

ITU TRIATHLON WATER QUALITY STATEMENT

Sergio Migliorini

ITU Medical Committee chair

Triathletes are very intense exposed to the contaminated water during training and triathlon competitions. They can become infected due to water ingestion and or due to skin or mucous membrane contact with the water. (Schep G. 1992) It is very plausible that, during a competition, some athletes are more prone to develop infections than under normal circumstances. There are several physiological mechanisms during exercise that may lower the resistance to infections during and shortly after an endurance effort like a triathlon. It is mainly based upon three mechanisms:

- the hormonal stress reaction
- the drop in some specific immune parameters like the concentration and activity of natural killer cells
- the possible failure of local protective mechanisms of the gastrointestinal tract and of the skin.

Water quality problems

The most important health problem due to contaminated swimming water is associated with microbiological contamination.

For triathlon the most relevant pathogens are in order of importance associated with the following risk factors:

1) Human and animal faecal contamination

There is an association with the following pathogens: enterococci/faecal streptococci, E.Coli, faecal coliformi, total coliform, salmonella, shigella, campylobacter, vibrio cholera, gastro enteritis viruses, enteroviruses, parasitic protozoa, some other exotic parasites, Aeromonas and Plesiomonas.

2) The occurrence of rodents

Most relevant are brown rats and muskdeer, who can pass leptospirae in their urine into the water when they are infected. A determination of leptospirae in surface water is very complicated and not feasible. The most important reason is the very low dose that is necessary for an infection (below the limit of laboratory detection) and the fact that the concentration of leptospirae in the water is almost always extremely low.

3) *Eutrofication of the water*

Some pathogenic bacteria like *Aeromonas*, *Plesiomonas*, *Cyanobacteria*, can actually multiply themselves in surface water. This multiplication is stimulated if the water contains more nutritious matter (eutrofication). People may be exposed to Blue-Green algae or Red Tide algae toxins by drinking or bathing in contaminated water.

4) *Bird colonies*

Since birds can be infected with *Plesiomonas*, *Campylobacter* and *Salmonellae* they may contaminated the water with those organisms.

5) *Industrial cooling water installations*

It is proven that naturally occurring and potential severely pathogenic amoeba's can grow in a hot environment like the plume of an industrial cooling installation.

Risk factors

The most important risk factor is faecal contamination due to human faeces. Animal faeces is less important in harbouring human pathogens. Human faeces can come into the water directly (bad sanitation, in many countries discharge of non purified sewage and by discharge from house boats). However also purification of sewage is not able to control all the disease causing organisms. Dependant on the flow and the extent of the discharge there can be large fluctuations in the quality of the water.

Faecal contamination can harbour many potentially pathogens. It is not feasible to test all those micro organisms. Further on there is also a lack of data considering the quantitative relationship of the concentration of many of those pathogens and the risks of disease. Especially the viruses are the most hazardous.

The commonly used indicator.

Bacterial indicators of faecal contamination considered are enterococci/faecal streptococci, *E.Coli*, faecal coliformi and total coliform. Thermotolerant coliform bacteria are present in human and animal faeces. However they also occur in other environments that bear no relationship to faecal contamination (discharge from paper industry, brewery's etc). *Escherichia coli* (*E.Coli*) is a species of faecal coliform that is specific for faecal material from humans and other warm-blooded animals. Enterococci are a subgroup within the faecal streptococcus group and are distinguished by their ability to survive in salt water. Faecal coliforms as a group were determined to be a poor indicator of the risk of GI illness (US EPA 2002).

