

GLOBAL WATER PATHOGEN PROJECT

**PART TWO. INDICATORS AND MICROBIAL SOURCE TRACKING MARKERS**

# **MICROBIAL INDICATORS - “WORKHORSES” IN THE FIELD OF HEALTH-RELATED WATER QUALITY TESTING**

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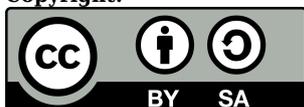
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**Citation:**

Farnleitner, A. and Blanch, A. 2017. Microbial Indicators - "Workhorses" in the Field of Health-related Water Quality Testing. In: J.B. Rose and B. Jiménez-Cisneros, (eds) Global Water Pathogen Project. <http://www.waterpathogens.org> (A.Farnleitner, and A. Blanch (eds) Part 2 Indicators and Microbial Source Tracking Markers) <http://www.waterpathogens.org/book/editorial> Michigan State University, E. Lansing, MI, UNESCO.

<https://doi.org/10.14321/waterpathogens.5>

Acknowledgements: K.R.L. Young, Project Design editor; Website Design: Agroknow (<http://www.agroknow.com>)

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**Last published:** August 1, 2018

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## Summary

The goal of this brief summary chapter is to provide the readers with an overview of the chapters in Part II: Indicators and Microbial Source Tracking Markers.

This synopsis addresses:

- A brief statement on how applicable microbial indicators are selected for health-related water quality investigations.
- The three main categories of indicators and indicator types that were selected for discussion in Part II.
- A list of the main themes discussed in the Part II chapters.
- Acknowledgment that constantly evolving information in this field will be updated on the GWPP website.

Microbial indicators still prove to be indispensable tools in health-related water quality investigations. The combined use of data from indicators and epidemiological studies of pathogens is of very deep complementary nature. It's concerted application is and will be an essential part in microbial diagnostics to guide target-oriented and sustainable water safety management.

## Part II: Indicators and Microbial Source Tracking Markers

### Microbial Indicators - "Workhorses" in the Field of Health-related Water Quality Testing

Although it is more than 100 years ago since their introduction, microbial indicators still prove to be indispensable tools in health-related water quality investigations. Recent activities, such as the development of genetic microbial fecal source tracking markers, demonstrate the outstanding importance of indicators also in novel analytical concepts. Application of indicators is delivered in many "colors and flavors", for example, indicators are used for system assessment, monitoring and surveillance, or, verification and validation. In addition, microbial indicators essentially support health-risk assessment and QMRA from fecal pollution hazards. It has to be emphasized, that the combined use of data from indicators and epidemiological studies of pathogens is of very deep complementary nature. It's concerted application is and will be an essential part in microbial diagnostics to guide target-oriented and sustainable water safety management.

### Facing the Complexity of Biological Systems: or the Search for Optimal Solutions

Universally applicable microbial indicators do not exist! The selection of suitable sets of parameters, applicable determination methods, and useful concepts of application have to be realized with respect to the questions being addressed and the specific background of the given

situation. Without any doubt, this needs expert proficiency and in-depth knowledge of the problem and situation. Appropriate solutions also strongly depend on the availability of resources, laboratory infrastructure and analytical-technical skills. Currently available methods provide a great deal of different approaches, ranging from traditional cultivation based technologies to advanced molecular biological detection. In this respect it is important to note - especially for the field of microbiology - that results strongly depend on the method of determination, and even slight modifications often result in major differences in the precision and accuracy of the data. Standardized methods or exactly described procedures are thus a strict pre-requirement to make data comparable for different situations and systems.

### Basic Indication Types and Used Classification Schemes

To appropriately reflect the range of currently available indicators and indication types, whilst keeping classification as simple as possible, three main categories were selected within the edited section:

- Indicators of general and host-associated fecal pollution (fecal indicators)
- Indicators to assess treatment or disinfection efficacy (treatment indicators)
- Indicators to assess surface and subsurface microbial transport (indicators of mobility and fate)

The chosen classification provides a practical, up-to-date, and problem-driven visionary approach. However, in futures editions, classification may be adapted and/or extended, if needed. Indicators of general fecal pollution, such as the traditional fecal indicator bacteria *Escherichia coli*, are used to detect fecal pollution from human and animals, without an indented discrimination. In contrast, host-associated fecal indicators are applied to discriminate between sources of fecal contamination. **Microbial source tracking markers** (MST-markers) fall within this newly emerging group of indicators. For example, quantification of human-associated MST-markers makes it possible to specifically trace human fecal pollution from waste water emissions in the aquatic environment. Microbial treatment indicators are used to assess the reduction of pathogens during (waste) water treatment, sanitation, or disinfection processes. As pathogens can show a huge variation in resistance against certain treatment or disinfection processes, treatment indicators are to be carefully chosen to avoid critical misinterpretation (and consequently biased QMRA). Indicators for the assessment of subsurface microbial transport are emphasized in the GWPP and are closely related to the investigated hydrogeology of the soil- and ground water system. Such applications are frequently linked to the use of hydrological transport models and mathematical simulations (e.g. to estimate safe setback distances of wells from pit latrines or other emission sources).

### Focus and Structure of the Edited Section

The main focus of the section indicators and MST-

markers is aimed to support investigation and monitoring schemes of the human fecal pollution pathway (including excreta and waste water) and associated sanitation technologies. Potentially relevant fecal pollution sources from animals are not neglected, and, if possible, are included in the methodical considerations. Real-world-problems in water resources management often face a combination of microbial hazards, and all relevant sources thus have to be considered for target-oriented and effective management measures. The structure of the chapters reflects the following main thematic themes:

- Introduction to important indicators and determination methods. Only a useful "selection" with emphasis on quantitative methods is presented (reference to standards whenever possible).
- Quantitative information on the occurrence of fecal indicators and MST-markers in excreta, raw and treated waste water and expected levels of reduction of treatment indicators during selected treatment, disinfection and sanitation procedures.
- Basic information on persistence and resistance of the presented microbial indicators.
- Basic overview on the application of indicators and MST-markers.

A lot of "cross-connections" are articulated and this will

facility easy access to other related sections of the GWPP on-line resource. Especially PART 3 (specific excreted pathogens) and PART 4 (persistence and management of risks) which include closely related topics and require joint considerations.

### **Dynamic Development of the On-line Resource Reflects Rapid Progress in the Field**

Driven by progress in life science and biotechnology, possibilities in microbial diagnostics are permanently increasing by a breathtaking speed. It is expected that the field of indicators and MST-markers will be strongly influenced by this "evolutionary" process also in the future. To reflect the status quo of science and technology the section "Indicators and MST-Markers" will thus constantly be updated.

### **The Editors of the Part II: Indicators and Microbial Source Tracking Markers**

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