ABSTRACT
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Source-to-Outcome Microbial Exposure and Risk Modeling Framework

A Quantitative Microbial Risk Assessment (QMRA) is a computer-based data-delivery and modeling approach that integrates interdisciplinary fate/transport, exposure, and impact models and databases to characterize potential health impacts/risks due to pathogens. As such, a QMRA exercise fits well with multimedia modeling paradigms that have been widely exercised in the chemical and radionuclide communities, using software system architectures, like the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES). FRAMES provides the infrastructure to seamlessly link disparate models and databases, providing an assessor with the ability to construct an appropriate conceptual site model from a host of modeling choices, so a myriad number of QMRA analyses can be supported and reproduced. The Microbial Risk Assessment Interface Tool (MRA-IT) is an open-source, integrated software environment for performing an application of the pathogen exposure, intake, dose, and risk, containing several key components, including, but not limited to, pathogen specification, exposure scenario identification, and dose-response relationships. The current version of MRA-IT lacks upstream fate and transport components that produce pathogen and indicator concentrations in the water column prior to exposure. The MRA-IT is seamlessly linked, using FRAMES, with upstream fate and transport models. The final package is a software technology framework that focuses on linkages across the source-to-outcome continuum and provides an illustrative demonstration of microbial fate and transport, exposure routes and scenarios, intake volumes, dose, and risk computations.