Water quality control consists of :

- a) ***Sanitary inspection*** . Quite obviously measurable entities that are not however so specific indicators of the water quality, like :
- the colour of the water that may not change in an abnormal way
 - the absence of oils that float on the water or that cause smelling
 - the absence of a smelling of phenol

- a transparency of the water of more than one meter. When the diminishing transparency is caused by algae this can be considered as a sign of eutrofication and of an indicator of inferior water quality.
 - the absence of the Blue-Green Algal Bloom or the Red Tide Algal- Bloom
 - the absence of rodents
 - the absence of industrial cooling water installations
 - the absence of garbage
 - sewage discharge or the occurrence of house and boats
- b) ***Bacterial and or viral tests.*** Those test are a measure for faecal contamination and they are very important regarding swimming associated health risks. Traditionally the microbiological quality of waters has been measured by the analysis of indicator microorganisms. Human enteric virus are the most likely pathogens responsible for waterborne diseases from recreational water, but detection methods are complex and costly for routine monitoring and so the main parameters analysed for compliance with the Directive are indicator organisms.

EEA Standards

The **Directive 2006/7/EC** reduced the number of parameters from 19 to 2 key microbiological parameters and the faecal contamination is assessed by determination of two mandatory indicator bacteria :

- Escherichia Coli
- Enterococci

The choice of microbiological parameters is based on available scientific evidence provided by epidemiological studies conducted by the WHO and health Institutes in Germany, France and Netherlands.

For some characteristics E. Coli may be considered a more useful indicator than faecal coliforms and it has been included in all recent laws regarding fresh, marine and drinking waters.(Baudisova D.1997, Briancesco R. 2005) E.Coli and enterococci are adequate indicators of GI illness in marine water. In fresh water, E. Coli is a more reliable as consistent predictor of GI illness than is enterococci. E.Coli was superior to enterococci at predicting illness and the E.Coli guideline level was supported because exposure below presented no significant risk, whereas exposure above were associated with an elevated and statistically significant increased risk of GI illness(Foulon et al 1983, Kay et al.1994, McBride et al.1998). The body of literature does support the use of enterococci and E.Coli as useful predictors of GI illness in marine environment

(Wade TJ et al. 2003) Also salmonellae and enteroviruses there are standars, however one will not determine those micro organisms on a routine base.

EEC has a guideline limit that indicates the value that one should try to realize excellent swimming water.

For Sea and Transitional waters

A	B	C	D
	Excellent quality	Good quality	Sufficient quality
1) Enterococci ufc/100 ml	100(*)	200(*)	185(**)
2) E. Coli ufc/100ml	250(*)	500(*)	500(**)

(*) according to percentile 95°

(**) according to percentile 90°

For Inland waters

A	B	C	D
	Excellent quality	Good quality	Sufficient quality
1) Enterococci ufc/100 ml	200(*)	400(*)	330(**)
2) E. Coli ufc/100ml	500(*)	1000(*)	900(**)

(*) according to percentile 95°

(**) according to percentile 90°

- c) ***Weather forecast*** : where the event is running under rainy conditions the microbiological contamination could improve.

Standards under discussion

It is very difficult to prove that an infection is due to an exposure with swimming in a surface water since :

- a) The symptoms are often quite vague and aspecific. So the disease is often not properly diagnosed.
- b) Viral examinations are very difficult, because there can be so many possible viruses responsible for the disease.
- c) Numerous epidemiological studies of waterborne illness in developed countries indicate that the common aetiological agents are more likely to be viruses and parasitic protozoa than bacteria (Levy et al.1998)
- d) It is very difficult to establish the relationship with the exposure to the swim water because there is no routine testing for those viruses and because the symptoms in general only start several weeks after the exposure.
- e) No treatment is available for those viral illnesses so a practical working doctor is not so eager to find out which virus was the cause of the disease. In the contrary when a doctor considers a possible leptospirosis infection that may look quite similar it has much more practical implications for the treatment to determine whether or not the patient is infected.

We learn from this that it may very well be possible that the health problems associated with faecal contaminated swimming water do not restrict themselves to the rather innocent gastroenteritis.

ITU Water Quality Rules

Since 2010 ITU adopted the EEC standards 2006/7/EC of bathing water quality.

Especially for international competitions it is absolutely necessary to get a clear view on the water quality of such competitions. Since in some countries there is risk for some very serious disease causing health problems (Migliorini S,2009).

