

Food Safety Research Consortium

A MULTI-DISCIPLINARY COLLABORATION TO IMPROVE PUBLIC HEALTH

Valuation Methodologies and Data Needs for the Foodborne Illness Risk Ranking Model

Background

The valuation of health outcomes 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 at the University of Maryland School of Medicine, as a project of the Food Safety Research Consortium (FSRC). This document describes the methodologies used for valuation within FIRRM, including the overall approach, assumptions, data sources, problems encountered, and opportunities and needs for future research. For more information about the model, please see the Methodology Primer.

It is imperative to include valuation of health outcomes in the model in order to compare disparate pathogens using a single metric that embodies public preferences. Pathogen-related diseases have very different symptoms, severities, and rates of hospitalization, death, and chronic sequelae, among other distinctions, and ranking by incidence measures is insufficient for taking these disparities into account.

FIRRM includes three types of valuation methodologies, two that provide economic valuations of health outcomes, the Cost-of-Illness (COI) and Willingness-to-Pay (WTP) methods, and another that estimates loss in terms of Quality Adjusted Life Years (QALYs).

Approach

The overall approach used by FIRRM is to classify all cases of each pathogen into various health outcomes, which are organized in symptom-severity outcome trees. The economic costs and QALY losses are calculated for each health outcome, which are then summed to obtain totals for each pathogen. This general approach is based on the method employed by the USDA's Economic Research Service (ERS) in its COI studies of foodborne illness, including Buzby et al. (1996), Buzby and Roberts (1997), and ERS (2003), among others.

ERS studies use the COI approach, though they incorporate some WTP values in their estimations of the costs of deaths and chronic sequelae. FIRRM includes these COI values as well as WTP values from an extensive literature search, including a library of Values of Statistical Life (VSL), which can be selected for mortality valuation.

FIRRM includes valuation only on a small subset of pathogens. At this stage, it contains full valuation for the four pathogens for which ERS has produced detailed COI analyses (*Salmonella*, *E. coli* O157:H7, *Listeria*, and *Campylobacter*). Work is underway to include the valuation of further pathogens.

Symptom-Severity Outcome Trees

FIRRM uses a classification scheme similar to that used by ERS in its COI analyses. In the model, all health outcomes for each pathogen are organized according to symptom-severity outcome trees. For each pathogen, illnesses are first categorized by medical care: those who are hospitalized, those who visit a physician, and those who do not seek medical care. These three health states are further divided into sub-categories (e.g. pregnant women vs. newborns), where appropriate. Cases in each health outcome either recover or decline into a worse health outcome, such as chronic sequelae or premature death. Each of these health outcomes is then assigned economic and QALY values per case, which are multiplied by the estimated number of cases of each health outcome.

Cost-of-Illness

The COI valuation approach approximates the costs of illness to the measured economy, and includes medical expenses, foregone earnings, and productivity losses to employers. COI is often recognized as a lower bound of the societal costs of illness (Harrington and Portney 1987) because it ignores the value that affected individuals place on feeling well, avoiding pain, taking part in recreational activities, and other welfare effects.

For each of the four completed pathogens, FIRRM incorporates the most recent COI estimates by ERS, which are based on literature, government data, and third-party data. The data on medical costs and productivity loss are not structurally identical across pathogens, as the health states, symptoms, and available data for each pathogen is unique. Therefore, some ERS studies use up-to-date values while others use cost estimates from as far back as 1978 (updated to current dollars). To value mortality, ERS uses multiple approaches. Buzby et al. (1978) relies on the Landefeld and Seskin method for computing VSLs, which is based largely on lost productivity and dependent on age, whereas later studies incorporate the age-independent range of values found by Viscusi (1993), based on hedonic-wage studies.

Due to the same complexity and data issues that limit comparisons between the four ERS COI analyses, we did not expand COI estimates within FIRRM beyond these four pathogens. We hoped early in the process that recorded data on symptoms from case control studies and outbreaks could be used to determine the states and rates in the outcome trees so that they would be “data driven,” but this was determined to be impossible due to lack of data. Rather, they require a great deal of personal judgment and tailoring to the individual pathogen. Much additional work is required to produce symptom-severity outcome trees for the remaining pathogens, and to estimate the COI values for the health states within these trees. In doing so, attention must be paid to standardizing the approach used for COI estimations of foodborne illness.

