

WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases

Taking Stock and Charting the Way Forward



Geneva, 25–27 September 2006



World Health
Organization

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List of acronyms

ADG	Assistant Director-General
BOD	Burden of Disease
CE	Cystic echinococcosis
CHERG	Child Health Epidemiology Reference Group
DALY	Disability-Adjusted Life Year
FERG	Foodborne Disease Burden Epidemiology Reference Group
FBD	Foodborne diseases
GBD	Global Burden of Disease
GSS	Global Salm-Surv
FOS	Department of Food Safety, Zoonoses and Foodborne Diseases
MERG	Malaria Monitoring and Evaluation Reference Group
NSAGI	National Studies of Acute Gastroenteritis
OIE	Organisation for Animal Health
PAHO	Pan American Health Organization
SDE	Sustainable Development and Environmental Health
WHO	World Health Organization
WHS	World Health Survey
YLL	Years of Life Lost
YLD	Years Lived with Disability



Definitions

Foodborne diseases

Foodborne diseases (FBD) can be defined as diseases commonly transmitted through food. FBD comprise a broad group of illnesses caused by microbial pathogens, parasites, chemical contaminants and biotoxins.

Burden

The burden of disease can be defined as the incidence and prevalence of morbidity, disability, and mortality associated with acute and chronic manifestations of diseases.

DALY (Disability-Adjusted Life Year)

The DALY measure combines the years of life lost due to premature death (YLL) and the years lived with disability (YLD) for varying degrees of severity, making time itself the common metric for death and disability. One DALY is a health gap measure, equating to one year of healthy life lost.



Preamble

Joint Statement

**by participants of the WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases
25-27 September 2006
Geneva, Switzerland**

Recognizing that foodborne diseases are an important cause of illness and death worldwide, the World Health Assembly in 2000 identified prevention and control of foodborne diseases as a public health priority. To allocate resources for appropriate foodborne disease control efforts most effectively, precise information on burden of disease is needed. Although burden of foodborne disease estimates have recently been established in several countries, global estimates and additional national estimates are needed to inform public health policy-makers.

The World Health Organization (WHO), through the Global Burden of Disease Initiative, has developed a rigorous approach to estimation of burden of disease from numerous causes and risk factors, but global estimates are needed for the human health burden of pathogens and chemicals transmitted through food. WHO leadership is essential to ensure a coordinated approach in the derivation of burden of foodborne disease estimates, and the participants in this Consultation welcome the launch of such an initiative by WHO's Department of Food Safety, Zoonoses and Foodborne Diseases (FOS). In particular, given the complex and multidisciplinary nature of this issue and the wide variety of stakeholders involved, FOS, with its established leadership in food safety, is in an ideal position to provide the essential guidance.

Therefore, key recommendations of the Consultation include:

- WHO's burden of disease activities should be extended to encompass a broad spectrum of diseases commonly transmitted through food and from a variety of causes, including chemicals.
- WHO's Department of Food Safety, Zoonoses and Foodborne Diseases should provide leadership in the coordination of efforts to estimate the burden of foodborne diseases.
- WHO should establish a technical reference group to provide expert advice and guidance to WHO concerning the derivation of burden of foodborne disease estimates.
- WHO Member States are urged to undertake public health surveillance for diseases commonly transmitted through food and conduct studies aimed at determining burden of disease estimates.



Figure 1 - Prevention of FBD includes vaccination against various pathogens such as rotavirus.

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Executive summary

Foodborne diseases (FBD) encompass a wide spectrum of illnesses and are a growing public health problem worldwide. Reliable epidemiological estimates on the burden of these diseases are important in order to assess the impact of food safety measures and advise policy-makers on the cost-effective use of resources. Although several international initiatives are under way, no precise and consistent global information exists to date.

WHO's Department of Food Safety, Zoonoses and Foodborne Diseases (FOS) therefore launched an initiative to estimate the global burden of foodborne diseases from all major causes, including chemicals and zoonoses, at an international consultation. This was held in Geneva, Switzerland, from 25 to 27 September 2006 and was attended by over 50 experts from around the world. The objectives of the meeting were:

1. to launch an appeal for wider collaboration with a detailed plan of action and time frame;
2. to develop a strategic framework for burden of disease estimation that involves all relevant partners; and
3. to propose elements of a standard protocol for conducting burden of illness studies in countries to obtain estimates.

The meeting included a mixture of presentations by experts in the field (http://www.who.int/foodsafety/publications/foodborne_disease/burden_sept06/en/), group-work to address the objectives, and plenary discussions to agree on the outcomes of the Consultation.

The result of the Consultation was a draft *strategic framework* for the assessment of burden of foodborne diseases, which included: (a) the outline of an *evidence map* for assimilating existing information on the burden of disease [along themes of (i) acute infectious diseases, (ii) chronic manifestations of infectious diseases and (iii) acute and chronic non-infectious illness (Table 2)] and (b) a *time frame* outlining the individual strategic activities in relation to the evidence framework (Figure 9). Relevant international collaborators were identified and will be approached by WHO. Meeting participants agreed that it was desirable to use summary measures, such as the disability-adjusted life year (DALY) for any estimation of global burden. In addition, the participants agreed on the contents of a standard protocol for foodborne disease burden studies at country level including infectious and chemical causes.

In order to complete the strategic and technical framework, participants mandated WHO to establish a Foodborne Disease Burden Epidemiology Reference Group (FERG) and proposed the relevant skill mix required for this group. A number of funding agencies were identified that might be approached by WHO to enable the execution of this work. The Consultation concluded with the drafting of a Joint Statement of Support (see Preamble) for the Initiative.

1

Introduction

The meeting was opened by Dr David Heymann, Acting Assistant Director-General, Communicable Diseases (CDS), on behalf of Mrs Susanne Weber-Mosdorf, Assistant Director-General, Sustainable Development and Environmental Health (SDE).

Mr Martyn Kirk, of the Department of Health and Ageing, Government of Australia, and Ms Kathryn Doré, of the Public Health Agency of Canada, were elected as Chairperson and Rapporteur respectively.

Dr Claudia Stein welcomed participants on behalf of WHO's Department of Food Safety, Zoonoses and Foodborne Diseases (FOS) and introduced the draft agenda (Appendix 2).

2

Consultation objectives

For several years WHO has been encouraging Member States to quantify the national burden and causes of foodborne disease^{a,1}. Although several foodborne disease burden estimates now exist²⁻⁵, they are mainly from developed countries. In large parts of the world the data required to underpin such estimates are completely lacking.

The broad goal of this Consultation was therefore to develop a strategy for WHO towards improved estimates of the global burden of foodborne diseases from all major causes. A multidisciplinary group of national and international experts (Appendix 1) was convened in order to discuss and review existing epidemiological approaches in this area, identify gaps, consider options for addressing these gaps and provide the overall framework for WHO to proceed towards a global estimate of the burden of foodborne diseases. The detailed purpose of the Consultation was as follows:

- to launch an appeal for wider collaboration with a detailed plan of action and time frame;
- to develop a strategic framework for burden of disease estimation that involves all relevant partners; and
- to propose elements of a standard protocol for conducting burden of illness studies in countries to obtain estimates.



Figure 2 - Contamination of food occurs across the entire chain from farm to fork.

^a In 2002, WHO convened a Consultation on 'Methods on Foodborne Disease Surveillance in Selected Sites' held in Leipzig, Germany, from 18 to 21 March. The Consultation categorized disease surveillance systems according to their capacity to generate information on foodborne diseases and developed a general work plan for conducting studies to identify the burden of foodborne diseases in selected countries. As a result, such studies have been initiated in Cuba, Jordan, Slovenia and Viet Nam.

3

Definitions and scope of the Initiative

Foodborne diseases (FBD) can be defined as those associated with the ingestion of contaminated food. The burden of disease (BOD) can be defined as the incidence, prevalence of morbidity, disability, and mortality associated with acute and chronic manifestations of foodborne diseases.

In terms of scope, the Burden of Foodborne Disease Initiative should focus initially on microbial, parasitic, and chemical (including biotoxic) contamination of food. Subsequently, other aspects such as the burden associated with an absence of essential elements in the diet (e.g. folic acid leading to neural tube defects), food allergies, related issues such as avian influenza, Bovine Spongiform Encephalopathy, and infections transmitted through direct contact with food animals might be considered.

Meeting participants recognized that many diseases transmitted by the fecal-oral route were transmitted via contaminated water, food and environments, as well as infected persons and animals. For clarity, the Consultation unanimously recommended that “Global Burden of Foodborne Diseases” be renamed “Global Burden of Diseases caused by Agents Commonly Transmitted through Food”.

