World Health Organization Initiative to Estimate the Global Burden of Foodborne Diseases

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Summary

Foodborne diseases are a multi-sectoral public health risk closely linked with the agricultural and animal health sectors. Many foodborne diseases are zoonotic in nature. The World Health Organization (WHO) seeks to measure for the first time the real impact of foodborne diseases through the advice of its independent expert body, the Foodborne Disease Burden Epidemiology Reference Group (FERG). Through the FERG, the WHO works on both assembling and appraising existing data as well as supporting countries in conducting their own studies into the national burden of foodborne disease. This is complemented by efforts to ensure that the findings are meaningful and useable to policy-makers and other research end-users to implement informed policy and interventions. For the Initiative to operate effectively and achieve its objectives, linkages and collaboration at all levels, especially at the human–animal interface, need to be fostered.

Keywords

Foodborne diseases – a major challenge to global public health

Increases in the incidence of foodborne diseases, often associated with outbreaks, threaten global public health security and raise international concern. With growing international trade, migration and travel the spread across borders of contaminated foods and food products accelerates. There are a variety of prominent factors in food and agriculture systems that contribute to the spread of pathogens at the human–animal interface, a number of these pathogens being foodborne. These factors include the number of livestock, the spatial concentration of livestock production, the existence of mixed biosecurity regimes, growth in the export of animal-source products, inappropriate vaccination and drug use, and exploitative farming systems (13). The increasing complexity of food market chains compounds this public health risk.

Foodborne diseases can be defined as those conditions that are commonly transmitted through ingested food (18). Traditionally, foodborne diseases have been associated with acute, rather mild and self-limiting gastrointestinal symptoms (nausea, vomiting and diarrhoea) caused by microbial contamination of food. Foodborne diseases, however, can lead to serious, chronic sequelae affecting the cardiovascular, musculoskeletal, respiratory and immune systems. Multi-organ failure, abortions and neurological disorders are other consequences of food contamination. Chemical contamination of foodstuffs, including methyl mercury, lead, arsenic, dioxins and aflatoxins (among others) may cause acute and chronic health effects such as neuro-developmental disorders, cardiovascular disease, cancers and renal disease.

Each year, almost 2.2 million people, mostly children in developing countries, die from diarrhoeal diseases (17). A considerable proportion of these diseases are likely to be transmitted through unsafe food. The full picture of the impact and costs of foodborne diseases is, however, larger than the burden resulting from diarrhoeal diseases alone and needs to encompass a variety of conditions caused by bacteria, viruses, parasites (many of which are zoonotic) and chemical hazards, as well as naturally occurring toxins. To prevent and better manage these potentially
deadly and costly impacts on societies, reliable data on the global burden of foodborne diseases from major causes are required to guide food safety policies and improve global public health (18).

Traditional surveillance systems – often considered to be one of the main sources of evidence informing public health policy-making – tend to capture only a fraction of the existing foodborne and zoonotic disease burden. The limitations of surveillance systems are well known: they are prone to under-reporting and may not capture human illnesses due to infection following the ingestion of specific foods or the sequelae arising with certain foodborne diseases (5). For instance, a study found that approximately one-third of cases of epilepsy in people living in regions endemic for Taenia solium were associated with neurocysticercosis (11).

**World Health Organization Initiative to Estimate the Global Burden of Foodborne Diseases**

The World Health Organization (WHO) launched the Initiative to Estimate the Global Burden of Foodborne Diseases in 2006 (details of the WHO mandate in food safety can be found in Box 1). It was established to address the challenges posed by under-reporting and provide policy-makers with more complete information on the public health impact of unsafe food in a comprehensive, integrated manner. The additional disease burden linked to other food-related problems (obesity and malnutrition) is not being addressed within the scope of this Initiative, but assessed through separate efforts (16, 19 [p. 13]).

The Initiative to Estimate the Global Burden of Foodborne Diseases capitalises on WHO's public health leadership capacity to assemble the first ever quantitative description of the foodborne disease burden globally. Estimates of the burden of foodborne diseases worldwide will be calculated according to age, sex and WHO region for a defined list of causative microbial, parasitic and chemical agents by the end of 2013. The Initiative uses a summary health metric in the form of the disability-adjusted life year (DALY) (16). This single, time-based metric was developed in the 1990s by WHO and its partners to describe death and loss of health due to diseases, injuries and risk factors for all regions of the world. The DALY metric quantifies the relative contributions of different causes of health loss (in terms of mortality, morbidity and disability), making it easier to compare the health impact of one disease to that of another (2, 10).

