Health-Based Targets for Drinking-Water Safety and Regulation

Collaborative Research Initiative, Reference Number DWI70/2/264

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Contents of Enclosed:

1. Summary of research (PDF)
2. Drinking water disease outbreak database (Excel File)
Introduction:

In collaboration with the Drinking Water Inspectorate (DWI), the Water Institute at UNC has carried out a research project with the purpose of describing the relative health burden of drinking water system failures to better inform drinking water safety and policy. Support was provided to address the lack of a standardized database of worldwide microbial drinking water disease outbreak (DWDO) data. This involved conducting a systematic review to capture all accessible DWDO reports or review literature, collating that data into a standardized database, and synthesizing the evidence to assess the relative health burden of the various DWDO causal factors. The usage of systematic review - the most comprehensive and replicable form of review - and the associated database creation immediately fill that need for a central repository. It represents the broadest such effort to date, and maximizes the potential breadth and depth of DWDO analysis.

Methods:

The research consisted of three main components: literature collection, database development, and statistical analysis. We conducted the systematic review to gather and collate all accessible DWDO literature worldwide published before Sept 2011 into the database. The formulaic review process gathered hundreds of individual outbreak reports and narrative (selective) reviews, which themselves merited further analysis to garner additional sources and their data.

Initial results:

After this data was collated, the database (attached) contained information from 1,565 reported drinking water disease outbreaks. Around 72% of these outbreaks occurred in the U.S., while 9%, 6%, 2% and 11% occurred in the U.K., Canada, India and other countries, respectively. Bacterial agents were listed as the primary microbial agent in 42% of outbreaks, while the primary agent was a protozoan parasite, virus, unknown agent or a combination of agents in 18%, 12%, 27% and 1% of outbreaks, respectively. The number of reported cases in each outbreak ranged from 2 to 403,000, with the mean and median coming to 864 and 48 cases, respectively.

Of interest were the data pertaining to attack rates, i.e. the percentage prevalence of the disease during the outbreak. If mean attack rate differs greatly among the three groupings of outbreaks caused by catchment, treatment or distribution failure-induced outbreaks, that could signify that one of those deficiencies carries a relatively greater health risk than the other two. Of the five types of attack rate data captured, the one related directly to the exposed group – equal to the percentage of the number of cases divided by the number of people exposed to the water system failure - was analyzed for catchment, treatment, and distribution-deficiency outbreaks (with data from 77, 60 and 54 studies, respectively) to observe potential trends. The
means of those data, for the catchment, treatment, and distribution-deficiency outbreaks, were 31.9%, 25.9% and 21.2%, respectively. While this indicates a potential difference in the descending “severity” of the three types of DWDO causal factors in that order, the only statistically significant difference (p<0.011) is between the means of the catchment and distribution-induced outbreaks. This must be qualified by the bias arising from frequent underestimation of the attack rate for the latter events (due to probable overestimation of the exposed population in the localised event).

Discussion and future work:

The systematic review source composition shows that the majority of outbreak data come from line-item reports within narrative reviews of a specific time period for a given country, such as U.S. Centers for Disease Control annual summaries or frequent U.K. pathogen-specific outbreak reviews. This indicates a global need for greater breadth and depth in national or regional DWDO surveillance systems. The distribution of outbreaks is dominated by North Atlantic and bacterial or unknown-agent events, while in terms of case numbers it is skewed to the right (i.e. heavily influenced by the few wide-scale outbreaks). Most interestingly, the attack rate analysis shows that catchment-failure outbreaks are associated with a significantly higher risk of disease than are treatment-failure events, with distribution-failure ones having the lowest risk due to their more-localised nature.

These findings, especially the latter revelation, draw needed attention to the underlying trends in worldwide DWDO surveillance, distribution and health impact. Accordingly, we are currently working on two follow up steps. The first is a journal article that will present the initiative, summary statistics, analyses, and ‘lessons learned’. Secondly, we are in the process of making the database publicly available on an open website so as to facilitate further research and enable future updating on the topic. Both the journal article and web initiative would acknowledge DWI support and we would be pleased to discuss the findings and follow up actions further.