4

Methodological approaches and measures for foodborne disease burden estimation

4.1 Methodological approaches

4.1.1 Discussion

Several options were discussed:

a) Syndromic approach

A starting point for determining the global burden of illnesses or conditions caused by pathogens/toxins commonly transmitted through food might be the generation of a list organized by principal disease syndromes (Table 2). This syndromic approach is a relatively simple and low-cost initial step in gathering reliable information on the burden of disease associated with syndromes such as gastroenteritis. For example, all countries that collect data on diarrhoeal disease can contribute data. The syndromic method, however, may be less suitable for specific disease patterns (e.g. chemicals and cancer). Moreover, the low specificity of syndromic information limits its usefulness for foodborne illnesses. Complementary approaches are needed to define better the burden of diarrhoeal illness associated specifically with foodborne transmission.

b) Etiologic agent and risk factor approach

The starting point for several countries has been to use data on pathogens causing laboratory-confirmed diarrhoeal disease and to partition these data by most probable route(s) of transmission. The information generated is then extrapolated to all diarrhoeal disease and adjusted for underreporting. Compared to the syndromic approach, this method results in more specific estimates of foodborne illness. Alternatively, the total burden of illness for a specific pathogen, such as *Campylobacter* can be estimated and the proportion of relevant clinical presentations, such as gastroenteritis, Guillain-Barré syndrome, reactive arthritis and irritable bowel syndrome calculated⁶.

Better methods are needed to separate pathogens causing diarrhoea and other symptomatic illnesses from those that individuals excrete asymptotically, hence do not cause actual disease burden. Experts advising WHO's Child Health Epidemiology Reference Group (CHERG)^b will track asymptomatic infections weekly and use stool specimens and serology for best antigen detection. Where diseases have a high degree of endemicity, there can be relatively long periods of asymptomatic shedding. This may lead to an overestimate of infection that will need to be adjusted in any resulting model.

^b CHERG was first convened by WHO in 2002 with funding from the Bill and Melinda Gates Foundation. It is composed of leading external and internal experts to complete and publish epidemiologic reviews for each of the major causes of mortality, morbidity and disability in children under 5 years. To date, CHERG has successfully published on all major causes, notably with an acclaimed series in *The Lancet* on child mortality in 2005.

The approach to chemical contamination of food uses a different risk paradigm than microbiological contamination. Unlike microbiological contaminants, where one tends to start with the health effect and extrapolates back to the putative infectious causes, the starting point in chemical contamination is often the dose response. Health effects of chemical exposure can be extrapolated by knowing the dose response relationship and the level of contamination of food. Much of the foodborne chemical information currently available is from developed countries which have a comparatively low burden of acute chemical-related diseases. However, acute chemical poisoning is a serious cause of morbidity and mortality in developing countries; this may warrant the collation and estimation of such data in these settings particularly.

The group of experts agreed that both syndromic and risk-factor information is needed to answer questions about food safety and inform intervention measures. However, there was some disagreement about whether pathogen-specific rates are of such high importance for interventions, particularly since there is a considerable proportion of illness for which pathogens are unknown. Settings where foods are prepared or become contaminated (e.g. home, restaurant, street vendors, primary production) are also of interest in guiding interventions, but it was noted that, in reality, epidemiological studies rarely separate different sources of exposure to contaminated foods. In summary, it was clear that the approach taken in many developed countries for food-based chemicals used exposure to estimate disease, while microbial risks were estimated by attributing a proportion of disease to a given mode of transmission.

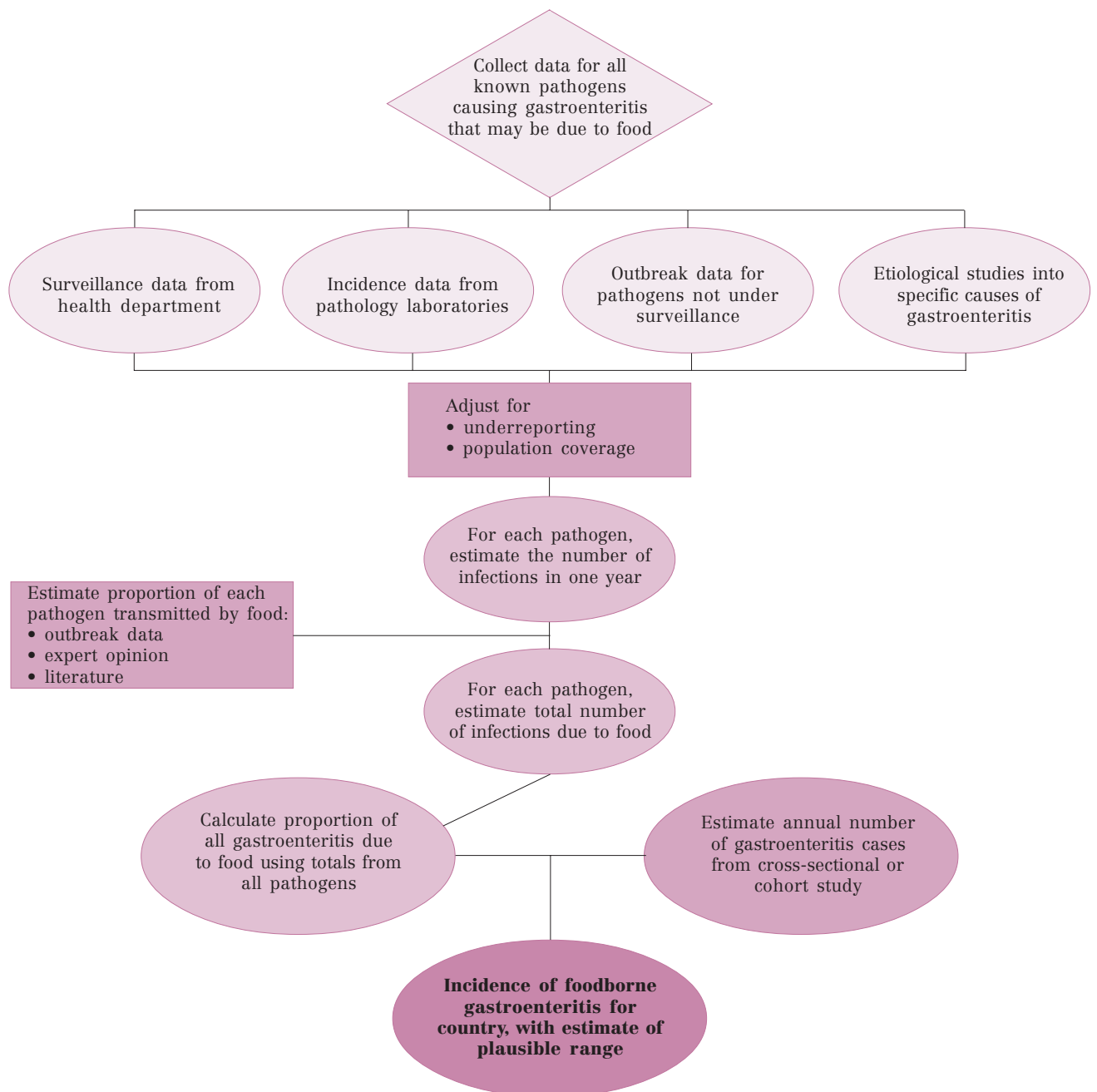
c) Attribution methods

A variety of methods has been used to ascertain the proportion of illness caused by foodborne agents using a syndromic case definition of gastrointestinal disease and/or pathogen specific causes likely to be attributable to food consumption. Investigators have used a combination of the following sources to assess the modes of transmission of foodborne agents:

- systematic reviews;
- routine surveillance data with enhanced laboratory capacity/ molecular techniques, combined with systematic surveillance of foods and food-producing animals;
- population-attributable risks from analytical studies (e.g. case control studies);
- intervention studies where disease reductions have been observed from improved food surveillance of outbreaks comparing reported modes of transmission for different agents;
- Delphi method (expert opinion).

For illnesses of unknown etiology, a protocol is needed to estimate the proportion that is foodborne. For example, in some national studies the proportion of gastroenteritis transmitted by all known pathogens is assumed to be the same for gastroenteritis of unknown etiology to derive an estimate (Figure 3). This issue is again discussed in section 5.1.2.

Figure 3 - The process for estimating the incidence of foodborne gastroenteritis in a specific country.



