AN ANALYSIS OF SPATIAL VARIABILITY IN DISINFECTION BY-PRODUCT CONCENTRATIONS FOR EXPOSURE ASSESSMENT APPLICATIONS

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Background and Aims: Many epidemiological studies of disinfection by-products (DBPs) in public water systems (PWSs) rely on system average trihalomethane (i.e., THM4; sum of chloroform, dibromochloromethane, bromodichloromethane, and bromoform) and haloacetic acid (i.e., HAA5; sum of monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid and dibromoacetic acid) concentrations as surrogates for chemical-specific personal exposures. The study objective is to assess intra-system variation and evaluate the utility of various methods for determining spatial variability of DBPs.
Methods: To determine the utility of system-averages in estimating DBP levels, we assessed spatial variability in THM4 and HAA5 monitoring data for 144 and 132 PWSs in Massachusetts from 1995-2004. High spatial variability was defined using three methods. Methods 1 and 2 consider a PWS to have high spatial variability if the absolute difference between at least two sampling locations is • 20 and • 30 • g/L, respectively. Method 3 categorizes concentrations based on cut-points of regulatory significance (<40 µg/L, 40-80 µg/L, >80 µg/L), and a PWS is defined as having high spatial variation if same-day sample concentrations fall into multiple categories.
Results: For THM4, 108 PWSs (75%) had high spatial variability according to Method 1, compared to 95 PWSs (66%) using Method 2. Results for HAA5 were lower with 79 PWSs (59%) and 60 PWSs (45%) based on Methods 1 and 2, respectively. Over half of these PWSs had high THM4 and HAA5 spatial variability for at least 25% of their sampling dates. Using only chlorinated surface water PWSs from 1996 (17 PWSs), we found comparable results from Methods 1 and 3, with 76% of PWSs having high spatial variation.
Conclusions: The spatial variability noted within PWSs could result in misclassification bias if system averages are used to estimate individual-level DBP exposures. Therefore, exposure assessment approaches should target systems with minimal spatial variability for epidemiological application.