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WEATHER VARIATIONS AND LOCATION DRIVE WATERBORNE INFECTIOUS DISEASE OUTBREAKS IN THE US

Weather, geographic factors, and **drinking water** sources all influence waterborne infectious disease outbreaks in the United States, according to researchers from Columbia University. This finding is significant amidst increasingly frequent floods, more extreme droughts, and heavier seasonal rainfall linked to climate change.

Researchers analyzed data from 516 hospitals across 25 U.S. states on (1) hospitalizations for 12 bacterial, parasitic, and viral waterborne infections, (2) weather and soil condition data from 2000 to 2011 to determine climate impact, (3) drinking water sources, (4) geographic area, and (5) rural versus urban environments.

The pathogens studied included *Legionella*, *Pseudomonas*, non-tuberculous mycobacteria, *Salmonella*, *Campylobacter*, *Shigella*, *Escherichia coli*, *Cryptosporidium*, *Giardia*, various species of amoebas and other protozoa, and norovirus.

Waterborne **pathogens** can cause severe intestinal, respiratory, or systemic infections in vulnerable individuals. Meteorology, hydro-climatology, and drinking water infrastructure affect infectious disease transmission, but their roles are not well understood and can vary depending on the type of pathogen or geographic region.

While **biofilm-forming** bacteria (*non-tuberculous mycobacteria*, *Pseudomonas*, *Legionella*) are ubiquitous, pathogens that cause gastrointestinal diseases are often introduced into the environment through human or animal waste.

Rainfall, flooding, and drought influence pathogen levels and dispersion in water. Flooding facilitates the movement of pathogens into sediments, soil, and water, overburdens sanitation systems, and can lead to the release of untreated wastewater. Drought, on the other hand, concentrates pathogens by lowering water levels.

Hospitalizations due to waterborne diseases during the 12-year study period amounted to 57,335. Biofilm-forming bacteria accounted for 81% of hospitalizations and 60% of respiratory infections involving *Pseudomonas*. Other common causes of hospitalization included non-tuberculous mycobacteria (9.6%), *Salmonella* (8.0%), and *Legionella* (4.1%). Hospitalization rates for biofilm-forming intestinal bacteria were significantly higher in areas where groundwater was predominantly used for drinking, as well as in areas with private water filtration systems. Hospitalization rates for cryptosporidiosis were nearly three times higher in groundwater compared to surface water, while giardiasis rates were slightly higher for surface water.

Among intestinal bacteria, hospitalizations caused by *Campylobacter* and *E. coli* were more often linked to groundwater, whereas *Salmonella* and *Shigella*-related hospitalizations were similar between both types of drinking water.

Rainfall, flooding, and rural areas were associated with zoonotic-related hospitalizations, while hospitalizations for infections caused by biofilm-forming bacteria were linked to soil moisture, with rates being higher in urban environments than in rural ones.

The ability of microorganisms to persist in the **environment** or withstand water treatment measures varies, which may explain the individual impact of weather conditions.

While drinking water and wastewater treatment dramatically reduce the transmission of waterborne infectious diseases, systems can become contaminated, especially as infrastructure ages.

Understanding the factors responsible for these infections could help develop an early warning system, enabling public health authorities to direct resources to prevent the consumption of contaminated drinking water.

Adapted after Mary Van Beusekom, 16 August 2024