Source: Adapted from Foodborne Illness in Australia: Annual incidence circa 2000. Department of Health and Ageing, Government of Australia, Canberra 2005

In developing regional or global estimates of disease, intercountry variations in the proportion of illnesses attributed to food must be considered in the attribution model. This clearly depends on many factors including the dominant causes of foodborne illness and dietary habits in those settings. There was some debate regarding the validity of applying the proportion of disease attributed to food for developed countries to developing countries. It is possible that risk profiles may be similar in developed countries and developing nations that are making major improvements in their food safety systems. Alternatively, there may be different pathogens

contaminating food and at much higher levels, which will affect the incidence of foodborne disease in developing countries. This could be further compounded by the fact that food-based risks in many developing countries are different due to local food preferences and production methods. Moreover, differences in health status, co-morbidity and other vulnerabilities between countries, including malnutrition, are likely to affect foodborne disease incidence and their resulting complications.

Figure 4 - Bacterial contamination can be made visible through certain optic techniques.
Different food preferences and preparation methods may reduce or increase the risk of foodborne diseases.



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d) Combined methods for burden of disease estimation

The Global Burden of Disease (GBD) Study (see Textbox 1) examines disease and mortality burden from over 130 different causes using a combination of different approaches, including a comparative risk assessment framework which assesses the contribution of various risk factors to burden.

Textbox 1 - Global Burden of Disease (GBD) Study

Health policies should be based on accurate and meaningful health information. Much of the information collated, however, cannot be directly translated into policy. Health data from routine statistics or epidemiological studies are often fragmented, frequently concentrate on fatal health outcomes, and may only be partially available. Studies which investigate particular conditions may exaggerate claims on mortality. This is largely a reflection of co-morbidity where several co-existing pathologies contribute to and compete for the cause of death. Moreover, traditional statistics use a variety of different measures, which do not permit direct comparisons of the cost-effectiveness of different interventions.

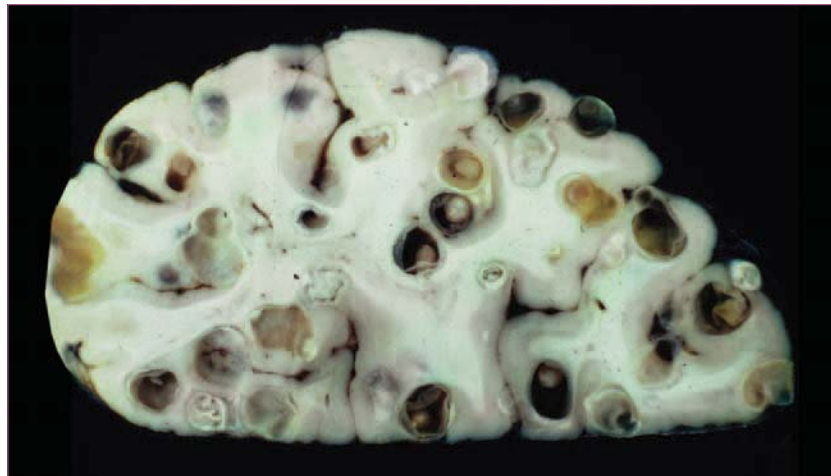
The GBD Study¹ approach - which was adopted by WHO for its reporting on health information in the late 1990s - addressed these problems and proposed a single metric, the Disability Adjusted Life Year (DALY). DALYs express the years of life lost to premature death (YLL) and the years lived with disability (YLD) for varying degrees of severity, making time itself the common metric for death and disability. One DALY is therefore a health gap measure, equating to one year of healthy life lost. DALYs are internally consistent and disaggregate co-morbidity, hence de-coupling epidemiological estimates from advocacy. Disadvantages of the DALY approach include the need for strong value judgments on disability and age, thus placing emphasis on death and morbidity in young adulthood.

Burden of disease studies should not produce a plethora of new research but instead capitalize on existing information and translate it into a single measure. Burden of disease studies include elements of disease modelling, risk assessment and burden projections; the latter inform policy-makers where to target preventive strategies and what to expect in terms of future disease burden. Missing elements in the traditional GBD approach are the downstream effects on trade, agriculture and social costs. Using the DALY metric, however, these can be developed and should be incorporated in the global burden study of diseases commonly transmitted through food.

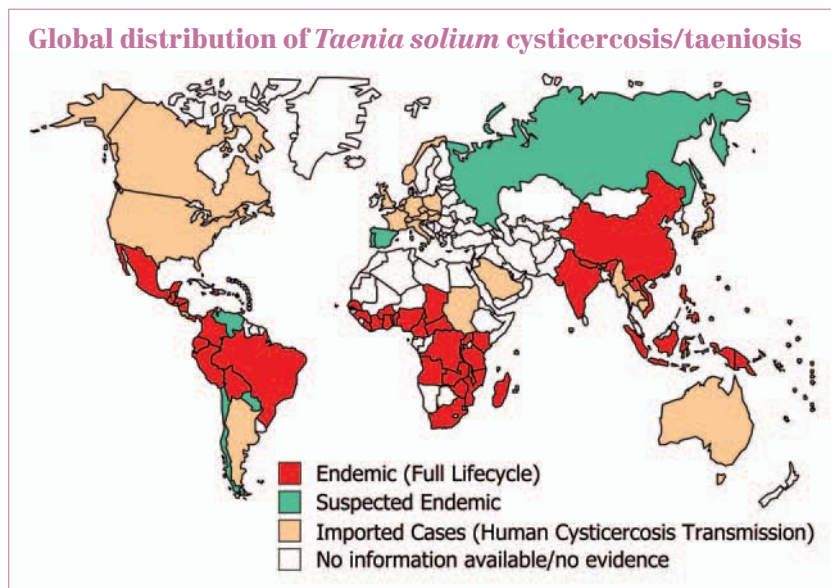
¹ Murray CJL, Lopez AD (eds), 1996. The Global Burden of Disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020. Global Burden of Disease and Injuries Series, Volume 1. Cambridge: Harvard University Press.

One of the strengths of the GBD approach is that it permits the estimation of disability associated with disease, particularly where mortality may be low but disabling long-term sequelae arise. One such example in the area of foodborne diseases would be the incidence of epilepsy as a result of trematode infection leading to neurocysticercosis (Figure 5).

Figure 5 - Neurocysticercosis, a preventable cause of epilepsy and its global distribution.



©Dr T. Nash, U.S./National Institutes of Health



©Dr L. Willingham, WHO/FAO Collaborating Center for Parasitic Zoonoses

While the GBD Study did not specifically examine risks associated with unsafe food it assessed (in its second round in the year 2000) the global burden of unsafe water and poor sanitation using nationally representative household-level exposure data on water quality and hygiene⁷. This burden was calculated using estimated disease reductions from multiple community intervention studies. The risk assessment thus relied on the impact of interventions rather than characterization of the burden of disease per se.

4.1.2 Recommendations for chapter 4.1 - Methodological approaches

Based on the discussions above, participants agreed that a combination of syndromic and etiologic agent-specific approaches is required to best estimate the burden of foodborne disease.

Recommendation I

WHO should **combine syndromic and etiologic agent-specific approaches** to estimate the global burden of foodborne diseases. This needs to be followed by an attribution of the **proportion of DALYs that is likely to be foodborne.**

One way to proceed would be to start with overall enteric disease burden studies adjusted for underreporting, then estimate pathogen- and chemical-specific burden and subsequently attribute the burden to foodborne, waterborne, person-to-person and animal-to-person modes of transmission.

In doing so it was recommended to primarily **focus on:**

- diseases which have a known high burden or are likely to have significant burden, and
- pathogens and chemicals that were most likely to contaminate food as well as the degree of preventability of contamination.

4.2 Etiologies to be included in the burden of disease assessment

4.2.1 Discussion

Participants discussed which etiologic agents should receive the focus when applying the combined approach outlined above. It was recognized that enteric pathogens would play a significant role in foodborne disease. Several chemicals were examined but it remained unclear how to rank them for importance, particularly for those causing chronic disease; this calls for further fundamental work. It was noted that there is potentially good burden of disease information for a number of agents. Table 1 may serve as a preliminary discussion table for further and more detailed exploration. Meeting participants noted that the burden of disease from acute chemical poisoning due to food was potentially high in developing countries, but data quality and availability might be very variable. The burden of disease due to food allergies will also require some attention.

Participants discussed which specific clinical (syndromic) presentations and agent-specific causes should be included in a framework for foodborne disease estimation and charged a small subgroup to draft the results (Table 2). The framework respects the following considerations:

- an integration of both microbial and chemical causes of foodborne disease;
- diseases are included on the basis of their relative importance (i.e. severity and incidence), the strength of existing evidence in developed and developing countries and the availability of burden of illness data at country and global levels; and
- a description of acute as well as chronic health effects. (It is important to consider the chronic sequelae as otherwise the DALYs due to contaminated food might be under-estimated.)

