2.6 Country Studies Task Force

Two systematic reviews were commissioned:

- Polinder, S., Haagsma, J.A., Stein, C. & Havelaar, A.H. 2012. Systematic review of general burden of disease studies using disability-adjusted life years. *Population Health Metrics*, 10: Art 21. Available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3554436/ Accessed 2015-10-17.
- Haagsma, J.A., Polinder, S., Stein, C.E. & Havelaar, A.H. 2013. Systematic review of foodborne burden of disease studies: quality assessment of data and methodology. *International Journal of Food Microbiology*, 166(1): 34– 47. Available at http://www.sciencedirect.com/science/article/pii/S0168160513002778 Accessed 2015-10-17.

The results from one of the country studies have been published:

Kumagai, Y., Gilmour, S., Ota, E., Momose, Y., Onishi, T., Bilano, V.L.F., Kasuga, F., Sekizaki, T. & Shibuya, K. 2015. Estimating the burden of foodborne diseases in Japan. Bulletin of the World Health Organization, 93(8): 540–549.

The preparation of material to augment the resources developed by the CSTF was commissioned from Sandy Campbell (Knowledge Translation Consultant, New Mexico, USA). The results of that work have been included in the Situation analysis, knowledge translation and risk communication guidance manual, one of the tools and resources developed by the CSTF.

2.7 Other relevant publications

The following articles were written by FERG members and WHO staff:

- Stein, C., Kuchenmuller, T., Hendrickx, S., Pruss-Ustun, A., Wolfson, L., Engels, D. & Schlundt, J. 2007. The Global Burden of Disease assessments – WHO is responsible? *PLOS Neglected Tropical Diseases*, 1: Art e161. Available at http://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0000161 Accessed 2015-10-17.
- Havelaar, A.H., Cawthorne, A., Angulo, F., Bellinger, D., Corrigan, T., Cravioto, A., Gibb, H., Hald, T., Ehiri, J., Kirk, M., Lake, R., Praet, N., Speybroeck, N., de Silva, N., Stein, C., Torgerson, P. & Kuchenmüller, T. 2013. WHO Initiative to Estimate the Global Burden of foodborne diseases. *Lancet*, 381(Suppl. 2): S59.
- Hird, S., Stein, C., Kuchenmüller, T. & Green, R. 2009. Meeting report: Second annual meeting of the World Health Organization Initiative to estimate the global burden of foodborne diseases. *International Journal of Food Microbiology*, 133: 210– 212.
- Kuchenmüller, T., Hird, S., Stein, C., Kramarz, P., Nanda, A. & Havelaar, A.H. 2009. Estimating the global burden of foodborne diseases – a collaborative effort. *Eurosurveillance*, 14(18): 1– 4. Available at http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19195 Accessed 2015-10-17.
- Lake, R.J., Havelaar, A.H. & Kuchenmüller, T. 2013. New research on estimating the global burden of foodborne disease. pp. 260– 271, *in:* J. Sofos (ed.). *Advances in microbial food safety*. Vol. 1. Woodhead Publishing, Oxford, UK.
- Lake, R.J., Stein, C.E. & Havelaar, A.H. 2014. Estimating the burden of foodborne disease.. pp. 73– 79, *in:* Y. Motarjemi (ed.). *Encyclopedia of Food Safety*. Vol. 1. Academic Press, Waltham, MA, USA.
- Kuchenmulller, T., Abela-Ridder, B., Corrigan, T. & Tritscher, A. 2013. World Health Organization Initiative to Estimate the Global Burden of foodborne diseases. *Revue Scientifique et Technique-Office International des Epizooties*, 32(2): 459– 467.

3 OVERVIEW OF THE SCIENTIFIC APPROACH

OVERVIEW OF THE SCIENTIFIC APPROACH

3.1 The DALY metric

As mentioned in the report from the initial consultation, the Initiative was encouraged to use summary measures of public health as the metric for the burden of FBD. The disability adjusted life year (DALY) metric was chosen for the following reasons:

- It is an established WHO metric with international application; and
- It is consistent with the Global Burden of Disease project.

