WHO/HSE/WSH/10.04

ADDENDUM TO THE

WHO GUIDELINES FOR SAFE RECREATIONAL WATER ENVIRONMENTS,
VOLUME 1, COASTAL AND FRESH WATERS

LIST OF AGREED UPDATES

Addendum to Guidelines for Safe Recreational Water Environments, Vol 1
World Health Organization – Geneva, Switzerland

CONTENTS

1. INTRODUCTION

This addendum provides updated information based on new scientific evidence to explain matters relating to faecal pollution in the 2003 volume of the Guidelines for Safe Recreational Water Environments, Volume 1, Coastal and Fresh Waters.

The addendum is the product of presentations and discussions that took place at an expert meeting held in January 2009 at World Health Organization headquarters in Geneva. Participants included researchers, regulators, and epidemiologist from seven countries. The meeting was convened to review emerging evidence regarding faecal pollution and human health in connection with recreational bathing waters. Through the course of the meeting it was decided that there was insufficient new evidence nor were there significant advancements in water quality monitoring to warrant a new edition of the Guidelines. Rather, it was decided that updated information based on best available evidence would be better presented in an addendum to the existing Guidelines. Therefore, each participant, according to their expertise, contributed material to this addendum.

The items in the addendum are listed in the numerical order (by page) in which they appear in the Guidelines. Only those references that are not yet listed in the Guidelines are listed in the addendum. For further information regarding the meeting presentations and discussions reference is made to the report of the meeting on WHO Guidelines for Safe Recreational Water Environments Meeting Report, World Health Organization, 14-16 January 2009 - WHO/HSE/WSH/09.07, also available on the Water, Sanitation and Health pages of the WHO web site (www.who.int/water_sanitation_health).

2. UPDATED ITEMS

THROUGHOUT
Replace "Norwalk Virus" with "Norovirus", **except** in Table 4.3.
Likewise on pg. 57, second paragraph, "Norwalk-like viruses" should be changed to Noroviruses.

INTRODUCTION
page xxiiii
Replace paragraph 5 that begins with "Population groups" with:
Some population groups, such as the very young, the elderly, the immunocompromised, and tourists, might be more susceptible to local endemic pathogens and, thus, may be at higher risk to swimming-associated disease. Children are clearly at higher risk because of their swimming behaviour and immature immune systems, while visiting populations may be at higher risk because they have not been previously exposed to local pathogens. Little is known about the risk of disease for the elderly and immunocompromised exposed to recreational waters. Extensive exposure to recreational waters by these higher risk groups should be considered in the development of risk assessments and by managers of water resources.

CHAPTER 4. FAECAL POLLUTION AND WATER QUALITY

Page 54, TABLE 4.1 EXAMPLES OF PATHOGENS AND INDEX ORGANISMS CONCENTRATED IN RAW SEWAGE

Replace second row, "Viruses", with the following:

Viruses		
Adenoviruses	Ocular, respiratory and urinary infections, gastroenteritis	47 600-11 600 000
Enteroviruses	Central nervous system, ocular and respiratory infections	0-3 723
Noroviruses	Gastroenteritis	380-7 100 000
Rotaviruses	Gastroenteritis	400-85 000

Update Footnote (a) with the following references:

Bofill-Mas, et al., 2006; Costán-Longares et al.,2008; Iwai et al., 2009.

Page 55, BOX 4.1 FAECAL STREPTOCOCCI/INTESTINAL ENTEROCOCCI
Replace current Box 4.1 with new Box 4.1 below:

Faecal streptococci and *E. coli* are used to index of faecal pollution in recreational waters. However, they may not be useful in tropical waters due to potential growth in soils/sediments. However, they may not be useful in tropical waters due to potential growth in soils, in fact molecular methods has proved that *E. coli* can become "naturalized" in the environment and do not necessarily indicate recent faecal pollution (Ishii et al., 2007; Ishii and Sadowsky, 2008).

Faecal streptococci is a bacterial group that includes species of different sanitary significance and survival characteristics (Gauci, 1991; Sinton & Donnison, 1994) and species prevalence differs between animal and human faeces (Rutkowski & Sjogren, 1987; Poucher et al., 1991; see Table 9.8 in Bartram & Rees, 2000). The taxonomy of this group has been subject to extensive revision (Ruoff, 1990; Devriese et al., 1993; Janda, 1994; Leclerc et al., 1996) and contains species of two genera—*Enterococcus* and *Streptococcus* (Holt et al., 1993). Although several species of both genera are included under the term enterococci (Leclerc et al., 1996), the species most predominant in the polluted aquatic environments are *Enterococcus faecalis*, *E. faecium* and *E. durans* (Volterra et al., 1986; Sinton & Donnison, 1994; Audicana et al., 1995; Figueras et al., 1998; Borrego et al., 2002). In fresh water *E. faecium* prevails over *E. faecalis* while in seawater occurs the other way around (Figueras et al., 1998).