Table 1 - Chemicals for which more reliable quantitative information on foodborne disease burden may exist

Chemical agent	Associated disease endpoint (type of study showing the association)	Quantitative information	Assumptions to estimate foodborne burden of disease
Arsenic (As)	<ul style="list-style-type: none"> • Skin cancer and lesions (cohort, cross-sectional, and ecological studies of As in drinking water) • Bladder cancer (ecological, case-control, cohort studies of As in drinking water) • Lung cancer (ecological, case-control, cohort studies of As in drinking water) • Diabetes (cross-sectional, case-control studies of As in drinking water) • Cardiovascular disease (cohort, case-control, cross-sectional, and ecological studies of As in drinking water) 	<ul style="list-style-type: none"> • Dose response information from several sites including Argentina, Bangladesh, Chile, India, Taiwan and USA • The amount of As consumed in food has been reported for a number of countries including Australia, Brazil, Canada, Croatia, Japan, Spain, UK and USA • Mean total As intake from food and beverages is reported to range from 15 µg/day for Canadian 1-4 year olds to 291 µg/day for adults in the Basque region of Spain 	<ul style="list-style-type: none"> • Inorganic As in drinking water is the same as inorganic arsenic in food • The contribution of As from water used to prepare food can be estimated • The amount of inorganic As in food can be estimated
Cadmium (Cd)	<ul style="list-style-type: none"> • Itai-itai disease (cross-sectional, ecological, and cohort studies) 	<ul style="list-style-type: none"> • Increase in abnormal urinary variables associated with Cd content in food; increase in total mortality assoc. with Cd content in rice; increase in mortality from renal disease associated with Cd content in rice; increase in Itai-itai disease associated with Cd content in rice (studies all conducted in Japan) • Cd concentrations in foods have been reported for a number of countries including Denmark, Finland, Japan, The Netherlands, Sweden, UK and USA; daily dietary intake from food known for Belgium, Finland, New Zealand, Sweden, UK and USA 	<ul style="list-style-type: none"> • Urinary variables may be used as indicators of disease • The increase in total mortality and the increase in mortality from renal disease may reflect an increased risk from Cd
Lead	<ul style="list-style-type: none"> • Excess mental retardation (cross-sectional, cohort studies) • Cardiovascular disease (cohort, case-control, cross-sectional studies) • Anaemia (ecological, cross-sectional) 	<ul style="list-style-type: none"> • Dose response association of blood lead levels with blood pressure and neurological effects (numerous studies in several countries) 	<ul style="list-style-type: none"> • The contribution of lead in food to the lead levels in blood can be estimated
Methyl mercury	<ul style="list-style-type: none"> • Neurological effects (cohort studies) • Blood pressure (cohort) • Heart rate variability (cohort) 	<ul style="list-style-type: none"> • Dose response association of mercury in cord blood and maternal hair with effects on neurological tests, blood pressure, and heart rate variability in children (studies have been conducted in the Faroe Islands, New Zealand and Seychelles) 	<ul style="list-style-type: none"> • Estimates of the amount of methyl mercury in fish may be based on biologic indices of mercury exposure (e.g. blood and hair)

Source: Herman Gibb, Sciences International, Inc., Alexandria, VA, USA.

Table 2 - A fully integrated approach to foodborne diseases combining syndromic and agent-specific clinical presentations (“evidence map”)

Category		Clinical syndromes	Examples
Infectious disease	<ul style="list-style-type: none"> • Chronic sequelae 	<ul style="list-style-type: none"> • Reactive arthritis • Guillain Barré syndrome • Irritable bowel syndrome • Epilepsy • Retinopathy • Renal failure • Cancer • Multi-organ failure 	<ul style="list-style-type: none"> • <i>Salmonella sp.</i> • <i>Campylobacter sp.</i> • <i>Yersinia sp.</i> • <i>Campylobacter sp.</i> • <i>Campylobacter sp.</i> • <i>Salmonella sp.</i> • <i>Cryptosporidium sp.</i> • <i>Giardia sp.</i> • <i>Taenia solium</i> • <i>Toxoplasma gondii</i> • Shiga-toxin producing <i>Escherichia coli</i> (STEC) • <i>Helicobacter pylori</i> • <i>Opisthorchis viverrini</i> • <i>Trichinella spiralis</i> • <i>Mycobacterium bovis</i>
	<ul style="list-style-type: none"> • Acute 	<ul style="list-style-type: none"> • Gastroenteritis • Meningitis • Septicaemia • Acute neurological symptoms • Perinatal loss • Acute hepatitis 	<ul style="list-style-type: none"> • <i>Campylobacter sp.</i> • Non-typhoidal <i>Salmonellas sp.</i> • <i>Cryptosporidium</i> • <i>Giardia sp.</i> • <i>Shigella sp.</i> • Norovirus • Bacterial toxins • <i>Yersinia sp.</i> • <i>Cyclospora sp.</i> • Enteropathogenic <i>E. coli</i> (EPEC) • STEC • Marine biotoxins (e.g. Diarrhetic Shellfish Poisoning) • <i>Listeria monocytogenes</i> • <i>Salmonella sp.</i> • <i>Brucella</i> • <i>Salmonella</i> (incl. typhoid) <i>sp.</i> • <i>Listeria monocytogenes</i> • <i>Clostridium botulinum</i> • Marine biotoxins • <i>Listeria monocytogenes</i> • <i>Toxoplasma gondii</i> • Hepatitis A • Hepatitis E
Chemicals	<ul style="list-style-type: none"> • Acute • Chronic 	<ul style="list-style-type: none"> • Gastroenteritis • Neurodevelopmental disorders • Cancer • Renal disease 	<ul style="list-style-type: none"> • Organophosphates • Lead • Methylmercury • Aflatoxin • Arsenic • Acrylamide • Dioxins • Cadmium

4.2.2 Recommendations for chapter 4.2 - Etiologies to be included

Based on the discussions above and the results outlined in Table 2, the participants made the following recommendation:

Recommendation II

WHO should use the fully-integrated framework outlining syndromes and causative agents shown in **Table 2 as a basis for the global burden of foodborne diseases estimation.**

In addition, the participants proposed that:

Recommendation III

WHO should make special efforts to estimate the global burden of foodborne diseases due to **chemical and parasitic causes.**

4.3 Burden of disease measures to be used

4.3.1 Discussion

The impact of each etiologic agent can be expressed in terms of disability-adjusted life years (DALYs). This metric conforms to existing WHO protocols developed for the GBD initiative (Textbox 1) and is increasingly used in the description of diseases potentially transmitted through food, including those caused by parasites (Textbox 2).

Textbox 2 - Methods for global burden assessment: echinococcosis¹

Cystic echinococcosis (CE) is a zoonotic disease caused by the larval stages of the dog tapeworm *Echinococcus granulosus*. Risk factor analysis has suggested that as much as 30% of CE is transmitted through food by contamination with parasite eggs. To estimate the global burden of CE, a variety of sources of data to estimate human incidence and animal prevalence were used by investigators of the University of Zurich. These included OIE data, official government reports, detailed multilingual literature searches and published reports of detailed case studies for some locations. In addition, modelling techniques were utilized to estimate missing data.

CE is primarily a space-occupying disease of the liver. Consequently, disability weights for liver cancer were used based on disease-free liver cancer, pre-terminal liver cancer, terminal liver cancer and death. The proportion of cases of CE assigned to each category was based on a literature survey of several series of cases and their clinical outcome following surgical intervention. Likewise age-weighting was also based on literature reports. Stochastic techniques were used to model this uncertainty and hence overall DALY and financial estimates were calculated based on a median and 95% confidence intervals.

The small number of case-finding reports confirmed that underreporting is in the region of 75%. The global burden of CE was estimated to be approximately 1 million DALYs (95% CI 860 000-1 175 000) assuming underreporting of cases, with perhaps 200 000 new cases of CE each year. The financial burden of disease in purchasing-power parity estimates is approximately US\$ 4.1 billion per annum of which 46% is associated with human treatment and morbidity and 54% is animal health costs.

¹ Torgerson PR, Budke CM. Epidemiology and Modelling Group, WHO Collaborating Centre for Parasitic Zoonoses, Institute of Parasitology, Faculty of Medicine and VetSuisse Faculty, University of Zurich, Winterthurerstrasse 266a, 8057 Zurich, Switzerland.

Other references: Carabin H., Budke C.M., Cowan L.D., Willingham A.L. 3rd, Torgerson P.R. (2005). Methods for assessing the burden of parasitic zoonoses: echinococcosis and cysticercosis. *Trends in Parasitology*, 21: 327-333.

However, relying exclusively on DALYs can make some diseases less visible. Participants expressed concern that some measures of social burden are not well captured by DALYs, such as costs associated with diminished production and trade of infected food-producing animals. Other drawbacks of the DALY approach include subjective value judgements made on disability weights and age-weighting, as well as the fact that traditionally the burden of stillbirths is not considered in the derivation of DALYs (which is relevant to the burden of toxoplasmosis and listeriosis).

