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Time series study of weather, water quality, and acute gastroenteritis at Water Safety Plan implementation sites in France and Spain

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Highlights

- Acute gastroenteritis rates increased after runoff events preceded by a dry period.
- Acute gastroenteritis rates were positively associated with elevated turbidity levels.
- Lag times for hydrological exposure indicators suggested viral pathogens.

Abstract

Water Safety Plans (WSPs), recommended by the World Health Organization since 2004, can help drinking water suppliers to proactively identify potential risks and implement preventive barriers that improve safety. Few studies have investigated long-term impacts of WSPs, such as changes in drinking water quality or public health; however, some evidence from high-income countries associates WSP implementation with a reduction in diarrheal disease. To validate the previously observed linkages between WSPs and health outcomes, this time series study examined site-specific relationships between water-related exposures and acute gastroenteritis rates at three locations in France and Spain, including the role of WSP status. Relationships between control or exposure variables and health outcomes were tested using Poisson regression within generalized additive models. Controls included suspected temporal trends in disease reporting. Exposures included temperature, precipitation, raw water quality, and finished water quality (e.g., turbidity, free chlorine). In France, daily acute gastroenteritis cases were tracked using prescription reimbursements; Spanish data aggregated monthly acute gastroenteritis hospital visits. The models identified several significant relationships between indicators of exposure and acute gastroenteritis. Lag times of 6-9 days (including transit time) were most relevant for hydrological indicators (related to precipitation, runoff, and flow) at the two French sites, indicative of viral pathogens. Flush events (defined as surface runoff after a two-week antecedent dry period) linked to nonpoint source pollution were associated with a 10% increase in acute gastroenteritis rates at one