COMPLETION NOTICE
SA ¶4(f) Evaluate multiple indicator/method combinations to develop quantifiable relationships (P15)

Summary of the Study

The study examines the quantifiable relationships between combinations of multiple fecal indicator bacteria (FIB) and analytical methods (AM) as they relate to gastrointestinal illness (GI) risks in swimmers (i.e., linkage approaches). Specifically, the study evaluates quantitative polymerase chain reaction (qPCR) and membrane filtration (MF) method comparisons, using available *Enterococcus*, *Bacteroidales* and *E. coli* data. Two different linkage approaches are explored: Risk Link and Water Quality Link. The Risk Link approach uses FIB-GI relationships generated from two epidemiological studies to determine densities of alternative FIB/AM combinations corresponding to the same GI risk level for swimmers. The Water Quality Link approach links an indicator-method combination, for which there is no health effects relation, to an indicator-method combination with a health effects relation via a quantifiable relationship between their measured fecal indicator bacteria densities. As part of this approach, the uses of paired water quality data, rather than the linkage of health effects curves alone, were explored.

Summary of Findings

This study created quantifiable relationships between multiple FIB/AM combinations and GI risks, using both the Risk Link and Water Quality Link approaches. Three demonstrations were explored using the Risk Link approach. The first demonstration illustrated the linkage of *Bacteroidales* and *Enterococcus*, as measured by qPCR. Health effects curves for both of those indicator-method combinations were developed concurrently as part of the NEEAR marine studies. The second demonstration illustrated a technique for assessing health effects curves from different epidemiology studies with similar study designs, but conducted at different times and settings. In this linkage, epidemiological studies by Dufour[1] and Marion et al.[2] were evaluated as they both show a relationship between GI and *E. coli*, as measured by MF. Health effects curves for the aforementioned studies pooled statistically, indicating that while the epidemiology studies differ temporally and spatially, the relationships between indicators and health effects are similar. The third demonstration illustrates a harmonization of health effects curves from two epidemiological studies using different illness definitions and analytical methods. In this demonstration, a comparison of the FIB-GI slopes generated from Cabelli[3] and the NEEAR marine studies (Fairhope, Goddard and Biloxi) allowed for the generation of *Enterococcus* density values, as measured by either MF or qPCR, at the same risk levels.

---

[1] Dufour, A.P. 1984. Health Effects Criteria for Fresh Recreational Water. EPA-600/1-84-004. Research Triangle Park, NC: USEPA.

[2] Marion, J.W., Lee, J., Lemeshow, S., Buckley, T.J. 2010. Association of illness and recreational water exposure during advisory and non-advisory conditions at an inland U.S. beach. Water Research 44(16): 4796-4804.

[3] Cabelli, V.J. 1983. Health Effects Criteria for Marine Recreational Waters. EPA-600/1-80-031. Research Triangle Park, NC: USEPA.

Use of the paired (qPCR and MF) water quality data, from the epidemiological studies in the Great Lakes as part of EPA's NEEAR study, allowed for an exploration of the Water Quality Link approach. For purposes of this analysis, paired water quality data could not be pooled across beaches, indicating that the Water Quality Link approach may work only on a site-specific basis.

This study has been completed as of December 15, 2010.