Resolving how morbidity and mortality that is foodborne can be distinguished from that associated with unsafe water and sanitation remains a challenge. For example, the number of DALYs resulting from water and sanitation are close to the total worldwide burden calculated for diarrhoeal disease⁵. Clearly, a proportion of these diarrhoeal cases are attributable to unsafe food but the exact burden remains to be quantified and attempts will need to be made to arrive at a proportional attribution to food and water. The group noted that

there had been many positive outcomes of the WHO International Collaboration on Enteric Burden of Illness Studies⁶ where countries had compared and contrasted findings for national studies. Specific partnerships thus far suggest enhanced linkages between the Foodborne Disease Burden Initiative and the GBD efforts. One key area for future collaboration is the global burden of unsafe water and sanitation area.

Studies reporting burden of disease estimates focusing on mortality give underestimates since, for example, case fatality for some foodborne illnesses (including rotavirus infection) has declined in many countries (due to interventions such as oral rehydration therapy and introduction of vaccines), while morbidity remains high.



Figure 6 - Looking fresh - being safe?

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The World Health Surveys (WHS) were discussed as a potential source of burden of foodborne diseases information. However, the WHS collected only data on the incidence of diarrhoeal disease in children with an estimate of symptom duration.

A study of diet and health in The Netherlands (Textbox 3) compared chemical and microbial foodborne disease using DALY estimates. The study found that contamination of food due to chemicals and microorganisms caused similar burden of disease. The study highlighted how the burden of acute disease can be minimized in countries with extensive regulation of food safety. The Consultation agreed that WHO should encourage Member States to conduct similar assessments.

⁶ The International Collaboration on Enteric Burden of Illness Studies was formed in 2004 under the auspices of the World Health Organization. The group currently has participants from over 30 countries. The main aims of the collaboration are: (a) to foster communication between people researching the burden of enteric diseases; (b) to share study designs and results of studies; (c) to provide advice to countries wishing to conduct burden of illness studies; and (d) to contribute to global foodborne disease burden estimates. The collaboration has largely concentrated on the burden of disease that is likely to be microbiological in nature (see also Reference 3).

Textbox 3 - Our food, our health: healthy diet and safe food in The Netherlands¹

This nationwide study assessed the health impact and safety of the diet of the Dutch population by examining nutritional aspects (including unfavourable dietary intake) and dietary composition as well as the effect of microbial and chemical contamination of food. To provide a direct comparison of these different factors, health impact was expressed in Disability Adjusted Life Years (DALYs) per annum.

Using largely the comparative risk assessment approach, the study examined both acute and chronic health effects, including: (a) the effect of the consumption of saturated fats, trans-fatty acids, fish, fruit and vegetables on the incidence of cardiovascular diseases and cancer; (b) the incidence of gastroenteritis (including its sequelae and mortality) due to microbial foodborne contamination by known pathogens; and (c) the effects of main chemical constituents and contaminants, including allergens.

The overall conclusion was that although the Dutch diet is safer than ever the composition of the Dutch diet is still far from the recommended. Obesity as a result of an unfavourable diet was found to be the greatest threat causing 215 000 DALYs to be lost every year and an average reduction in life expectancy of 1.2 years in people over the age of 40 years. Yet foodborne infections remained a persistent problem with 4.5 million cases of gastroenteritis each year resulting in approximately 1000-4000 DALYs lost. This is comparable to the health loss due to AIDS or bacterial meningitis. A similar result was recorded for allergies caused by chemical contaminants resulting in approximately 1000 DALYs lost every year.

The authors concluded that a reduction in overweight and obesity, as well as the promotion of a healthy dietary composition, should be a public health priority in The Netherlands. They also advocated better risk assessment methods and risk communication with consumers.

¹ FX Rolaf van Leeuwen, National Institute for Public Health and the Environment, Bilthoven, The Netherlands. The study report can be accessed online under: www.rivm.nl/en

4.3.2 Recommendations for chapter 4.3 - Burden of disease measures to be used

Participants advised WHO that any strategy to assess this disease burden should reflect the internally consistent GBD approach which applies the DALY, a metric that is generally accepted, widely used by WHO and helpful for cost-effectiveness analyses. Participants also suggested to follow the GBD approach in describing the uncertainty inherent to the estimates.

Recommendation IV

WHO should **employ the internally consistent Global Burden of Disease (GBD) methodology** in the assessment of the global burden of foodborne diseases. The impact of each syndrome and etiologic agent should be **expressed in terms of Disability Adjusted Life Years (DALYs)** wherever possible.

Recommendation V

For clarity and consistency, **point estimates of the burden together with uncertainty distributions** should be used in **technical publications**, while a **“single most likely value”** is suggested for **non-technical audiences**.

5

Burden of Foodborne Disease Studies at country level

5.1 Country protocols

5.1.1 Discussion

Country protocols for conducting foodborne disease burden studies may differ for developed and developing countries because of different capacities. Moreover, the type of disease-specific pathogens may vary due to different laboratory capacity, and differences in the prevalence of etiological agents.

Existing protocols for assessing the burden of illness could be adapted for use in this global burden initiative. These protocols have been developed to determine the burden of foodborne disease and the burden associated with a wide range of specific pathogens and food types. They include active, integrated surveillance systems (i.e. FoodNet, OzFoodNet), population studies (cross-sectional/cohort surveys), and laboratory surveys examining a wide range of etiologic agents as well as targeted risk factor studies (e.g. case-control studies). Examples of such protocols include:

- The Netherlands' study (both biological and chemical protocols (Textbox 3)
- Cuba and Jordan's Burden of Illness Studies (Textbox 4)
- UK's Infectious Intestinal Diseases Study (IIDS)⁴
- CDC's Biomonitoring and EPA Integrated Risk Information System (IRIS)^d
- Canada's National Studies of Acute Gastrointestinal Illness (NSAGI)⁸
- Australia's OzFoodNet⁵
- US FoodNet and foodborne disease estimates²

These protocols can be modified according to national/regional capacities to assist countries in establishing baselines on the burden of enteric illness and on specific etiologies. The Consultation recognized that the study conducted in Jordan on limited pathogens may represent a good model of simplified burden assessment that could be used in countries with limited surveillance data (Textbox 4).

^d www.epa.gov/iris

Textbox 4 - The Jordan Burden of Illness Study¹

As part of WHO's strategy to reduce the burden of foodborne diseases globally, Jordan was selected as the first sentinel site in the Eastern Mediterranean Region to study the burden of disease due to *Brucella*, *Salmonella* (including *S. Typhi*) and *Shigella* infections.

Burden of disease was estimated using nationwide population and laboratory surveys along with a validation study to approximate internal validity. Estimates were calculated by determining two proportions: (1) the proportion of ill persons >1 year of age in the Jordanian population who sought care and (2) the proportion of ill persons >1 year of age who sought care and submitted a clinical stool or blood specimen to a laboratory. Multipliers were defined as the inverse of each of these proportions. The burden of disease estimates were determined by multiplying the number of laboratory-confirmed cases ascertained via the nationwide laboratory surveys by these two multipliers.

The study indicates significant underreporting and under-diagnosis of the above-mentioned pathogens from ministry of health laboratories, probably due to specimen preservation and transportation. Approximately only two in five persons with diarrhoea sought medical care. Burden of illness calculations revealed an estimated annual incidence (per 100 000) of 130, 123 and 306 for *Brucella*, *Salmonella* and *Shigella* respectively. Although this is quite likely an underestimate of the real burden of disease, the study still provides baseline information of the burden of selected foodborne pathogens for one year in Jordan and serves as a model for other sentinel sites.

Moreover, study results have been used to advocate for improved specimen transportation, laboratory capacity and reporting systems as well as the establishment of sentinel site laboratory-based surveillance for *Salmonella* and *Shigella*. Future studies to determine the economic burden of other foodborne pathogens (e.g. *Campylobacter*, *E. coli*) have been recommended to advise policy-makers on cost-effectiveness of interventions and reallocation of resources.

¹ Gargouri Darwaza N. Surveillance Department, Disease Control Directorate, Ministry of Health, Amman, Jordan, 2003

Participants welcomed the Jordan Burden of Illness Study protocol as a very good starting point since it was feasible, effective and relatively low cost; it also used a systematic flowchart to adjust for underreporting of data similar to the one outlined in Figure 3 of this document. The Jordan estimates provided the country with valuable baseline prevalence information and demonstrated the extent of under-diagnosis and underreporting.