The DALY is calculated by adding the number of years of life lost to mortality (YLL) and the number of years lived with disability due to morbidity (YLD):

DALY = YLL + YLD

The YLL due to a specific disease in a specified population is calculated by the summation of all fatal cases (n) due to the health outcomes (l) of that specific disease, each case multiplied by the expected individual life span (e) at the age of death.

$$YLL = \sum_{l} n_l \times e_l$$

YLD is calculated by accumulation over all health outcomes (l), the product of the number of cases (n), the duration of the illness (t) and the severity weight (w) of a specific disease. It should be noted that the calculation for YLL implicitly includes a severity weight factor. The severity weight or disability weight (DW) factors are in the range zero to one, with the severity weight for death being equal to one.

$$YLD = \sum_{l} n_l \times t_l \times w_l$$

DALYs may be calculated using a **prevalence** approach which estimates the current burden of disease in a population, considering previous events. However, the more common approach is to use **incidence**, i.e. both current and future health outcomes are included. Future outcomes include sequelae and mortality resulting from the initial disease within a defined time period.

To define life expectancy for the calculation of YLL life expectancy tables for the population being studied may be used. Alternatively, life expectancy that reflects an ideal of human potential may be used.

3.2 Overarching methodology decisions by FERG in relation to DALY estimates

3.2.1 Hazard-based approach

The burden of disease estimation is hazard-based because:

- it allows a complete estimate of the burden of disease due a specific hazard;
- it includes all related sequelae; and
- measures to address foodborne diseases are often hazard specific.

3.2.2 Incidence-based approach

DALYs, and more specifically their YLD component, may be calculated from an incidence or a prevalence perspective. While incidence-based YLDs are defined as the product of the number of incident cases and the duration and disability weight (DW) of the concerned health state, prevalence-based YLDs are defined as the product of the number of prevalent cases and the corresponding DW [1,6]. In the incidence-based approach, all health outcomes, including those in future years, are assigned to the initial event (e.g., exposure to a certain hazard). This approach therefore reflects the future burden of disease resulting from current events. In the prevalence-based approach, on the other hand, the health status of a population is assessed at a specific point in time, and prevalent

diseases are attributed to initial events that happened in the past. This approach therefore reflects the current burden of disease resulting from previous events. For burden of FBD studies, the incidence-based YLD approach was deemed the most appropriate approach, because (1) this approach is more sensitive to current epidemiological trends [2]; (2) is more consistent with the hazard-based approach, since it has the point of infection (or primary health effect from exposure) as starting point for the calculations; and (3) is consistent with the estimation of YLLs, which by definition follows an incidence-based approach, as mortality can be seen as the incidence of death [3]. Nevertheless, the prevalence- and incidence-based approaches yield similar overall results if the epidemiology of disabilities and the population age-structure are constant over time [2]. However, burden estimates for specific age groups will always differ between the prevalence- and incidence-based approaches, because the former assigns the burden to the age at which the burden is experienced, while the latter assigns the burden to the age of disease onset [4].

Using the incidence for the burden estimations is important for diseases having a long period between exposure and appearance of clinical signs. An incidence-based approach for the burden estimations fits better with a hazard-based approach. However, incidence figures are not always available. For example, in the case of peanut [*Arachis hypogaea*] allergy, only prevalence figures are available. When only prevalence figures are available, incidence can be estimated based on the prevalence figures and on the duration of the disease.

Regions

Several options were available for reporting on a regional basis (14 subregions based on child and adult mortality, as described by Ezzati *et al.* [5]; 21 GBD regions [6]; and 13 GEMS Cluster Diet Regions[1]). The subregions based on mortality were chosen.[2] Countries grouped into each of the 14 subregions are listed in Appendix 2.

Reference year

The reference year for the calculation of absolute numbers was 2010.

Attribution

The choice of a method to attribute a proportion of disease incidence to foodborne transmission was a major decision for the project. The rationale for choosing a global expert elicitation process was developed after consideration of alternatives, as described below.