Water quality tests submit to ITU

- According to ITU rules, the LOC must submit water quality tests :
- Two months before the competition
- 7 days before the competition
- On the first competition day of the event for statistical purposes only.

Samples of the water collected from three different locations on the swim course will be separately analysed and the poorest results will determine if the swim can take place. The swim will be allowed if the following values are below the level of tolerance in the different types of water.

a) Sea and Transitional waters:

- PH between 6 and 9
- Enterococci not more than 100 per 100 ml (ufc/100ml)
- E. Coli not more than 250 per 100 ml (ufc/100ml)
- Absence of positive visual evidence of Red Tide Algal bloom.

b) Inland waters

- PH between 6 and 9
- Enterococci : not more than 200 per 100 ml(ufc/100ml)
- E. Coli not more than 500 per 100 ml(ufc/100ml)
- The presence of Blue-Green Algal bloom/scum (cyanobacteria) with more than 100.000 cells/ml.
- This test is only acquired in case of positive visual evidence of Blue Green Algal bloom. Because of the potential for rapid scum formation daily sanitary inspection is mandatory by the LOC Medical Director in the two weeks before the competition in the area prone to scum formation. Where not scums are visible, but the water shows strong greenish discoloration, turbidity and the transparency is less than 0.5 m the cyanobacteria test must be performed.

ITU recommend to organize only triathlons in swimming water that falls in the Excellent water quality category. If the water quality test shows values out of the tolerance limits as indicated above the swim will be cancelled, unless the ITU Medical Committee permits the Good Water Quality category.

The water quality results delivery may vary from 48 hours to 96 hours depending on the methodology that the laboratory is using; therefore, making a decision on competition delay based purely on data that is not reflecting the current conditions 100% is not advisable. Particularly in cases where the event is running under raining conditions ITU use approach recommended by WHO to guide decision making (Water Quality Decision Matrix) by combining :

- water quality analysis
- sanitary inspection
- weather forecasts

Water Quality Decision Matrix - Sea and Transition water

		<i>Two past results</i> E.Coli < 250 Enterococci <100	<i>Last results</i> E.Coli 250 to 500 Enterococci 100 to 200	<i>Two past results</i> E. Coli 250 to 500 Enterococci 100 to 200	<i>Last results</i> E.Coli > 500 Enterococci >200
Sanitary Inspection category	Low	1	2	2	4
(susceptibility to fecal influence)	Moderate	1	2	3	4
	Hight	2	3	3	4

Key for levels:

1) *Very Good Water Quality* : (E.Coli < 250 ufc/100ml or Enterococci < 100 ufc/100 ml) with no or potential visual pollution during sanitary inspection or forecasted heavy rain;

2) *Good Water Quality* : (E.Coli < 250 ufc/100 ml or Enterococci < 100 ufc/100 ml) with poor visual pollution during sanitary inspection or forecasted heavy rain.

2) *Good Water Quality* : (E.Coli 250 to 500 ufc/100ml or Enterococci 100 to 200 ufc/100ml) with no or potential visual pollution during sanitary inspection or forecasted heavy rain.

3) *Fair Water quality* : (E.Coli 250 to 500 ufc/ml or Enterococci 100 to 200 ufc/ml) but with potential or poor visual pollution during sanitary inspection and/or potential for forecast heavy rain;

4) *Poor Water Quality* : (E.Coli >500 ufc/ml or Enterococci >200) with any visual pollution during sanitary inspection and /or potential for forecast heavy rain.