In addition to the provision of accurate health information, the Initiative aims to encourage public health decision-makers to use the burden of foodborne disease estimates to guide their food safety policies, and to strengthen the capacity of countries by conducting national assessments of the burden of foodborne disease (22).

**Box 1**

**World Health Organization mandate in food safety**

The World Health Organization (WHO) is a specialised agency of the United Nations, serving as the directing and coordinating authority for international public health. Its mission is ‘the attainment by all people of the highest possible level of health’ (15). WHO’s overarching role in food safety and zoonoses is to reduce negative human health outcomes related to foodborne and zoonotic diseases by advising and assisting its Member States to reduce exposure to unacceptable levels of zoonotic and food safety hazards throughout the farm-to-fork chain. WHO’s responsibilities in this area are enshrined in the 1948 WHO Constitution (15) and have been re-emphasised by the World Health Assembly Resolutions 53.15 on Food Safety (May 2000) (14) and 63.3 on Advancing Food Safety Initiatives (May 2010) (20). Three key strategic directions are being promoted for the period 2012–2021 (12):

- advocate and assist in the development of risk-based, sustainable, integrated food safety systems
- provide science-based measures along the entire food chain to protect health by assessing, preventing and responding to food safety and zoonotic risks
- improve international and national cross-sectoral collaboration, and enhance communication and advocacy.

**The Foodborne Disease Burden Epidemiology Reference Group**

The Foodborne Disease Burden Epidemiology Reference Group (FERG) was established in 2007 as an external, independent expert body of multi-disciplinary and internationally renowned scientists to advise WHO on achieving the Initiative’s objectives. The procedure of using technical expert groups for burden of disease assessment has been previously and successfully applied by other WHO programmes; the lessons learned from these programmes guided the principles behind the establishment of the FERG (12).

The FERG applies an integrated approach, drawing upon research and practical experience in both the animal health and food safety sectors. It bridges previously dissociated disciplines (including food sciences, epidemiology, veterinary sciences, microbiology, chemical and other risk assessment, food policy and regulation, statistics and
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geographic information systems) to generate findings that are meaningful to all scientific constituencies. The work is broken down into six thematic Task Forces (Fig. 1), covering:

– enteric diseases
– parasitic diseases
– chemicals and toxins
– source attribution (attributing the burden of diseases to specific food sources)
– national studies on the burden of foodborne disease (and knowledge translation)
– computation.

The FERG contributes to the Initiative’s work both globally and nationally. At a global level, the FERG assembles, appraises and reports on estimates of the burden of foodborne disease. More precisely, the FERG:

– conducts epidemiological reviews for mortality, morbidity and disability associated with each of the major foodborne diseases (data sources commonly included in the systematic reviews are: published research studies, unpublished research studies, routine data from countries with reliable surveillance systems, and databases such as PubMed, CAB abstracts [BIDS], WHO library [WHOLIST] and SIGLE [System for Information on Grey Literature in Europe]; the reviews for foodborne zoonotic diseases also take into account the prevalence of diseases in animal health settings, including data from surveillance, slaughterhouses, laboratories, etc., as appropriate)

– assembles, appraises and reports on existing estimates of the burden of foodborne disease and provides models for burden estimates where data are lacking

– develops source attribution models to estimate the proportion of disease that is foodborne

– develops user-friendly tools for studies on the burden of foodborne diseases and food safety policy context mapping at country level.

The causative agents for which FERG aims to provide burden estimates by the end of 2013 are listed in Table I. Many of the hazards are zoonotic, and this list demonstrates the importance and necessity of integrating animal health and foodborne disease research data through integrated surveillance activities in national systems.

While work on assessing the disease burden related to the causative agents in this list is still ongoing, preliminary results of the FERG highlight that the burden of foodborne diseases seems to have been greatly underestimated. To date, the topics of peer-reviewed publications derived from the FERG work include: diarrhoeal disease, alveolar echinococcosis, neurocysticercosis, trichinellosis, foodborne trematodiases and peanut allergy. These and other sources of information are available on the WHO website (www.who.int/foodsafety/foodborne_disease/ferg/en/index7.html).

At the national level, studies of foodborne disease in individual countries will supplement the global epidemiological reviews and provide first-hand burden...
estimates. Four pilot country studies were launched at a ‘kick-off’ meeting at the end of 2011. Representatives from the pilot countries (Albania, Japan, Uganda and Thailand) met at this meeting to familiarise themselves with the study tools that FERG had developed (Fig. 2). The FERG Country Study Task Force has been overseeing the implementation of the national foodborne disease pilot studies and provides technical support where required. Specific training opportunities will be offered to the countries to increase their capacity in and ownership of foodborne disease burden estimation. At the global level, the FERG pilot countries will refer to both animal health and foodborne disease data in order to assess their national foodborne disease burden, based on a country-specific list of identified priority hazards.

