Occurrence and factors related to the presence of human pathogenc viruses in aquifers serving small public water supplies

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Introduction and problem

Roughly 185,000 public water systems in the United States and its territories use ground water as a primary source. A full assurance that drinking water is not fecally contaminated is a key issue for any drinking-water system. Fecal contamination of ground-water supplies originates from a variety of sources including onsite septic systems; domestic sewerline breaks; overland flow from urban, agricultural, and natural areas; leachates from sanitary landfills; and recharge from surface waters or reclaimed wastewater. Viral contaminants, because of their small size and persistence in the environment, may be more of a threat to ground water than bacterial or protozoan contaminants associated with fecal contamination.

Insufficient monitoring information is available on the occurrence of pathogenic viruses in ground water and the factors that influence the vulnerability of ground water to contamination. The paucity of information is especially apparent for those ground-water supplies classified as small systems (those that serve less than 2,500 people). People drinking water from small public ground-water supplies may be at higher risk for exposure to bacterial and viral contamination than people drinking water from larger public supplies because monitoring requirements for small systems are much less stringent than for the larger systems.

Currently, USEPA is gathering information to promulgate requirements for disinfection of ground-water systems (Macler, 1995) under the Ground Water Rule (GWR). Identifying which ground waters are or may be vulnerable to fecal contamination is an important issue in the development of ground-water disinfection criteria. One approach to vulnerability assessment is to examine the occurrence of viruses in certain hydrogeologic and land-use settings.

Goals and objectives

This project was designed to aid in development of the GWR and to fill the gap of information on the occurrence and factors related to the presence of enteric viruses and their indicators in aquifers serving small public water supplies. Specific objectives are to

- determine whether enteric viruses are found in small public ground-water supplies at a higher frequency than has been found in other ground-water supplies,
- determine the factors that affect the presence of enteric viruses in small public ground-water supplies, and
- determine whether indicators of fecal contamination are adequate predictors of the presence of enteric viruses.

Approach

Data will be collected from a network of 32 wells in urban and suburban areas of southeastern Michigan. Selected for sampling are small public-supply wells—community, transient noncommunity, or noncommunity nontransient--that use ground water deemed not under the direct influence of surface water. Each well will be sampled for microbiological

indicators and pathogens a total of five times from July 1999 through June 2001. This includes five regular samples and one sample spiked with poliovirus vaccine. Ground-water samples will be analyzed for enteric viruses by RT-PCR and cell-culture methods; for somatic and F-specific coliphage by single-agar layer and enrichment methods; and for total coliforms, *Escherichia coli*, and enterococci by membrane-filtration methods.

Water-quality samples were collected and analyzed once per well during the period of study, from June through October 2000. Determinations included major constituents (including bromide and chloride), nutrients, boron, and dissolved organic carbon.

Ancillary data are being collected by the USGS or compiled from a variety of sources. These data include environmental, geologic, and land-use data that can be used as factors related to the distribution of microorganisms.