Enterococci, a term commonly used in the USA, includes all the species described as members of the genus *Enterococcus* that fulfil the following criteria: growth at 10 °C and 45 °C, resistance to 60 °C for 30 min, growth at pH 9.6 and at 6.5% NaCl, and the ability to reduce 0.1% methylene blue. Since the most common environmental species fulfil these criteria, in practice the terms faecal streptococci, enterococci, intestinal enterococci and *Enterococcus* group may refer to the same bacteria. In this chapter, the term intestinal enterococci has been used, except where a study reported the enumeration of faecal streptococci, in which case the original term has been retained.

The International Organization for Standardization (ISO) has developed two methods one based on the Membrane Filtration Technique (MF) and the other based on the Most Probable Number (MPN) using a miniaturized 96-well system to enhance precision (Bartram & Rees, 2000—chapter 8). The MF method (ISO 7899-2) employs the classical m-Ent culture media (with 1% sterile solution of TTC incubated for 44 ± 4 h at 36 ±2°C), after which a transplantation of the filter to bile esculin azide agar (incubating for 2 h at 44 ± 0.5 °C) allows for confirming all colonies that appear as dark brown to black as intestinal enterococci. This confirmation step is essential to avoid false positives (Figueras et al., 1996). The MPN (ISO7899-1) enumerates intestinal enterococci on basis to their capacity to growth at 44 ± 0.5°C and of hydrolysing 4-methylumbelliferyl-b-D-glucoside in the presence of thallium acetate, nalidixic acid and 2,3,5-triphenyltetrazolium chloride, in specified liquid medium being the reaction visualized by the emission of fluorescence in 36-72 h. Details are given on the following page.

New approaches to the quantification of faecal indicator organisms in recreational waters are emerging. Molecular methods such as quantitative Polymerase Chain Reaction (qPCR) are being employed in epidemiological studies and showing promise in predicting illness rates in swimmers (Wade et al., 2006; 2008; Ahmed et al., 2008a). Such approaches also have potential utility as a rapid method of water quality

assessment to inform decisions on 'advisory' notices and timely management of health risk at bathing waters. There is an indication of weak but significant correlation (least squares regression R^2 0.46) between intestinal enterococci, enumerated by culture methods (e.g. colony counts from membrane filtration), and genome copy cell equivalents enumerated by qPCR (Haugland et al., 2005). However, it is not recommended that simplistic functional relationships between these parameters are assumed and used to convert between parameter sets because their fate and transport in the environment is very different. It is likely that future epidemiological studies will deploy both culture and molecular methods in parallel and further information on their statistical comparability will emerge in the medium term to underpin a more rigorous comparative evaluation of their public health and management utility.

It may be important to identify human versus animal enterococci, as greater human health risks (primarily enteric viruses) are likely to be associated with human faecal material and therefore more emphasis on human sources of pollution is made in the sanitary inspection categorisation of (see Table 4.12). Grant et al. (2001) presented a good example of this approach. They demonstrated that enterococci from storm water, impacted by bird faeces and wetland sediments and from marine vegetation, confounded the assessment of possible bather impact in the surf zone at southern Californian beaches. There will, however, be cases where animal faeces are an important source of pollution in terms of human health risk.

E. coli are bacteria that replaced faecal coliforms as a more specific index of faecal pollution because it is a more specific indicator of faeces from warm blooded animals. It is considered an indicator of recent faecal pollution due to its higher decay rate than intestinal enterococci, both in fresh water and sea water (Table 9.6 in Bartram & Rees, 2000).

Of the two ISO methods, one is based on MF and the other on the MPN (Bartram & Rees, 2000). The MF (ISO 9308-1) allows two alternative procedures the first is the *standard test* and uses lactose TTC agar with Tergitol-7 and requires a probabilistic confirmation of the colonies (at least 10). The second is the *rapid test* that use tryptone soya agar (4-5 h at 36 ± 2°C°C) after which a transplantation of the filter to tryptone bile agar (19-20 h at 44 ± 0.5°C) allows for confirming all the colonies that turn red after the addition of drops of the indole reagent (on their top) as *E. coli*. Transplantation can be avoided if both media are included in the same Petri dish and a programmed incubation is used. This ISO method was designed for drinking water or treated waters and may not be useful for contaminated marine waters or fresh waters with many interfering microbes. The MPN method ISO 9308-3 (96 wells)