5.1.2 Recommendations for chapter 5.1 - Country protocols

After discussing the elements of country protocols in some detail, participants recommended core data requirements, details of which are outlined in the subsequent section.

Recommendation VI

The following **core data requirements** are recommended for foodborne disease burden studies at country level:

- A. magnitude, distribution and health impact data;
- B. possible exposures and sources of pathogens and chemicals;
- C. associated diseases as indicators;
- D. presence of etiologic agents and/or disease in domestic animals or wildlife consumed as food.

A. Magnitude, distribution and health impact data

- number of clinical cases and number of laboratory confirmed cases (obtained from available syndromic and laboratory surveillance systems and outbreak data);
- etiology;
- number of hospitalized cases (morbidity) and deaths (mortality);
- geographical distribution (i.e. urban and rural data);
- temporal distribution (i.e. seasonality);
- age and gender of cases;
- population data:
 - total population
 - population by age-group and gender.

The **representativeness** of the above epidemiological and laboratory surveillance data is an important consideration in interpreting the findings. An understanding of the **sensitivity and validity** of microbiological and chemical assay/test methods is critical and adjustments may need to be made in order to account for test accuracy.

Similarly, **disease-underreporting studies** must be undertaken and appropriate correction factors calculated and applied. Underreporting estimates can be obtained through suites of studies assessing the proportion of the population with given symptom(s), identifying the proportion who seek health care and submit laboratory specimens, as well as the proportion of positive specimens and details/results of laboratory testing (Figure 3). However, such information will vary between studies and particularly between countries; correction factors therefore need to be country specific.

B. Possible exposures and sources of pathogens and chemicals

- potential sources of chemical and pathogen exposure;
- national data on food consumption;
- methods of food preparation;
- biological measures of chemical and pathogen exposure (e.g. blood, urine).

The above data can be collected through cross-sectional studies of the population or through sentinel studies in rural and urban settings.

C. Associated diseases as indicators

- epilepsy as an indication of neurocysticercosis from *Taenia solium* infection;
- cholangiocarcinoma due to endemic liver fluke infections (*Opisthorchis viverrini*) where people commonly consume raw fish.

Figure 7 - Foodborne trematodiasis caused by the liver fluke *Opisthorchis viverrini*.

Foodborne trematodiasis caused by the liver fluke *Opisthorchis viverrini* is highly prevalent in north-eastern Thailand. The parasite life cycle involves the fresh water *Bithynia* snail and *Cyprinoid* fish (A-inset) as reservoir/definite hosts. People become infected by eating raw or under-cooked fish (*Koi pla* – in Thai) (B) harbouring infective metacercariae. The parasite then loses its cystic envelope in the duodenum, migrates to extrahepatic bile ducts and the liver. The fluke reaches maturation in a month (C) and excretes eggs into faeces. With latrines of poor hygienic standard, especially those near natural water reservoirs (A), parasite eggs pass to the water where snail and fish can be infected. Man then eats raw fish and completes the life-cycle. The infection is associated with several chronic hepatobiliary diseases such as cholangitis, cholecystitis, gallstones, and the life-threatening disease, cholangiocarcinoma (CCA) - bile duct cancer (D). Thailand has reported the highest incidence of CCA in the world.



Source: Figure prepared for WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases, Geneva, 25-27 September 2006 – B. Sripa.

D. Prevalence and incidence in animal reservoirs

- *trichinella* found in meat, which is an indication of potential infections in humans;
- cysticercosis in pigs, indicating potential human infections;
- methylmercury in fish.

5.2 Consultation, training and communication

5.2.1 Discussion

Given the generally sparse data on the burden of foodborne diseases, especially in developing countries, it was suggested that WHO may wish to undertake regional consultations in order to assist countries in identifying those diseases and conditions that have the highest burden of illness. WHO regions would indicate if data are available to estimate the burden of foodborne diseases. If data are not available, the WHO region or country may estimate the burden based on data from other relevant regions. Regions or countries should not be discouraged from making estimates if data are limited. Initial estimates with limited data can assist policy development and may generate work to validate findings. There might be limited data on which to base burden of disease estimates for some agents that are considered to present the greatest risks, but even provocative estimates can initiate valuable research. An example of effective collaboration and communication at regional and country level leading to burden of disease estimates are the efforts in WHO's American Region (Textbox 5).

Textbox 5 - International cooperation on foodborne disease burden of illness studies: a case study in the WHO's American Region¹

International cooperation on the burden of foodborne diseases is not just a matter of bringing the right professionals together. Food safety systems are complex in nature, and because of this complexity strong partnerships are needed along the food continuum. These partnerships facilitate cooperation and information-gathering for appropriate control of FBD. In WHO's American Region (WHO/AMRO), FBD are subject to under-diagnosing, underreporting and missing data. In the last 10 years the countries in AMRO totaling a population of approximately 853 million reported less than 7000 outbreaks to the Regional Information System on Foodborne Diseases Surveillance - SIRVETA. A likely cause of the lack of information is that the majority of the countries have basic surveillance systems (i.e. no formal surveillance or only syndromic surveillance) and in almost all reported outbreaks there was no formal laboratory-based reporting. Factors that may contribute to these issues include economic development, access to health care, public health infrastructure, political stability, and demographic features (rural/urban, literacy, age, religion, food preferences).

To counter this, in 2004, WHO/AMRO, in alliance with the Public Health Agency of Canada (PHAC) and the Centers for Disease Control and Prevention (CDC), USA, promoted a method of estimating the burden and impact of FBD in the population which involves conducting surveys of the population, laboratory and surveillance systems. The strategy used was to establish partnerships with the countries, stakeholders and WHO/AMRO by means of creating awareness using the regional WHO-GSS (Global Salm-Surv) training courses, developing teaching material (lectures and exercises), assessing the capacity of the country in developing a FBD burden of illness study using a country workshop, and creating a national task force to implement the study. In the Americas, the burden and impact of FBD in the population has to date been documented in Cuba using sentinel sites, in Argentina in two pilot projects at local level (municipalities), and Chile, Costa Rica and Paraguay are ready to begin. It is projected that by 2013 (WHO's medium-term strategic plan of WHO/AMRO) at least 20 countries will have finished burden of illness studies in FBD.

¹ Enrique Pérez Gutiérrez, Food Safety Officer, Health Surveillance and Disease Management Area, Veterinary Public Health Unit, WHO Regional Office for the Americas, Brazil.

To increase the capacity of countries in assessing the burden of foodborne diseases, burden of illness should also be strengthened in the Global Salm-Surv^e training curriculum. PAHO has developed a training exercise based on a study in Jordan to outline how these assessments are conducted in WHO Global Salm-Surv courses.

5.2.2 Recommendations for chapter 5.2 – Consultation, Information Dissemination and Training

Participants felt that regional consultations in collaboration with the Food and Agriculture Organization of the United Nations (FAO) and other relevant international organizations are needed to facilitate the identification of diseases and conditions that are associated with the highest local burden of illness.

Recommendation VII

WHO should **collaborate closely with relevant partners**, including the **Food and Agriculture Organization of the United Nations (FAO) and others** to undertake **regional consultations** to discuss the regional specific profiles of foodborne syndromes and etiologic agent for future burden estimation.

^e World Health Organization Global Salm-Surv (GSS) is a global network of laboratories and individuals involved in surveillance, isolation, identification and antimicrobial resistance testing of Salmonella. It is part of WHO's endeavours to strengthen the capacities of its Member States in the surveillance and control of major foodborne diseases and to contribute to the global effort of containment of antimicrobial resistance in foodborne pathogens. GSS was started in January 2000 to build capacity for laboratory-based surveillance of foodborne diseases. The programme is targeted at microbiologists and epidemiologists who work in public health, veterinary services, food-related services or environmental health. Originally GSS focussed on isolation and surveillance for Salmonella, but has now extended to other major foodborne pathogens. The programme is overseen by a steering committee comprising national or international agencies with an interest in foodborne diseases. For more information: <http://www.who.int/salmsurv/en/>

A successful execution of this recommendation will require a communication strategy and training. It was suggested that it should include the following elements:

Recommendation VIII

Communication and training to execute burden of disease studies:

- WHO to communicate the importance of burden estimates for food safety policy development; this should be coordinated by WHO regional offices;
- WHO to facilitate training involving WHO staff and colleagues from countries experienced in this area of work;
- Emphasize burden of disease methods in the Global Salm-Surv training curriculum;
- WHO to disseminate information on burden of disease training by existing networks.

Participants suggested that countries wishing to conduct burden of disease studies should fulfill the following criteria:

- demonstrated political commitment to food safety;
- location in regions where the prevalence of foodborne disease is a recognized concern (i.e. confirmed cases, high-risk dietary habits) and where burden of illness evidence is scant;
- presence of an existing basic infrastructure to support the study (e.g. surveillance system in place, laboratory capacity).