The FERG country study tools and training modules will be evaluated and revised after completion of the four pilot studies. The improved tools will be made available to other countries interested in conducting their own national foodborne disease burden studies, several of which have already approached WHO and signalled their interest.

Table I
Foodborne Disease Burden Epidemiology Reference Group list of priority causative agents

<table>
<thead>
<tr>
<th>Enteric diseases</th>
<th>Parasitic diseases</th>
<th>Chemicals and toxins</th>
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<tbody>
<tr>
<td>– Staphylococcus aureus</td>
<td>– Alveolar echinococcosis (Echinococcus multilocularis)</td>
<td>Aflatoxin</td>
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<tr>
<td>– Clostridium perfringens</td>
<td>– Anisakis spp.</td>
<td>Lead</td>
</tr>
<tr>
<td>– Bacillus cereus</td>
<td>– Congenital toxoplasmosis (Toxoplasma gondii)</td>
<td>Methylmercury</td>
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<tr>
<td>– Clostridium botulinum</td>
<td>– Cystic echinococcosis (Echinococcus granulosus)</td>
<td>Cadmium</td>
</tr>
<tr>
<td>– Brucella spp.</td>
<td>– Foodborne trematodes (Clonorchis sinensis, Opisthorchis viverrini, Fasciola hepatica, Paragonimus westermani)</td>
<td>Organophosphate pesticides</td>
</tr>
<tr>
<td>– Listeria monocytogenes</td>
<td></td>
<td>Cyanide in cassava</td>
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<tr>
<td>– Mycobacterium bovis</td>
<td>– Intestinal protozoa (Cryptosporidium spp., Entamoeba histolytica, Giardia spp.)</td>
<td>Peanut allergen</td>
</tr>
<tr>
<td>– Norovirus</td>
<td>– Neurocysticercosis (Taenia solium)</td>
<td>Arsenic</td>
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<tr>
<td>– Non-invasive Salmonella</td>
<td>– Trichinellosis (Trichinella spiralis)</td>
<td>Dioxin</td>
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<tr>
<td>– Shiga-toxin-producing Escherichia coli (STEC)</td>
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<td></td>
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<tr>
<td>– Invasive Salmonellae (including serotypes Typhi, Paratyphi and infections due to non-typhoidal strains)</td>
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</table>

Source: World Health Organization

Fig 2
Foodborne Disease Burden Epidemiology Reference Group: pilot foodborne disease burden countries
Although estimating the global burden of foodborne disease is in itself an important scientific endeavour, this work will only be relevant to public and animal health if the findings inform decision-makers in developing appropriate policies and programmes to address the risks arising from contaminated food. Specific interventions aiming to foster evidence-informed policy-making in food safety are complementing the foodborne disease burden country studies.

Addressing the challenge of linking research to policy and action along the food chain

Though considerable investments are made in public and animal health research worldwide, evidence demonstrates that policy-makers often fail to optimally utilise scientific findings, leading to inefficiency, reduced health outcomes and lost productivity (6).

Incorporating scientific evidence into the policy cycle on food safety is a complex undertaking (4). Simply publishing research findings and relying on the scientific results to influence decision-making has proved insufficient (8). Researchers and policy-makers operate in distinct spheres of influence, information and priorities (1), leading to structural and professional tensions that hamper the process (9). In response, the emerging literature on the research–policy link advocates a shift from a linear view of research adoption towards a more complex and dynamic model, requiring two-way interaction between researchers and policy-makers (3).

Three main approaches exist to promote the interactions between policy-makers and researchers (7):

a) Push strategies – So-called ‘push’ strategies focus on the research side. They rely on the assumption that the research community can more effectively transfer and facilitate the uptake of scientific evidence when they know:

– how to present research to audiences that they believe need to receive it
– with what effect the findings should be transferred.

