GLOBAL WATER PATHOGEN PROJECT
PART FIVE. CASE STUDIES

HOW TO USE THE GWPP KNOWLEDGE? A RISK MANAGEMENT APPROACH FOR SAFE SANITATION

Susan Petterson
Water & Health Pty Ltd.
Griffith University
Corlette, Australia

Gertjan Medema
KWR Watercycle Research Institute
Nieuwegein, Netherlands

Copyright:

This publication is available in Open Access under the Attribution-ShareAlike 3.0 IGO (CC-BY-SA 3.0 IGO) license (<http://creativecommons.org/licenses/by-sa/3.0/igo>). By using the content of this publication, the users accept to be bound by the terms of use of the UNESCO Open Access Repository (<http://www.unesco.org/openaccess/terms-use-ccbysa-en>).

Disclaimer:

The designations employed and the presentation of material throughout this publication do not imply the expression of any opinion whatsoever on the part of UNESCO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. The ideas and opinions expressed in this publication are those of the authors; they are not necessarily those of UNESCO and do not commit the Organization.

Citation:

Petterson, S. and Medema, G. (2019). How to use the GWPP knowledge? A risk management approach for safe sanitation. In: J.B. Rose and B. Jiménez-Cisneros, (eds) Water and Sanitation for the 21st Century: Health and Microbiological Aspects of Excreta and Wastewater Management (Global Water Pathogen Project). (S. Petterson and G. Medema (eds), Part 5: Case Studies), Michigan State University, E. Lansing, MI, UNESCO.
<https://doi.org/10.14321/waterpathogens.67>

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

Last published: May 15, 2019

Summary

The GWPP provides a great deal of information and scientific data about pathogens and indicator organisms in excreta and wastewater and the effect of sanitation options and environmental processes on these pathogens. The aim of this Case Studies section is to show how this information can be used to support safe design and management of sanitation systems in different parts of the world. Conditions vary considerably in different local contexts, and those contexts will drive how the risk management questions can be addressed. The intent of the selection presented is to give examples of how scientific data on pathogens and indicators have been used to support sanitation management in different settings, different sanitation systems and applications and different management considerations.

The case studies are compiled with a user audience in mind: sanitation policy makers, water quality & safety officers at national or regional authorities, city councils or water and sanitation utilities etc. Each case study is described in a short management summary, followed by a more detailed management description of the case study. Case studies are based on scientific papers, reports or theses and a link to these scientific studies is provided.

The case studies have been organised by risk management objective into four categories:

1. Is it safe?

Six case studies are given from Vietnam, Bolivia, Australia and South Africa. These case studies demonstrate how to apply the framework to assess whether a sanitation management activity or action is safe.

2. Regulation for safe system design.

The Australian national guidelines for wastewater reuse are based on the principles of risk management and QMRA. A summary of the Australian guidelines is provided, together with two case studies from regional New South Wales.

3. System planning: evaluation of alternative scenarios.

These five cases studies provide examples and tools for planning of sanitation systems: a stepwise risk assessment to evaluate different pathogen exposure pathways in rural communities in Brasil; a sanitation safety planning framework for urban communities; an approach to validate the adequacy of alternative sanitation options in Australia, a regional risk model to evaluate different sanitation scenario's in a river in Austria and a global model to evaluate the impact of different sanitation scenario's on pathogen concentrations in rivers worldwide.

4. Managing risks by targeting pathogen sources.

Three cases studies, from Spain, Austria and the USA, demonstrate how microbial source tracking markers (see GWPP Part 2) can be used to generate understanding of different human, livestock and wildlife sources of pathogens to support efficient safe and effective management of water systems.

Community well near Sihanoukville, Cambodia, that is potentially contaminated by pathogens from fecal waste disposal. Microbial Risk Assessment together with Microbial Source Tracking can assess pathogen health risks and identify options for management. (Photo provided by Susan Petterson)

A risk management approach to safe sanitation systems

The case studies have been compiled from a common risk management framework. This safe water framework (Carr & Bartram, 2004) is a general approach to assess the safety of a water or sanitation system based on the occurrence, fate, transport, potential exposure and health impact of pathogens.

This is the type of data that is compiled in the GWPP. Safe sanitation systems are a primary barrier for the protection of health as illustrated in Figure 1 and the risk framework is developed to determine the need for control measures for the protection of health in a systematic, evidence-based and transparent manner.

Figure 1. Sanitation as barrier to excreta-related pathogens (source: WHO, 2018)

The World Health Organization promotes the use of Sanitation Safety Plans (Figure 2) to support the development and operation of safe sanitation systems. The case studies demonstrate how the risk management

framework can be used for assessing the microbial safety of sanitation system (mainly step 3 and 4 of the Sanitation Safety Plan) in different contexts. The WHO Sanitation Safety Manual can be found here.

Figure 2. Steps in the Sanitation Safety Planning Process (source: WHO, 2015)

These risk assessment steps can be undertaken at different levels of detail depending on the resources available and the

objective of the assessment (see Figure 3).

Figure 3. The scale of microbial risk assessment: more detailed input facilitates more evidence-based risk management (source: WHO, 2016).

Sanitary inspection: An on-site visual evaluation of observable features and conditions at or in the vicinity of the water supply that may lead to an unsafe supply. Sanitary inspections are typically based on standardized forms/checklists to identify the most common issues that may lead to the introduction of hazards into the system. The fact sheets in the WHO Guidelines on sanitation and health (2018) provide the elements for such checklists for many sanitation systems.

Risk matrix: The risk assessment approach that makes a qualitative or semiquantitative evaluation of the likelihood that a hazardous event will occur and the severity or consequence of the hazard and combines them into a risk score or risk rating. The approach relies on expert judgement and can be undertaken at different levels of detail. For more information, see the WHO Sanitation Safety Plan manual (WHO, 2015) and Stenström et al (2011).

QMRA: A formal, quantitative risk assessment approach that combines scientific knowledge about the presence and nature of pathogens, their potential fate and transport in the environment, the routes of exposure of humans and the health effects that may result from this exposure, as well as the effect of natural and engineered barriers and hygiene measures. All this knowledge is combined into a single assessment that allows evidence based, proportionate, transparent and coherent management of the risk or waterborne infectious disease transmission (Figure 4).

Figure 4. Quantitative Microbial Risk Assessment: a tool for interpreting quantitative scientific data to support water safety management (source: WHO, 2016)

Many of the case studies in this section apply a formal QMRA approach. These studies have been summarised using the WHO QMRA framework (WHO, 2016). For more

details on QMRA methodologies and approaches see the WHO guidebook and the QMRA Wiki.

References

Carr, R. and Bartram, J. (2004). The Stockholm framework for guidelines for microbial contaminants in water. *Waterborne Zoonoses: Identification, causes and control*. (Cotruvo, J.A., Dufour, A., Rees, G., Bartram, J., R., C., Cliver, D.O. *et al.*, ed.). World Health Organization, IWA Publishing. Geneva. pp. 452-459.

Stenström, T.A., Seidu, R., Ekane, N. and Zurbrügg, C. (2011). *Microbial exposure and health assessments in sanitation technologies and systems*. Stockholm Environmental Institute. Stockholm.

WHO (2018). *Guidelines on sanitation and health*. World Health Organization. Geneva.

WHO (2016). *Quantitative microbial risk assessment: Application for water safety management*. World Health Organization. Geneva.

WHO (2015). *Sanitation Safety Planning: Manual for safe use and disposal of wastewater, greywater and excreta*. World Health Organization. Geneva.