

Food Safety Research Consortium

A MULTI-DISCIPLINARY COLLABORATION TO IMPROVE PUBLIC HEALTH

Disease Incidence Data and Methodologies in the Foodborne Illness Risk Ranking Model

Background

Estimation of the incidence of illness due to foodborne pathogens is a critical component of the Foodborne Illness Risk Ranking Model (FIRRM), an analytical tool jointly developed by Resources for the Future and the Department of Epidemiology and Preventive Medicine of the University of Maryland School of Medicine, as a project of the Food Safety Research Consortium (FSRC). This document describes the methodologies used to estimate disease incidence within FIRRM, including approach, assumptions, data sources, problems encountered, and opportunities and needs for future research. For more information about the model, please see the Methodology Primer.

The purpose of FIRRM is to rank the relative public health impacts of various pathogen-food combinations and the estimation of disease incidence is crucial to this task. Indeed, three of the five measures by which users can select to perform rankings are measures of incidence: number of cases, number of hospitalizations, and number of deaths.

FIRRM utilizes a top-down epidemiological approach for disease incidence. It relies on surveillance data of the annual number of cases, hospitalizations, and deaths due to specific pathogens, which are adjusted upwards to account for underreporting.

There are two primary methodologies and data sources used in FIRRM for the estimation of disease incidence. For national estimates, the model relies on Mead et al. (1999), in which surveillance data were used to estimate cases, hospitalizations, and deaths of 28 pathogens. The model replicates the methodologies within Mead et al., including the underreporting multipliers and the percentage of illnesses of each pathogen assumed to be due to foodborne causes. FIRRM also includes summary estimates of incidence for the state of Maryland for 1998-99 (to allow a closer temporal comparison with Mead), based on data collected as part of the Centers for Disease Control and Prevention (CDC)-funded Foodborne Disease Active Surveillance Network, or FoodNet.

Mead et al.

FIRRM replicates the estimates of incidence for the 28 bacterial, parasitic, and viral pathogens within Mead et al. (1999), starting with the reported surveillance data and following the methodology for accounting for underreporting.

Mead et al. (1999) bases estimates of number of cases on three types of surveillance data. For nine pathogens, it relies on active surveillance data collected as part of the national FoodNet program. For eight pathogens, it relies on passive surveillance data from sources such as the

National Notifiable Disease Surveillance System. For five pathogens, it relies on outbreak-related cases reported to CDC as part of the Foodborne Disease Outbreak Surveillance System. For the remaining six pathogens with no surveillance data, the study either uses data from a comparable pathogen or relies on the literature.

To calculate the number of illnesses caused by each pathogen, this surveillance data is multiplied by underreporting factors. Based on the literature, Mead et al. (1999) “used a factor of 38 for pathogens that cause primarily nonbloody diarrhea (e.g. *Salmonella*, *Campylobacter*) and 20 for pathogens that cause bloody diarrhea (e.g. *E. coli* O157:H7, *Shigella*).” For more serious illnesses such as *Listeria* and *Clostridium botulinum*, Mead et al. assumes a far lower multiplier of 2. Additionally, estimates for pathogens based on outbreak data were multiplied by 10 to account for unreported sporadic cases.

Additionally, Mead et al. (1999) includes estimates of hospitalization and fatality rates, also based on active and passive surveillance data and additional literature. These reported rates were multiplied by the estimates of number of cases, and then the resulting estimations of hospitalizations were multiplied by a factor of two to account for underreporting. Mead et al. also includes percent estimates for each pathogen of how much is due to foodborne illness.

FIRRM includes all of these surveillance numbers and methodologies. It also allows the user to easily change the underreporting multipliers used by Mead et al.

Maryland FoodNet

For the state of Maryland, FIRRM employs data on nine pathogens collected through FoodNet. This FoodNet data includes information on all cultures processed from doctors and hospitals within the Maryland catchment area for the nine FoodNet pathogens, by year, for 1998 and 1999. Information recorded for each culture includes whether or not the patient was hospitalized and whether or not the patient subsequently died. To estimate the total number of illnesses due to each pathogen, the model must account for those who become ill but never visit a physician, as well as ill patients for whom the doctor never requests a culture. Estimates of numbers of hospitalizations are based both on pathogen-specific reports and on estimates of numbers of patients seen with acute diarrhea who are hospitalized. It is assumed that deaths are not underreported.

The number of doctor visits is estimated by taking the number of non-hospital cultures of each pathogen and dividing by the reported percent of cases of diarrhea for which doctors order a culture; data are based on the 1998 Maryland FoodNet Physician Survey and the 1998-99 FoodNet Community Survey. To account for those who become ill but do not visit the doctor, the number of doctor visits is divided by the percent of cases of diarrhea for which individuals see a doctor; data are from the 1998-99 FoodNet Community Survey (Imhoff et al. 2000). Total non-hospital cases are then added to the number of hospital cultures, by pathogen, to obtain the estimated cases of each pathogen. The range for hospitalizations is based on reported number of hospitalizations by pathogen (low estimate) and percent of patients presenting to their physician with acute diarrhea who are hospitalized at least overnight; data are from the 1998-99 FoodNet Community Survey (Imhoff et al. 2000).

To estimate the number of these cases that are foodborne, FIRRM uses the estimates of percent foodborne from Mead et al.

Additional Data

FIRRM includes other estimates of incidence that may be selected instead of Mead et al. or the Maryland FoodNet data. It includes estimates of incidence used by the USDA's Economic Research Service in their Cost-of-Illness analyses. For all pathogens, the user can decide which data to use for estimates of cases. The user can mix and match with hospitalization and fatality rates also. For example, the user could estimate number of cases using Mead, but then apply the ERS fatality rate to estimate number of deaths.

References

- Mead, P.S., L. Slutsker, V. Dietz, L.F. McCaig, J.S. Bresee, C. Shapiro, P.M.Griffin, and R.V. Tauxe. 1999. Food-Related Illness and Death in the United States. *Emerging Infectious Diseases* 5(5): 607-25.
- Imhoff, B., J. Hadler, D. Morse, B. Shiferaw, D. Vugia, C. Medus, S. Lance-Parker, T. Karchmer, T. Van Gilder, the EIP FoodNet Working Group. 2000. The Substantial Burden of Acute Diarrheal Illness in the United States: A Running Total, FoodNet, 1998-1999. Paper presented at the 2nd International Conference on Emerging Infectious Diseases. July 2000, Atlanta, GA.

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