

Source specific fecal indicators

Emphasize human health risk in water quality monitoring

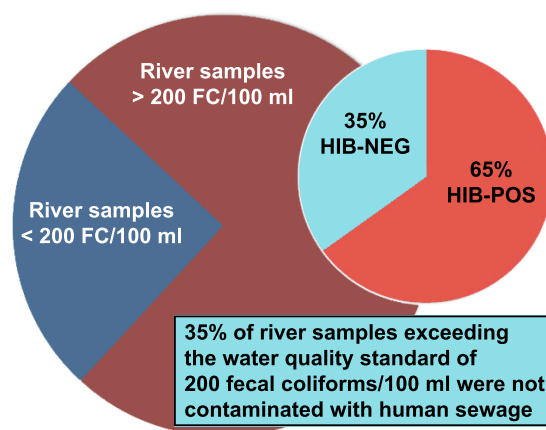
Key Message: Elevated levels of fecal indicator bacteria are used as a warning of possible pathogens in recreational waters. This general metric fails to discern the presence of human fecal pollution, which poses the greatest risk to public health. Consequently, waterways may have elevated levels of fecal indicators but the areas with the greatest health risk are not identified. Managers should implement methods specifically designed to detect human fecal pollution to prioritize remediation efforts.

Fecal Bacteria in Waterways

Pathogens, which can be any biological agents that cause disease or illness, are one of the most frequent water quality impairments in the U.S., accounting for over 10,000 of USEPA impaired waterways on the 303(d) list. Elevated counts of fecal indicator bacteria (FIB), including fecal coliforms, are routinely used to warn of possible pathogens in recreational waters. This general category of bacteria includes coliforms from human and non-human sources. In some cases, fecal coliforms can also be derived from environmental sources. In waterways where sanitation is limited or compromised, human fecal pollution and agricultural animal waste have a documented association with illness following exposure, while other fecal sources do not. Despite this specific linkage, the source of FIB is not considered when advisories, beach closures and remediation efforts are implemented. While this conservative approach ensures minimal human exposure to harmful pathogens, it may also lead to unnecessary restrictions or repair efforts.

Pinpointing the Source - Why is this important?

Fecal indicator bacteria generally do not cause disease, but they are an easy and cost-effective way to evaluate water quality compared to directly testing for specific pathogens. Hot spots for FIB pollution, however, are not always hot spots for human sewage (Figure 1). Sole reliance on FIB in management decisions may misdirect cleanup efforts by focusing on sources that are not associated with pathogens, thereby deemphasizing sources that are responsible for the highest human health risk.



being and natural resources.

Figure 1. River samples that did not meet water quality standards were not always impacted by sewage pollution. Risk from human pathogens would be comparatively lower in those samples. Samples were collected at sites in Milwaukee, WI from 2009-2013. Abbreviations: HIB=Human Indicator Bacteria FC=Fecal Coliforms

Until there are effective and affordable methods for analyzing waterways directly for pathogens, indicators that are specifically carried in humans or certain animals can be used to give better estimates of the risk of accompanying pathogens. Genetic markers in human *Bacteroides* and human *Lachnospiraceae*, two fecal bacteria highly associated with human fecal contamination, can be detected in sensitive molecular assays. Use of these robust markers identifies and prioritizes pollution sites that have a higher likelihood of accompanying pathogens. Tracking microbial sources is more complicated than FIB monitoring, but can be used as an investigative tool when sewage contamination is suspected.

Strategic Solutions

The ultimate rationale behind fecal pollution testing is to protect public health. Attempts to reduce disease outcomes by closing beaches and regulating bacteria through total maximum daily loads (TMDLs) are responses to elevated FIB in waterways. Under the Clean Water Act, states are required to implement TMDL bacterial load allocations for 303(d) listed impaired waters, resulting in costly management strategies for municipalities and non-governmental stakeholders, even when a minimal pathogen risk is involved. Thus, it is critical to distinguish human sewage pollution from less hazardous sources of fecal pollution to more accurately evaluate water quality. Identifying sewage-impacted waterways and sources will allow managers to confidently determine appropriate TMDL control strategies. By utilizing human specific indicators of fecal pollution in monitoring efforts, managers will be much more effective in protecting public health, well-

Policy Recommendation: Prioritize reducing human sources for the maximum human health benefit.

What is the Science Gap?

Here are three areas where further research would improve bacterial TMDL remediation strategies:

- Rapid detection methods or sensor technology for human sewage
- Ecology and viability of human fecal indicators in fresh and salt receiving waters
- Effective barriers to exfiltration of sewage from pipes and infiltration into stormwater systems

Additional Reading

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