Understanding the context and needs of the target groups may be an important input when developing dissemination techniques and tools (such as syntheses, policy briefs, videos) that make findings more accessible.

b) Pull strategies – So-called ‘pull’ strategies focus on the research user side. Policy-makers and other stakeholders can more effectively utilise research findings in their decision-making and practice when they have the capacity to identify and access relevant research, critically appraise its quality and local applicability, and apply it.

c) Linkages and knowledge-exchange strategies – According to the knowledge-exchange strategies, producers and users of research are brought together through an interactive process to create a more research-focused culture among the users of research and a more decision-relevant culture among the producers of research by fostering short- or long-term collaboration. These mutually beneficial partnerships may occur at any point in the research or policy process: when defining research questions and hypotheses, selecting appropriate research methods, implementing the research process, interpreting and contextualising the research results and applying the results to address practical issues in policy-making and practice.

From its inception, the Initiative has recognised the need to promote linkages between the food safety research and policy communities. Two main strategies have been applied:

– a specific subgroup of the FERG Country Studies Task Force, the Knowledge Translation and Policy Group (KTPG), was established with the overall mandate to facilitate the utilisation of the FERG's disease burden results and ensure that future food safety policy-making is based on solid epidemiological evidence

– FERG multi-stakeholder meetings have been convened to brief relevant stakeholders on the Initiative's progress and to obtain their input and feedback on preliminary findings in order to eventually encourage stakeholder buy-in and enhance the utilisation of foodborne disease burden data.

Knowledge Translation and Policy Group of the Foodborne Disease Burden Epidemiology Reference Group

The aim of the KTPG is to promote dialogue and exchange between the research and policy communities within the FERG, to foster mutual trust and understanding, and ultimately to tailor the studies' findings to the needs of the individuals holding decision-making powers, thereby catalysing action and impact. The KTPG consists of experts with a background in public health policy analysis, knowledge translation and/or food safety policy-making and regulation.

The work of the KTPG relies on two main pillars:

– food safety policy context mapping and situation analysis to provide country stakeholders and the WHO FERG with
a deeper understanding of the environmental factors which affect food safety policy formulation and implementation

- push, pull and exchange strategies.

**Food safety policy context mapping**

The translation of research evidence into national policies requires a clear understanding of the political, economic, socio-cultural and institutional environment of each country. Policy context mapping will be undertaken at global and national levels by the KTPG to provide information on the complexities of policy processes and the research–policy interfaces.

This analysis increases knowledge about the ongoing inter-relationships between institutions, such as those between the animal health, food safety and public health sectors. This knowledge is related to the various agents’ interests, power relationships, values and perceptions, and the structural, economic, political, social and cultural factors.

It also examines how these factors affect policy agenda-setting, policy formulation, policy implementation and policy outcomes. Ultimately, policy context mapping provides insights into how best to support the development and implementation of policies (including the potential need to foster integration between animal health and food safety), and identifies pathways of influence.

**Push, pull and exchange strategies of the Knowledge Translation and Policy Group**

Through the KTPG, the WHO Secretariat of the Initiative will increasingly invest in:

- raising the capacity of national researchers to conduct national studies of the burden of foodborne disease and ‘translate’ the results into a language and a format which appeal to its users (push approach)
- augmenting food safety decision-makers’ knowledge and understanding of burden of disease data, and how to critically appraise as well as utilise these in policy-making and practice (pull approach)
- promoting sustained dialogue and exchange between food safety researchers and decision-makers at the national level (exchange approach).

**Foodborne Disease Burden Epidemiology Reference Group multi-stakeholder meetings**

In connection with annual FERG meetings, at which all FERG Task Force members meet to review and appraise their work, WHO has convened stakeholder events where multi-sectoral partners from WHO Member States, multilateral agencies, scientific networks, relevant industries (food, livestock, animal health and agricultural), consumer groups, and the scientific and public media have gathered. FERG’s stakeholders play a dual role (see Fig. 3) in being both contributors to the Initiative (in terms of technical and financial support) and beneficiaries (in terms of being end-users of the Initiative’s findings).

The overall aims of FERG stakeholder events are to:

- provide an opportunity for all relevant sectors along the food chain to actively engage with the research conducted through the Initiative
- foster inter-sectoral cooperation, networking and fundraising
- gain global recognition of the impact of foodborne illness and solicit international support for the estimation of foodborne disease burden and the use of such epidemiological data.

The input received from the multi-sectoral partners at FERG stakeholder events is considered by the FERG and incorporated into future planning and implementation when feasible to ensure that the FERG’s findings will be as useful and meaningful to end-users as possible.

**Conclusion**

The Initiative to Estimate the Global Burden of Foodborne Diseases was launched by WHO in 2006 to fill the currently existing data gap on the extent and cost of foodborne diseases
worldwide. Many of the foodborne diseases assessed by the Initiative’s advisory body (FERG) are zoonotic. First results of the Initiative have been published in peer-reviewed articles, additional peer-reviewed publications will follow throughout the lifespan of the Initiative. The full report and global atlas on foodborne disease burden morbidity, disability and mortality, compiling the work of the FERG, will be made accessible online and through software available to scientists in developing countries in 2014.