Willingness-to-Pay

As compared to the COI method, the WTP approach more closely approximates actual societal costs as it estimates the value that individuals place on specific risk reductions in order to obtain the benefits to society of such risk reductions. Estimating WTP values, however, is complicated,

time-consuming, and resource-intensive. As a result, there are not nearly as many WTP values available for health outcomes as COI values.

FIRRM includes placeholders for WTP values in each health outcome for which COI values are computed, though there is little data to specify the values of these variables. The one area for which WTP values are well known is in mortality valuation. In addition to the ERS values of VSL based on Landefeld and Seskin and Viscusi, the model includes many other VSLs from the literature, from Krupnick's estimate of \$700,000 per statistical life (Krupnick et al. 2002) to the value of \$6.34 million used by the Environmental Protection Agency (U.S. EPA 1997, 1999). FIRRM also allows the user to vary the VSL by age, by assigning a higher value to children than to adults, a lower value to the elderly, or both.

Quality Adjusted Life Years

In addition to the two valuation methodologies described above, FIRRM includes valuation in QALYs, which are used extensively in the public health community, although economists generally consider them weak measures of individual preferences. The two most popular indices used to estimate QALYs are the Health Utility Index (HUI) and the Quality of Well Being (QWB) index. FIRRM uses the QWB index because it is relatively easy to use, whereas using the HUI would have required expert panels beyond the scope of the project.

Each health outcome is assigned scores for the four QWB components (Mobility, Physical Activity, Social Activity, and Symptom/Problem Complex). The user can change any of these four scores for any health outcome for any pathogen. These scores are summed to obtain a QWB score, which is subtracted from the baseline QWB score. The result is multiplied by duration, in years, to obtain the QALY loss of that health outcome. These QALY losses per case are multiplied by the number of cases, and summed across health outcomes, to obtain the sum of QALY loss by pathogen.

Future work is necessary to standardize QWB scores across pathogens and to determine QWB scores for health outcomes not yet assigned them. Another future step would be to include the HUI in addition to the QWB as an option for QALY valuation.

References

- Buzby, J.C., T. Roberts, C.T.J. Lin, and J.M. Macdonald. 1996. *Bacterial Foodborne Disease: Medical Costs and Productivity Losses*. AER-741. Washington, DC: USDA's ERS (Economic Research Service).
- Buzby, J.C. and T. Roberts. ERS. 1997. Guillain-Barré Syndrome Increases Foodborne Disease Costs. *FoodReview* 20(3): 36-42.
- ERS. 2003. Foodborne Illness Cost Calculator. <http://www.ers.usda.gov/data/foodborneillness>. (accessed September 10, 2003).
- Harrington, W. and P.R. Portney. 1987. Valuing the Benefits of Health and Safety Regulations. *Journal of Urban Economic* 22(1): 101-12.

Krupnick, A.J., M. Cropper, A. Alberini, N. Simon, B. O'Brien, and R. Goeree. 2002. Age, Health, and the Willingness to Pay for Mortality Risk Reductions: A Contingent Valuation Survey of Ontario Residents. *Journal of Risk and Uncertainty* 24: 161-75.

U.S. EPA (Environmental Protection Agency). 1997. The Benefits and Costs of the Clean Air Act, 1970 to 1990. Washington, D.C.: U.S. EPA, Office of Air and Radiation, Office of Policy.

- - -. 1999. The Benefits and Costs of the Clean Air Act, 1990 to 2010. Washington, D.C.: U.S. EPA, Office of Air and Radiation, Office of Policy.

Viscusi, W.K. 1993. The Value of Risks to Life and Health. *Journal of Economic Literature* 31: 1912-46.

Acknowledgments

The development of the FSRC Foodborne Illness Risk Ranking Model has been supported by a grant from The Robert Wood Johnson Foundation.

For Further Information Contact:

Jody Tick
Program Manager
Food Safety Research Consortium
Mailstop RFF
1616 P Street, NW
Washington, DC 20036
tick@rff.org / 202-939-3420