

COMPLETION NOTICE

SA ¶4(a) Conduct epidemiological studies at POTW-impacted marine beaches in Fairhope, Alabama and Goddard, Rhode Island (P1, P2)

Summary of the Study

EPA conducted two epidemiological studies at POTW-impacted marine beaches in Fairhope, Alabama and Goddard, Rhode Island. The results from those sites were combined with epidemiologic results for a third location in Biloxi MS; this summary of the study and the findings below are for the combined dataset from the three epidemiological studies.

The studies measured rapid test methods for detecting fecal indicator organisms in recreational water quality to develop associations between levels of these fecal indicator organisms and illnesses among swimmers. The fecal indicator bacteria *Enterococcus* was also measured by a standard culture method (EPA Method 1600).

The studies involved interviews of beach-goers and collection of water samples at marine beaches affected by treated sewage discharges in Mississippi in 2005, and Rhode Island and Alabama in 2007. Each beach site was located within 7 miles or less of a treated sewage discharge outfall from facilities that served populations of at least 15,000. Based on historical records, each beach site showed variability in water quality, but were generally in compliance with local and federal water quality guidelines.

Two 1-liter water samples were collected at 8:00 AM, 11:00 AM, and 3:00 PM along 3 transects perpendicular to the shoreline. At each transect, one sample in waist-high water (1 m deep) and one in shin-high water (0.3 m deep) were collected. Transects were located at least 60 m apart and encompassed the swimming area.

On summer weekends and holidays, beachgoers were offered enrollment in the study. Those who agreed completed three interviews: an enrollment interview, an interview upon leaving the beach and a telephone interview 10-12 days later. The second interview determined exposure to water and other activities during the beach visit. The telephone interview ascertained the occurrence of health symptoms experienced since the beach visit. Eighteen water samples were collected and tested each day for indicators of fecal contamination: *Enterococcus* spp. and *Bacteroidales* spp. using quantitative polymerase chain reaction, and *Enterococcus* using the standard culture based method. Swimmers were identified as those who immersed, at a minimum, their body in the water. Health endpoints studied include: gastrointestinal (GI) illness, upper respiratory illness, rash, earache, and eye irritations.

EPA conducted quality assurance/quality control procedures on all field data collected. EPA performed statistical analyses to evaluate the association between water quality and health endpoints.

Summary of Findings

We enrolled 6,350 beach-goers. The occurrence of GI illness among swimmers was associated with a log₁₀-increase in exposure to qPCR-determined estimates of fecal indicator organisms in the genus *Enterococcus* (AOR=2.6, 95% CI 1.3-5.1) and order *Bacteroidales* (AOR=1.9, 95% CI 1.3-2.9). Estimates of organisms related to *Clostridium perfringens* and a subgroup of organisms in the genus *Bacteroides* were also determined by qPCR in 2007, as was F+ coliphage, but

relationships between these indicators and illness were not statistically significant. This study provides the first evidence of a relationship between gastrointestinal illness and estimates of fecal indicator organisms determined by qPCR at marine beaches.

Further information is available in Environmental Health: *“Rapidly measured indicators of recreational water quality and swimming-associated illness at marine beaches: A prospective cohort study”* Timothy J Wade , Elizabeth Sams , Kristen P Brenner , Rich Haugland , Eunice Chern , Michael Beach , Larry Wymer , Clifford C Rankin , David Love , Quanlin Li , Rachel Noble and Alfred P Dufour - Environmental Health 2010, 9:66doi:10.1186/1476-069X-9-66
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This study has been completed as of December 15, 2010.