In addition to providing accurate health information, which is one of the key objectives of the Initiative, the Initiative envisages:

– strengthening the capacity of countries in conducting assessments of the burden of foodborne disease and increasing the number of countries that have undertaken studies of the burden of foodborne disease

– encouraging countries to use estimates of the burden of foodborne disease to set evidence-informed policies, with the ultimate aim of providing data and tools to support policy-makers and other stakeholders in setting appropriate, evidence-informed priorities for food safety at country level.

The importance of foodborne disease burden estimates in guiding food safety policy-making has been recognised by the international community and reaffirmed by WHO Member States in the 2010 Resolution of the World Health Assembly on ‘Advancing Food Safety Initiatives’ (WHA 63.3) (20). Burden of disease data are key to enabling food safety decision-makers to:

– appropriately allocate resources to foodborne disease prevention and control efforts, and prioritise specific food safety issues within a country

– provide a baseline against which to monitor and evaluate future food safety

– assist with the harmonisation of international trade and regulatory standards

– develop new food safety standards

– assess the cost-effectiveness of interventions

– quantify the burden in monetary costs.

Although primarily applied in public health, burden of foodborne disease data are important for the animal health sector to aid in assessing and demonstrating the public health benefits of veterinary interventions and in targeting control and prevention. Estimating the burden of foodborne disease is incomplete without considering the animal burden and associated losses in productivity or mortality that may have an impact on food security and trade.

The findings of the FERG will ultimately benefit the vast and diverse food safety stakeholder community, both by helping to establish a previously unmeasured baseline for foodborne disease and by contributing to global data generation. Food safety stakeholders, including the veterinary sector, continue to play a crucial role in contributing to the Initiative by providing technical support and primary data to allow for a more comprehensive understanding of the burden of disease at the human–animal interface.

L’initiative de l’Organisation mondiale de la santé pour évaluer l’impact mondial sur la santé des toxi-infections alimentaires

T. Kuchenmüller, B. Abela-Ridder, T. Corrigan & A. Tritscher

Résumé

Les toxi-infections alimentaires constituent un risque de santé publique qui intéresse aussi d’autres secteurs et plus spécifiquement ceux de l’agriculture et de la santé animale. En effet, nombre de maladies d’origine alimentaire sont zoonotiques par nature. L’Organisation mondiale de la santé (OMS) procède à la première tentative d’évaluation de l’impact réel des maladies d’origine alimentaire jamais conduite dans le monde, réalisée par l’un de ses groupes d’experts indépendants, le Groupe de travail de référence sur l’épidémiologie des maladies d’origine alimentaire (FERG). À travers le FERG, l’OMS s’efforce de réunir et d’évaluer les données existantes et d’aider les pays à réaliser leurs
Iniciativa de la Organización Mundial de la Salud para estimar la carga mundial de enfermedades de transmisión alimentaria

T. Kuchenmüller, B. Abela-Ridder, T. Corrigan & A. Tritscher

Resumen

Las enfermedades transmitidas por los alimentos constituyen un riesgo multisectorial para la salud pública, estrechamente ligado a los sectores de la agricultura y la sanidad animal. Muchas de esas enfermedades revisten carácter zoonótico. La Organización Mundial de la Salud (OMS) está tratando de cuantificar por vez primera el impacto real de las enfermedades transmitidas por los alimentos, valiéndose para ello del asesoramiento de un grupo independiente de expertos, el Grupo de Referencia sobre Epidemiología de la Carga de Morbilidad de Transmisión Alimentaria (FERG). Por medio del FERG, la OMS se dedica a reunir y evaluar los datos existentes y a respaldar a los países en la realización de sus propios estudios sobre la carga nacional de morbilidad de las enfermedades de transmisión alimentaria. Estas actividades se acompañan de una labor encaminada a lograr que las conclusiones sean instructivas y útiles para los planificadores de políticas y otros usuarios finales de las investigaciones, de tal modo que puedan instituir políticas e intervenciones fundamentadas. Para que la iniciativa funcione eficazmente y sirva a estos objetivos es necesario promover nexos y relaciones de colaboración a todos los niveles, sobre todo en la interfaz entre el hombre y los animales.

Palabras clave

Años de vida ajustados en función de la discapacidad – Carga de morbilidad – Inocuidad de los alimentos – Zoonosis.
References