Estimating the burden of FBD is complicated because most of the hazards causing foodborne disease are not transmitted solely by food. The relative impact of each route differs depending on the epidemiology of the disease causing microorganism (bacteria, virus or parasite) or chemical hazards. Other factors such as the geographical region, season and food consumption patterns also influence the role of different exposures routes [7, 8]. The estimation of the burden of FBD, therefore, requires

[1] http://www.who.int/foodsafety/chem/gems/en/index1.html Accessed 23 July 2014

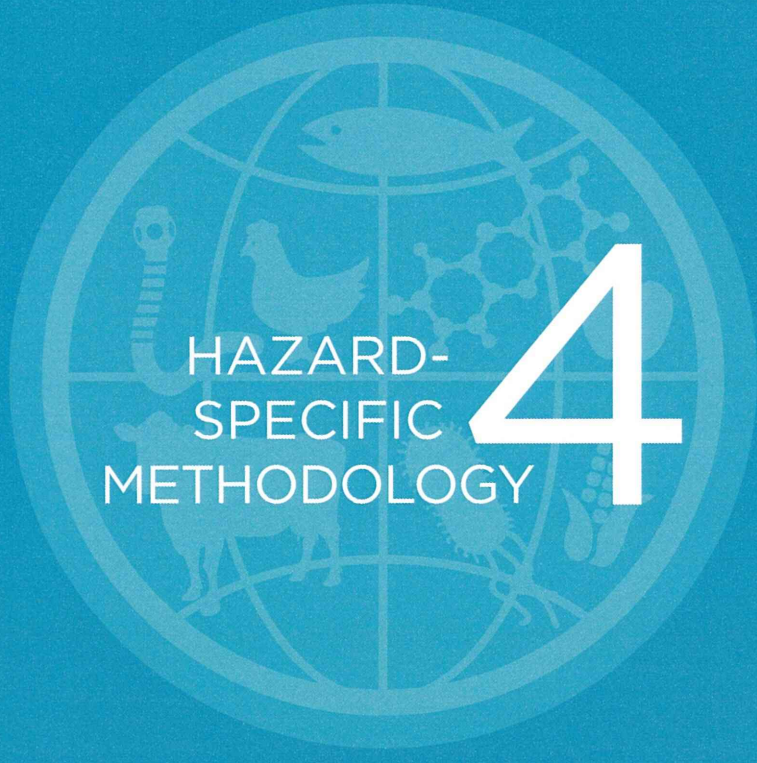
[2] The subregions are defined on the on the basis of child and adult mortality, as described by Ezzati *et al.* [5] Stratum A = very low child and adult mortality; Stratum B = low child mortality and very low adult mortality; Stratum C = low child mortality and high adult mortality; Stratum D = high child and adult mortality; and Stratum E = high child mortality and very high adult mortality. The use of the term 'subregion' here and throughout the text does not identify an official grouping of WHO Member States, and the "subregions" are not related to the six official WHO regions.

a delineation of the major transmission routes, including contaminated food, water, soil, air or contact with infected animals or humans. Previous efforts to quantify the contribution of specific sources (including types of foods) and transmission routes have been gathered under the term 'source attribution' or 'human illness attribution' [9, 10]. The applicability of available methods for source attribution of FBD at the global level was recently assessed by Pires [7].

Source attribution is an important tool for identifying and prioritizing effective interventions to prevent and control FBD [11]. The need for reliable source attribution estimates has prompted a growing body of research focusing on attribution, particularly for infectious agents [7, 10, 12, 13]. However, comprehensive attribution studies based on surveillance data and/or food monitoring and exposure data are still limited in scope, and to date have been performed for a few hazards only, or in a limited number of countries [14– 26].

In addition, existing studies have focused mainly on identifying specific food sources or animal reservoirs, whereas other potential transmission routes are often not quantified due to lack of data, or neglected due to the complexity of attribution models. Many studies, often designed as randomized controlled intervention trials, have been conducted to assess the importance of water, particularly for the transmission of diarrhoeal diseases (reviewed by [27] and [28]). However, other transmission routes, such as soil, air and direct contact with infected humans or animals, are generally not considered in those studies. Thus, for most countries, and at the global level, relevant studies and data for quantifying attribution of potential FBD to the major transmission routes do not exist.

In such situations, structured elicitation of scientific judgment may be used [7, 29]. When data are not available, or undertaking primary research is not feasible, a structured elicitation offers a transparent and mathematically rigorous way of evaluating and enumerating uncertainty distributions, from the judgments of many individual researchers, for quantifying risk models. Within food safety, the approach has been applied to provide national estimates for the proportion of illnesses attributable to food for specific infectious diseases [30– 37], or to inform modelling of foodborne disease risk assessment models by estimating specific model parameters and their uncertainty [38, 39].



4 HAZARD-SPECIFIC METHODOLOGY