The decision-making process regarding the implementation and specific country engagement/training should be democratic, pragmatic and transparent. It must be clear who makes decisions on implementation and specific country engagement and training, and if funding is channelled through WHO, governance issues must be addressed.

Figure 8 - Participants receive a lecture on foodborne disease laboratory techniques at a Global Salm-Surv international training course in China.



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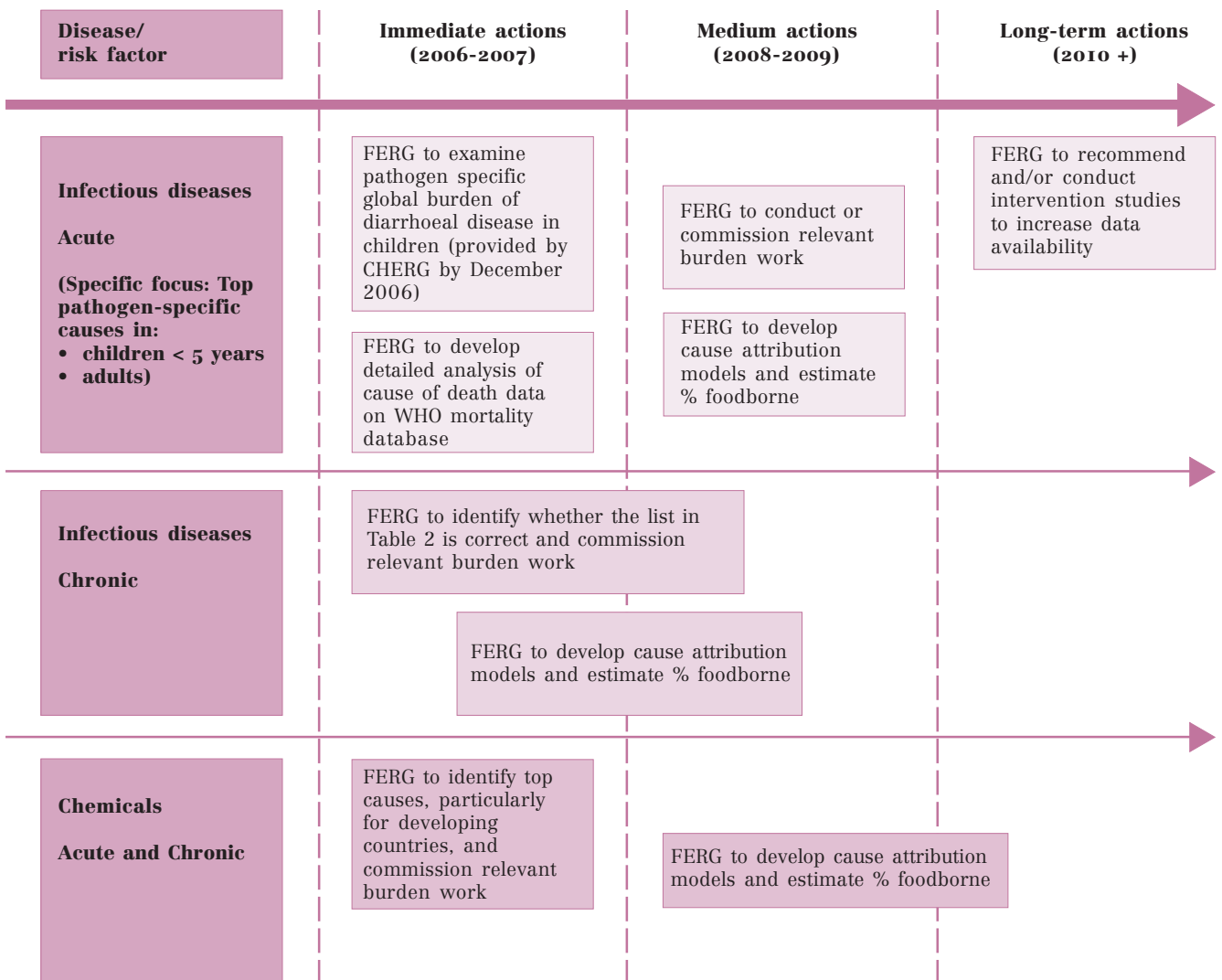
6

Strategic way forward

6.1 Burden of disease strategy and time frame for action

Participants discussed and agreed upon a strategic framework which WHO should employ to manage the process of arriving at burden of disease estimates as outlined in the "evidence map" (Table 2). The items shown in the three time periods indicate specific actions taken by investigators in the three syndromic disease categories agreed and recommended by the Consultation.

Figure 9 - Strategic framework for the execution of recommendations.



The Consultation therefore recommended:

Recommendation IX

A strategic framework indicating short-, medium- and longer-term action points (**Figure 9**) should be used by WHO in order to deliver burden of disease estimates for the syndromes outlined in the "evidence map" (Table 2).

6.2 The Foodborne Disease Burden Epidemiology Reference Group (FERG)

Participants endorsed the establishment of a group of experts which would convene regularly to advise WHO and oversee the work on foodborne disease burden as outlined above. This group may have various subgroups or task forces for specific aspects of disease burden. This mechanism has been successfully used by WHO's Department of Child and Adolescent Health and Development with its Child Health Epidemiology Reference Group (CHERG) as well as the Malaria Monitoring and Evaluation Reference Group (MERG).

The *core* or *oversight group* should include:

- a chairperson with extensive and internationally-renowned experience in both foodborne diseases and epidemiology of burden of disease;
- epidemiologists specializing in:
 - microbiology/enteric diseases
 - chemicals/toxicology
 - parasitic diseases
 - zoonotic diseases
 - source/cause attribution;
- WHO secretariat.

The *subgroups/task forces* may include further experts in the areas of:

- microbiology, toxicology, parasitology and virology;
- burden of disease methodologies;
- disease modeling, statistics and geographic information systems;
- microbiological and chemical risk assessment, and source attribution;
- clinical medicine and nutrition;
- food protection policy and regulation;
- advocacy;
- communication and training; and
- other experts as appropriate (e.g. economics, information management, ethics, public health law).

Recommendation X

WHO should establish a **multidisciplinary Foodborne Disease Burden Epidemiology Reference Group (FERG)** to execute the recommendations of this Consultation and oversee the process of burden of disease estimation.

Participants suggested that WHO approach donor agencies ranging from philanthropic organizations and aid agencies to United Nations partner agencies to fund this Initiative. Donor agencies may also include universities, which could provide support services and human resources (both faculty members and students). Academic institutions are also valuable for their infrastructure (including laboratory facilities), research experience and linkages to other potential funding sources, all of which can support sustainability. Regulatory agencies that develop standards for food safety quality could also be valuable collaborators in this Initiative.



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Figure 10 - International partnerships are essential to make our food safer.

7

Conclusions

The Consultation concluded that the estimation of the global burden of disease associated with foodborne causes is a multifaceted activity that will require collaboration between a wide variety of different groups. Estimation of disease burden should be tackled using a staged approach depending on the available evidence for different diseases and affected populations. The Consultation concluded that estimation of global estimates of foodborne disease burden was vital in order to establish the baseline and set targets for improvement.

7.1 Outputs of the Consultation

During the Consultation, the following products were developed:

- **an overall framework for assimilating existing information (i.e. the "evidence map")** on the burden of disease developed along themes of (i) acute infectious diseases, (ii) chronic manifestations of infectious diseases and (iii) acute and chronic non-infectious illness (e.g. foodborne chemical exposure); this framework is summarized in Table 2;
- **a strategic framework for burden of disease estimation** highlighting the actions foreseen to take place in the short-, medium- and longer-term of this Initiative (Figure 9);
- elements of a **standard protocol/manual for conducting burden of illness studies** in countries to obtain estimates. Core data requirements to be included in the country protocols related to the following areas (cf. Recommendation VI):
 - magnitude, distribution and health impact data;
 - possible exposures and sources of pathogens and chemicals;
 - associated diseases as indicators;
 - presence of etiologic agents and/or disease in domestic animals or wildlife consumed for food.

In addition, the participants agreed on:

- **a Consultation Joint Statement of Support** which forms the preamble of this report. The declaration expresses support for this global initiative and advocates for continued WHO leadership in taking this work forward. In addition, the statement is to be sent formally by the Consultation's Chairperson to WHO senior management, including the Director-General, Assistant Director-Generals and Director FOS.

7.2 Summary of recommendations:

Table 3 gives an overview of the recommendations developed during the Consultation.