Water Quality Decision Matrix - Inland water

		<i>Two past results</i> E.Coli <500 Enterococci <200	<i>Last results</i> E.Coli 500 to 1000 Enterococci 200 to 400	<i>Two past results</i> E.Coli 500 to 1000 Enterococci 200 to 400	<i>Last results</i> E.Coli >1000 Enterococci >400
Sanitary Inspection category	Low	1	2	2	4
(susceptibility to fecal influence)	Moderate	1	2	3	4
	Hight	2	3	3	4

Key for levels :

- 1) *Very Good Water Quality* : (E.Coli <500 ufc/100 or Enterococci <200 ufc/100ml) with no or potential visual pollution during sanitary inspection or forecasted heavy rain;
- 2) *Good Water Quality* : (E.Coli <500 ufc/100ml or Enterococci <200 ufc/100ml) with poor visual pollution during sanitary inspection or forecasted heavy rain;
- 2) *Good Water Quality* : (E.Coli 500 to 1000 ufc/100ml or Enterococci 200 to 400 ufc/100ml) but no or potential visual pollution during sanitary inspection or forecasted heavy rain;
- 3) *Fair Water Quality* : (E.Coli 500 to 1000 ufc/100ml or Enterococci 200 to 400 ufc/100ml) but with potential or poor visual pollution during sanitary inspection and/or potential for forecast heavy rain;
- 4) *Poor Water Quality* : (E.Coli >1000 ufc/100ml or Enterococci >400 ufc/100ml) with any visual pollution during sanitary inspection and/or potential for forecast heavy rain.

ITU recommend to organize only triathlon in swimming water that falls in the Decision Matrix Very Good Water Quality category . If the water quality decision matrix show values out of the ITU tolerance limits, the swim will be cancelled, unless ITU Medical Committee permits the Good Water Quality category.

4/02/2019

Dr Sergio Migliorini

ITU Medical Committee Chair
On behalf of the ITU Medical Committee



References

Bathing water quality EEA

<http://www.eea.europa.eu/data-and-maps/indicators/bathing-water-quality>

Baudisova D. Evaluation of Escherichia Coli as the main indicator of faecal pollution. *Wat Sci Technol* 35:333-6.,1997.

Briancesco R. Indicatori microbiologici e valutazione della qualità delle acque superficiali. *Ann Ist Sp Sanità* 41(3) 353-358, 2005

Foulon G, Maurin J, Quoi N, Martin-Buoyer G . Etude de la morbidité humaine en relation avec la pollutionbacteriologique des eaux de baignade en mer. *Rev Fr Sci Eaux* . 2:127-143.1983

Kay D, Fleisher JM, Salmon RL, Jones F, Weyer MD, Godfree Af et al. Predicting likelihood of gastroenteritis from sea bathing :results from randomized exposure. *Lancet* 344 :905-909.1994.

Levy DA,Bens MS, Craun GF,Calderon RL, Herwaldt, Surveillance of waterborne-diseases outbreaks US 1995-1996. *Morb MortalWkly Rep* 47:1-34, 1998.

McBride GB, Salmondo CE, Bandarana DR, Turner SJ,Lewis GD, Till DG. Helath effect of marine bathing in New Zeland. *JInt J Enviroment Health res.* 8.173-189,1998.

Migliorini S. ITU Medical Committee Report. ITU Congress Gold Coast Queensland (AUS) 2009.

Shep Goof . Water quality in international triathlons. *Rijksuniversitet Utrecht-ETU Medical Committee.*1992

Scotland.gov.uk Blue-Green algae (cyanobacteria) in inland waters : assessment and control of risks to public health.

<http://www.scotland.uk/publications/2002/05/14852/5357>

US EPA 2002 Implementation guidance for Ambient Water Quality Criteria for Bacteria. EPA-823 B-02-033 Washington DC.U.S. EPA Office of Water

Wade JW, Nikita P, Eisenberg JNS, Colford Jr. Do US Environmental protection Agency Water Quality Guidelines for recreational waters prevent gastrointestinal illness ? A systematic review and meta-analysis. Environmental health perspectives. Vol 111, 8, 2003

WHO Water quality : Guidelines, Standards and Health. Indicator of microbial water quality. IWA Publishing London UK 2001.

Thanos Nikopoulos, Sergio Migliorini : ITU Water Quality Matrix 2018