

## Water quality indicators and the risk of illness at beaches with nonpoint sources of fecal contamination

John M. Colford, Jr.<sup>1</sup>, Timothy J. Wade<sup>2</sup>, Kenneth C. Schiff<sup>3</sup>, Catherine C. Wright<sup>1</sup>, John F. Griffith<sup>3</sup>, Sukhminder K. Sandhu<sup>1</sup>, Susan Burns<sup>4</sup>, Mark Sobsey<sup>5</sup>, Greg Lovelace<sup>5</sup> and Stephen B. Weisberg<sup>3</sup>

<sup>1</sup> *University of California Berkeley, School of Public Health, Division of Epidemiology, Berkeley, CA*

<sup>2</sup> *United States Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Research Triangle Park, NC*

<sup>3</sup> *Southern California Coastal Water Research Project, Westminster, CA*

<sup>4</sup> *University of California Berkeley, Survey Research Center, Berkeley, CA*

<sup>5</sup> *University of North Carolina, Department of Environmental Sciences and Engineering, Chapel Hill, NC*

### ABSTRACT

**Background:** Indicator bacteria are a good predictor of illness at marine beaches that have point sources of pollution with human fecal content. Few studies have addressed the utility of indicator bacteria where nonpoint sources are the dominant fecal input. Extrapolating current water-quality thresholds to such locations is uncertain.

**Methods:** In a cohort of 8797 beachgoers at Mission Bay, California, we measured baseline health at the time of exposure and 2 weeks later. Water samples were analyzed for bacterial indicators (enterococcus, fecal coliforms, total coliforms) using both traditional and nontraditional methods, ie, chromogenic substrate or quantitative polymerase chain reaction. A novel bacterial indicator (Bacteroides) and viruses (coliphage, adenovirus, norovirus) also were measured. Associations of 14 health outcomes with both water exposure and water quality indicators were assessed.

**Results:** Diarrhea and skin rash incidence were the only symptoms that were increased in swimmers compared with nonswimmers. The incidence of illness was not associated with any of the indicators that traditionally are used to monitor beaches. Among nontraditional water quality indicators, associations with illness were observed only for male-specific coliphage, although a low number of participants were exposed to water at times when coliphage was detected.

**Conclusions:** Traditional fecal indicators currently used to monitor these beaches were not associated with health risks. These results suggest a need for alternative indicators of water quality where nonpoint sources are dominant fecal contributors.

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