Table 3 - Table of recommendations

	Topic	Recommendation	Page
Recommendations on methodological approaches and measures for estimation of foodborne disease burden.			
I.	Methodological approaches	Combined syndromic and etiologic agent-specific approach to be applied, followed by an attribution of the proportion of DALYs that is likely to be foodborne.	10
II.-III.	Etiologies to be included	"Evidence map" (cf. Table 2) to be used as draft for FERG. Emphasis on chemical and parasitic causes of foodborne diseases.	13 13
IV.-V.	Burden of disease measures to be used	The Global Burden of Disease (GBD) methodology to be employed; impact of foodborne diseases to be expressed in DALYs.	15
		"Single most likely value" for non-technical audiences to be used.	15
		Point estimates with uncertainty distribution to be used for technical publications.	15
Recommendations on country protocols			
VI.	Core data requirements	A. Magnitude, distribution and health impact data. B. Possible exposures and sources of pathogens and chemicals. C. Associated diseases as indicators. D. Presence of etiologic agents and/or disease in domestic animals or wildlife consumed for food.	18
VII.-VIII.	Consultation, training and communication	WHO to collaborate closely with the FAO and others to undertake regional consultations.	21
		WHO to communicate the importance of burden estimates for food safety policy development.	22
		Training to involve WHO staff plus colleagues from countries experienced in this area of work.	22
		Burden of disease to be emphasized in the Global Salm-Surv training curriculum.	22
		Dissemination of information on burden of disease training by existing networks.	22
Strategic way forward			
IX.	Burden of disease strategy and time frame for action	Investigators to take actions in three syndromic disease categories according to a time-bound strategy outlined in Figure 9.	24
X.	The Foodborne Disease Burden Epidemiology Reference Group (FERG)	WHO to establish a multidisciplinary FERG to execute the recommendations of the Consultation and oversee the process of BOD estimation.	25

The main thrust of taking the agenda of estimating the Global Burden of Foodborne Diseases Initiative forward will rest with the **strategic leadership from WHO/FOS and the Foodborne Disease Burden Epidemiology Reference Group (FERG)** which will provide WHO with expert advice and burden of disease estimates for consideration. FERG should proceed according to the action points outlined in the time-bound strategy for burden of disease estimation shown in Figure 9. WHO will approach funding agencies to execute the strategy.

It was recommended to extend the Burden of Foodborne Disease Initiative to a **broad spectrum of diseases commonly transmitted through food and from a variety of causes**. It should initially focus on microbial, parasitic, zoonotic, and chemical contamination of food. Subsequently other aspects (e.g. burden associated with nutritional aspects or issues such as avian influenza, food allergies, etc) should be considered.

Participants agreed that a **combination of syndromic and etiological agent specific approaches** was desirable for burden of disease estimations. The **starting point should be overall enteric disease burden** studies adjusted for underreporting, then estimating pathogen-specific burden and subsequently attributing the burden to foodborne, waterborne, and other modes of transmission. A **special emphasis of the Burden of Foodborne Diseases Initiative should be placed on assessing the chemical and parasitic causes of foodborne disease burden**, as only little work has been done in this field up to now.

It was also recommended that the burden of foodborne diseases estimates should be **measured in DALYs** (Disability-Adjusted Life Years). Despite some limitations DALYs are useful as an initial common currency for BOD estimates and form a basis for more detailed cost estimates related to the economic impact. **Single point estimates** were recommended for **non-technical audiences**, whereas **point estimates with uncertainty distribution** were recommended for technical publications.

Even with limited data at their disposal, **countries should be encouraged to estimate the foodborne diseases burden**. Beyond assisting policy development, challenging estimates can catalyze valuable research. For a more in-depth analysis on a national level which WHO Member States are urged to undertake, Consultation participants identified a number of country protocols as useful templates (such as the Jordan Burden of Illness Study protocol) and suggested key elements of a standard protocol/manual for conducting burden of illness studies. WHO's **Regional Advisers for Food Safety should assist countries in conducting these studies and identify foodborne disease issues specific to regions** and population groups (e.g. children).

In order to increase the commitment of governments to assessing the burden of foodborne diseases, **WHO is to provide information that demonstrates the importance of specific projects and the direct benefits** (e.g. through GSS activities) so as to enhance their epidemiological capacity in the field and their preparedness of implementing burden studies.

The **Joint Statement of Support** from the Consultation participants demonstrates the need for this Initiative and appreciation of WHO's leadership role. WHO is now working on implementation of the strategy and recommendations.

8

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Appendix 2- Agenda

WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases Geneva, 25–27 September 2006

Monday, 25 September 2006

- | | |
|-----------|---|
| 8:30-9:00 | Registration |
| 9:00-9:15 | Welcome
Dr David Heymann
Assistant Director-General, a.i., Communicable Diseases |
| 9:15-9:20 | Election of Chairperson and Rapporteur |
| 9:20-9:45 | Introduction
Claudia Stein <ul style="list-style-type: none">• Purpose and objectives of the meeting• Expected outcomes and products• The Global Burden of Foodborne Diseases Initiative - summary of approaches to date |

Session 1

MAPPING THE GLOBAL BURDEN OF FOODBORNE DISEASES

- | | |
|-------------|--|
| 9:45-10:10 | WHO's Global Burden of Disease (GBD) Study

Rationale, methods and status
Colin Mathers
Discussion |
| 10:10-10:35 | International collaboration on Enteric Burden of Illness Studies

Network, methods and results to date
Elaine Scallan
Discussion |
| 10:35-11:00 | Coffee break |
| 11:00-11:35 | Global burden of <i>salmonella</i> , <i>shigella</i> and <i>typhoid</i>

Rationale, methods and status
Jennie Musto
Discussion |
| 11:35-12:15 | Global burden of diarrhoeal diseases in children

Rationale, methods and status
Claudio Lanata
Discussion |

- 12:15-13:30 Lunch
- 13:30-14:10 Global burden of unsafe water, sanitation and hygiene
 Rationale, methods and status
 David Kay
 Discussion
- 14:10-14:50 Foodborne neglected tropical diseases and zoonoses
 Rationale, methods and status
 Sarah Cleaveland, Paul Torgerson and François-Xavier Meslin
 Discussion
- 14:50-15:30 Burden of foodborne chemicals
 Overview
 Herman Gibb
 Discussion
- 15:30-15:50 Coffee break

Session 2

TOWARDS A GLOBAL STRATEGY FOR ESTIMATING THE GLOBAL BURDEN OF FOODBORNE DISEASE

- 15:50-16:00 Introduction to group work - Part 1
 Claudia Stein
- 16:00-18:00 Group work 1 - Part 1

Tuesday, 26 September 2006

- 8:30-9:45 Reports from working groups
 Presentation of reports
 Discussion
- 9:45-10:30 Global Burden of Foodborne Diseases Initiative: Strategy
 Charting the "evidence map", identifying collaborators and next steps
- 10:30-11:00 Coffee break

Session 3

NATIONAL BURDEN OF FOODBORNE DISEASE PROTOCOLS

- 11:00-11:40 National burden of disease studies - country protocols
 National burden of disease manual and World Health Surveys
 Colin Mathers
 Discussion
- 11:40-12:00 WHO strategy for burden of foodborne disease studies
 Martyn Kirk
- 12:00-12:40 National burden of foodborne disease studies - current country protocols
 Elaine Scallan
 Discussion

- 12:40-14:00 Lunch
- 14:00-14:35 National burden of foodborne disease studies - the Jordan Burden of Illness Study
Neyla Gargouri Darwaza
Discussion
- 14:35-15:10 National burden of disease study - chemical causes
Rolaf van Leeuwen
Discussion
- 15:10-15:20 National burden of foodborne disease studies and a WHO strategy
- Introduction to group work - Part 2
Claudia Stein
- 15:20-15:45 Coffee break
- 15:45-18:00 Group work - Part 2

Wednesday, 27 September 2006

- 8:30-10:00 Reports from working groups
- Presentation or reports
Discussion
- 10:00-10:30 Coffee break
- 10:30-11:00 Burden of foodborne disease strategy and country protocols
- Discussion of working group reports
Strategic way forward and action points
Agreement on country protocols

Session 4

ACTION PLAN ON FOODBORNE DISEASE STRATEGY AND PROTOCOLS

- 11:00-11:45 Wrap-up - Strategy for Burden of Foodborne Disease Initiative
- Summary of all sessions 1-3 (Secretariat)
Next steps (report, core burden reference group, etc.)
- 11:45-13:00 Lunch
- 13:00-18:00 Special workshop on WHO Global Salm-Surv regional sites (for relevant collaborators, invited participants and SDE/FOS staff only)
- 13:00-18:00 GSS workshops
- Variable coffee breaks for groups

