SANCOR) bathing water criteria on an annual (non-seasonal) basis resulted in non- to marginal compliance in respect of contact recreation, despite considerable natural attenuation of faecal coliform numbers. The results show that it may be practically feasible to apply the existing criteria on a seasonal basis. All three lakes complied during the summer with a general contact faecal coliform density of 1 000 faecal coliforms per 100 ml.

Introduction

Ensuring that the microbiological quality of natural waters does not present a risk to human health is a priority for those responsible for the management of freshwater, estuarine or marine recreational water bodies. Surface waters, especially those within or near developed urban areas, frequently serve as conduits or sinks which receive varying amounts of treated sewage, occasional sewer overflows, storm water, industrial effluent and agricultural waste and runoff (Jones and Godfree, 1989). Swimmers in polluted water are exposed to significantly higher risks of contracting swimming-associated ear, eye, skin and gastro-intestinal illness (Stevenson, 1953; Cheung et al., 1991) than would be the case for non-swimmers or swimmers in unpolluted waters.

A variety of bathing water criteria exist, many with limits arbitrarily assigned and/or empirically derived in the absence of epidemiological studies (Brenniman et al., 1981). The historical development of bathing water criteria is reviewed by Salas (1986) and Lightfoot (1989). The universal application of bathing water criteria is precluded by local (site-specific) differences in immunity or resistance to pathogens, age composition of the user group, underlying pathogen density, transient visitor (tourist) populations, factors enhancing or prolonging microbial die-off, the presence of elevated numbers of bacteria in lake sediments, and varying types of recreational activity, each having different degrees of water contact and possibilities of water ingestion. This complexity of factors, which confounds the quantification of swimming-related disease, has been postulated as a case against the development of microbial criteria for bathing waters (Moore, 1975). With regard to the hazards to be encountered while swimming, Lacey and Pike (1989) concluded that "although there is a genuine need for guidance on issues involving recreational risks, there is no satisfactory approach to providing it. The measurement and prediction of such risks are technically difficult, and the evaluation of detriment is controversial". It is, however, arguably more beneficial to have even an arbitrary

measure of health risk than none at all.

The presence of pathogens in bathing waters constitutes the greatest cause for concern, and the existing criteria incorporate safety margins. There is conflicting evidence regarding the numbers of micro-organisms in water necessary for swimmers to contract illness. According to Crockett et al., 1989, "there is little or no evidence of swimmers contracting illness from water containing less than several thousand *E.coli* per 100 ml, although caution should be exercised as documented evidence is scarce." Also, the presence of a pathogenic micro-organism in sewage indicates that the corresponding disease is already circulating in the population (Moore, 1975). A recent study by Lightfoot (1989), conducted at 6 Canadian freshwater beaches, found that there was no evidence to suggest that bacterial count contributed to the prediction of illness in swimmers.

Contrary to these views are the findings of Cabelli et al. (1982 and 1983) which indicate that bathers are at risk in marine waters having as few as 10 enterococci or *E.coli* per 100 ml (Vasconcelos and Anthony, 1985; Holmes, 1989; CMNH, 1990). The presence of *E.coli* has been shown to be highly correlated with swimming-related illness in freshwater (Dufour, 1984; USEPA, 1986) and is generally regarded as the most specific indicator of contamination with the faecal wastes of warm blooded animals (Cabelli et al., 1982). A review of research findings where statistically significant excess rates of disease have been reported in the bather group (e.g. Cabelli, 1982), has shown these to be based on poor statistical correlations (Jones et al., 1991). Methodological problems which have complicated epidemiological studies may be more satisfactorily addressed by the use of specifically directed cohort studies (Lacey and Pike, 1989; Jones et al., 1991). The methodological and analytical issues pertaining to the setting of recreational criteria have been stipulated by Fleisher (1992).

Bathing water criteria are generally expressed as an allowable average concentration and a maximum value which is not to be exceeded for more than a given per cent of the time. The maximum acceptable bacterial density for a single sample is set higher than for the mean in order to avoid unnecessary beach closings based on single samples. The simple adaptation of a particular set of criteria is considered to be inappropriate in the absence of a thorough review of local circumstances and

Received 10 July 1992; accepted in revised form 17 November 1992