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Editorial: Microbial Source Tracking (MST) tools to identify the origins of fecal pollution in environmental water resources and the impact of microbial contaminants on human health

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Editorial on the Research Topic
Microbial Source Tracking (MST) tools to identify the origins of fecal pollution in environmental water resources and the impact of microbial contaminants on human health

1 Introduction

Fecal contamination of water bodies poses significant risks to both human health and ecological systems, as it introduces organic matter, nutrients such as nitrogen and phosphorus, and potentially pathogenic microorganisms. Such contamination can compromise water quality, leading to environmental degradation, waterborne microbial infections and economic losses, particularly in sensitive settings such as drinking water supplies, recreational waters, and shellfish harvesting areas. The frequent detection of enteropathogens across diverse aquatic ecosystems underscores the importance of rapidly and reliably identifying the sources of fecal pollution to support effective water quality management, remediation efforts, and public health risk assessments. Microbial Source Tracking (MST) encompasses a suite of tools designed to attribute enteric microorganisms to particular hosts and has been widely applied to identify fecal pollution sources in a range of environments. MST approaches can provide valuable insights into the origin and dynamics of water microbial contamination and offer a framework for assessing the potential implications of fecal pollution for ecosystems and human populations.

2 An overview of the Research Topic

Four papers were published within this Research Topic, primarily focusing on the application of MST tools to identify the origins of fecal pollution in different environmental water resources. Most contributions employed genetic marker-based MST approaches to trace specific fecal sources in aquatic environments, highlighting methodological developments and providing insights into contamination dynamics and the associated risks. One study, while not applying MST tools, relied on cultivation-based detection of fecal indicator bacteria (FIB) to assess contamination levels and their association with reported health outcomes. It was included due to its relevance to microbial pollution and public health in the context of environmental waters. Together, these studies provide an up-to-date overview of current research and underscore both the opportunities and challenges for advancing MST technologies and complementary monitoring approaches.

Lynch et al. evaluated the application of a high-volume sample concentration (EasyElute ultrafiltration) to enhance microbial recovery from source water, alongside standard grab sampling and filtration methods. Post-concentration analyses combined culture-based quantification of fecal indicator organisms and reference pathogens with 16S rRNA amplicon MST, in order to provide an integrated approach for monitoring animal-derived microbial risks in forested water supply catchments.

dela Peña et al. investigated fecal contamination in Manila Bay, Philippines, by applying 16S rRNA gene amplicon sequencing combined with MST. They collected microbial samples from both fecal sources—including sewage and various animals—and environmental water samples from tributary rivers, coastal stations, and offshore sites. By analyzing microbial community signatures, they aimed to link environmental microbial populations to specific fecal sources, assessing the potential of sequencing-based approaches for tracking contamination in the Bay.

Mukherjee et al. investigated fecal contamination of floodwaters following Hurricane Harvey along the Texas Gulf Coast in 2017. Surface water samples were collected at six locations in southeastern Houston immediately before and after the hurricane and then every 1–2 weeks over a 2-month period. The samples were analyzed for fecal indicators using *E. coli* enumeration and molecular methods, including qPCR for general and human-specific *Bacteroidales*, dPCR for antibiotic resistance genes and a human-associated plasmid, and 16S rRNA gene-based microbial profiling. SourceTracker2 was applied to estimate contributions from human fecal sources, providing a comprehensive assessment of contamination over time.

Odewade et al. assessed the impact of pit-latrine seepage on groundwater quality and waterborne disease prevalence across eight wards of the Funtua Local Government Area, Katsina State, Nigeria. Well water samples were collected from 15 locations twice per season (dry and wet) and transported immediately to the laboratory for analysis. Water quality was evaluated using standard physico-chemical and microbiological methods, with careful measurement of the distance between wells and pit latrines to assess potential associations with microbial contamination. The study provided a structured framework for understanding how the proximity of wells to pit latrines may influence groundwater safety and disease-related health risks in the community.

In conclusion, this Research Topic underscores the critical importance of understanding fecal contamination in diverse water systems and the need for reliable, high-resolution methods to safeguard both human health and ecosystem integrity. Fecal pollution remains a persistent threat to water quality worldwide, affecting drinking water, recreational waters, and coastal environments. These studies collectively demonstrated that advances in molecular techniques, combined with traditional monitoring approaches, improve the ability to identify contamination sources, track pollution dynamics, and evaluate associated risks.

Beyond technical advances, the findings highlight the need for context-specific monitoring frameworks that account for local environmental, infrastructural, and social conditions. Effective water quality protection relies not only on accurate detection but also on translating scientific insights into actionable policies and sustainable management practices.

Overall, these contributions show that addressing the ongoing challenges of fecal contamination and ensuring safe, resilient, and sustainable water resources that support both human needs and the health of aquatic ecosystems require continued investment in methodological development, integrated monitoring strategies, and interdisciplinary research.

Author contributions

AB: Conceptualization, Writing – original draft, Writing – review & editing. MME: Conceptualization, Writing – original draft, Writing – review & editing. PM: Conceptualization, Writing – original draft, Writing – review & editing.

Conflict of interest

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