Faster method to detect bacterial contamination in coastal waters

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Currently, beachgoers are informed about water-quality conditions based on results from the previous day's sample. Scientists must collect samples in the field, then return to a lab to culture them for analysis -- a process that takes a minimum of 24 hours.

Now, engineers from the UCLA Henry Samueli School of Engineering and Applied Science have sped up the process of analyzing bacterial concentrations to under one hour, through the development of a new in-field, rapid-detection method.

Since bacteria levels can change quickly in the water column, a one-day turnaround time simply isn't fast enough to adequately protect swimmers or prevent unnecessary beach closures, the engineers say.

This issue is especially pertinent in California, where gastrointestinal illness that can result from contact with contaminated beach waters has been estimated to cost Orange and Los Angeles county beach visitors between $21 million and $51 million per year in sick days and related issues.

Furthermore, California coastlines are subject to chronic water pollution problems due to sewage spills and urban runoff. Rainstorms in Southern California can further exacerbate this problem, as pollutants that have accumulated over time on street surfaces are suddenly flushed into our waterways and into the ocean.

Jenny Jay, UCLA associate professor of civil and environmental engineering, and Ph.D. student Christine Lee have advanced and tested a rapid method in marine and freshwater samples from beaches in Malibu and Santa Monica. To their knowledge, it is among the first viable in-field methods for rapid, portable fecal bacteria analysis. This research will be published in an upcoming issue of the Journal of Applied Microbiology and is currently available online.

Even for areas like the Southern California coast, which are close to state-of-the-art laboratories, transportation time, coupled with lab work, may mean that results often are not ready until the next day. With such a delay between sampling and results, the results may no longer be relevant due to the dynamic nature of water quality in beach environments.

The new rapid method represents a field-portable alternative to more expensive procedures, particularly where larger-scale, expensive equipment is not readily accessible. To decrease the time to determine results, the researchers have outfitted a portable kit to test samples for bacterial concentrations.

"We envision a tool that can be used by lifeguards to collect and analyze water samples throughout the day, providing beachgoers with up-to-date, near-real-time data on water conditions," Lee said. "This could also be useful in determining persistence of a bacterial contaminant after a pollution event, such as a sewage spill or a septic tank leaking."

"We are currently applying this method, in a new approach, to identifying contamination sources in which we can adaptively sample the environment in order to hone in on hotspots," Jay said.

The process uses magnetic beads conjugated to specific antibodies that identify and bind fecal bacteria that are used as standards for determining the safety of recreational waters, such as E. coli and

Enterococcus.

After a few filtration and isolation steps, the sample organisms are lysed and treated with an enzyme that catalyzes a light-emitting reaction with target ATP, the energy currency of a cell. Cells break down ATP to obtain energy important for cellular processes.

Scientists can then determine bacterial concentrations based on how much light is released by using a luminometer, a device that detects light emissions.

The process is called covalently linked immunomagnetic separation/adenosine triphosphate quantification technique (Cov-IMS/ATP).

The paper's other co-authors are UCLA electrical engineering professor William Kaiser and John Griffith, Ph.D., a senior microbiologist with the Southern California Coastal Water Research Project.

For the Southern California coast, using this detection method could significantly inform source-tracking practices.

"UCLA's rapid-method work is very exciting," said Mark Gold, D.Env., president of the environmental group Heal the Bay. "It could result in faster notification of the public on the health risks of swimming at contaminated beaches and better protection of public health."

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