

Warning system inadequate to prevent swimmers from getting sick at inland lakes

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New research shows a clear link between increasing levels of *E. coli* bacteria in an inland Ohio lake and a greater risk that swimmers in the water will suffer a gastrointestinal illness.

While the finding reinforces conventional wisdom, it is among very few studies to have quantified the risk for illness at an inland beach. Most similar work has examined the Great Lakes or coastal waters.

And there is a hitch: The testing method that measures *E. coli* levels at beaches takes at least 18 hours, and usually longer, to produce a result. So any swimming advisory based on that information is posted at least a day too late.

The researchers say their work calls attention to the need for a reliable method to predict when bacteria levels are likely to be higher than usual at an inland lake so advisories can be posted in a more timely way.

"It doesn't help, from a public health perspective, for the testing results to reveal themselves 24 hours after exposure has occurred. I think there's really a critical need for predictive methods, which allow us to anticipate, rather than to know after the fact, when *E. coli* levels will be elevated," said Timothy Buckley, associate professor and chair of environmental health sciences at Ohio State University and senior author of the study.

Such predictors of *E. coli* problems at inland lakes might be on the

horizon. The lead author of the paper, Jason Marion, a doctoral student in Ohio State's College of Public Health, hopes to identify reliable predictors that can be easily and quickly measured to allow advance warnings to beachgoers when risks for illness are increased.

Buckley and Marion emphasize that this work is not intended to discourage recreation at inland lakes, but is instead focused on preventing illness among beachgoers when water quality conditions are not ideal.

"We need a better way of telling swimmers when they are at risk," Marion said.

The study appears online ahead of print publication in the journal *Water Research*.

E. coli in water is considered an indicator of the presence of fecal contamination from warm-blooded animals. Most strains of the bacteria *Escherichia coli* do not cause illness in humans, but the bacteria's presence is an indicator that other pathogens are in the water as well.

At Ohio state parks, *E. coli* levels are tested in inland lakes every 14 days. If the level exceeds 235 colony-forming units (CFUs) per 100 milliliters of water, the next day officials post an advisory recommending against swimming, wading or playing in the lakes. Testing is conducted more frequently once this threshold has been reached, and advisories are removed once the levels drop.

In this study, the researchers collected 26 water samples at East Fork State Park in southwestern Ohio over 13 summer weekends in 2009. They also questioned people at the lake each weekend about their beach activities, and followed up with them by phone several days later to collect reports of any gastrointestinal symptoms associated with their

time at the lake.

A total of 300 households representing 965 individuals completed the entire survey process.

On two of the 26 sample days, *E. coli* densities exceeded the advisory threshold, with readings of 1,538 and 487 CFUs. The average bacteria level for the entire study period was 9.1 CFUs.

Across all days studied, those who swam, played or waded in the water were 3.2 times more likely to report a [gastrointestinal illness](#) - most commonly diarrhea, vomiting and nausea but also including stomach pain and fever - than were those who were at the beach but did not go in the water. That finding established a risk associated with exposure to water.

The statistical analysis showed that swimmers on days when *E. coli* levels were higher were at least seven times more likely to have reported illness than were swimmers on days with the lowest *E. coli* readings. By the numbers, 19 of 234 swimmers got sick when [bacteria](#) levels were between 59 and 1,551 CFUs, and 18 of 208 reported symptoms after water exposure when *E. coli* levels were well below the advisory threshold: between 11.3 and 59 CFUs.

"If we can extrapolate these results, there's a fair number of Ohioans being sickened by contact with recreational water across the state," Buckley said. "In addition to a better system to prevent illness, we'd like to see more emphasis on protecting lakes from becoming contaminated in the first place. There are public health costs when we don't take care of infrastructure. Who is taking that cost into account?"

Marion noted that the two days with significantly higher *E. coli* readings followed extremely heavy rains in the area and subsequent dramatic

elevations in water levels in the streams feeding into the lake. This suggests that contaminating substances from rural areas and population centers could have been entering the water more quickly and at higher concentrations than usual.

Such a connection suggests that one way to anticipate elevated *E. coli* levels in lakes would be to monitor rainfall and the related water level changes in tributaries to determine whether these conditions consistently affect lake [water](#) quality, he said.

The primary causes of *E. coli* contamination in inland waters are animal agriculture, nuisance wildlife, failing home septic systems or municipal wastewater treatment systems, and contamination from swimmers, Marion said. He noted that swimmer contamination also fouls swimming pools, so this risk of illness is not confined only to swimming in lakes.

The study also identified a higher risk of illness by people who ate food at the beach. While this could be caused by a number of factors, it led Buckley and Marion to suggest that limiting food consumption, or keeping one's hands clean while eating food, might be an additional way to lower the risk of getting sick at the beach. The transmission method of these pathogens to humans is through fecal-oral contact.

Provided by The Ohio State University

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