

# WHO Initiative to Estimate the Global Burden of Foodborne Diseases

**First formal meeting of the Foodborne Disease  
Burden Epidemiology Reference Group (FERG)**

*Implementing Strategy, Setting Priorities and Assigning the Tasks*



Geneva, 26–28 November 2007



**World Health  
Organization**

Front cover photo: *Food producers play an important role in food safety (Meat hung out to dry in the sun, Ratanakiri, Cambodia)*  
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Department of Food Safety, Zoonoses, and Foodborne Diseases  
Health Security and Environment

[http://www.who.int/foodsafety/publications/foodborne\\_disease/burden\\_nov07/en](http://www.who.int/foodsafety/publications/foodborne_disease/burden_nov07/en)



**World Health  
Organization**

## **WHO Library Cataloguing-in-Publication Data**

First formal meeting of the Foodborne Disease Burden Epidemiology Reference Group (FERG) : implementing strategy, setting priorities and assigning the tasks.

1.Food contamination. 2.Food poisoning - epidemiology. 3.Cost of illness. 4.Food hygiene - economics. 5.Food parasitology. I.World Health Organization. Dept. of Food Safety, Zoonoses and Foodborne Diseases. II.WHO Initiative to Estimate the Global Burden of Foodborne Diseases.

ISBN 978 92 4 159676 3

(NLM classification: WA 701)

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Printed in France



## Acknowledgements

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The Department of Food Safety, Zoonoses and Foodborne Diseases (FOS), World Health Organization (WHO), Geneva, Switzerland, wishes to express its sincere thanks to all those who contributed towards the success of this meeting.

First and foremost we wish to thank all participants for their valuable technical input and their collegiality during the meeting. We are particularly grateful to Professor Arie Havelaar for his leadership and outstanding chairmanship of the FERG at its first meeting, and Dr Olga Henao and Dr Enrique Perez Gutiérrez for their diligent and excellent rapporteuring.

We also wish to express our sincere gratitude to the Ministry of Health, Welfare and Sports of The Netherlands, and the Centers for Disease Control and Prevention (CDC), Atlanta, USA, for their generous financial support to this Initiative and meeting.

This report can be downloaded in electronic format from the following site:  
[http://www.who.int/foodsafety/foodborne\\_disease/ferg/en/index.html](http://www.who.int/foodsafety/foodborne_disease/ferg/en/index.html)



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## List of Acronyms

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<b>ADG</b>	Assistant Director-General
<b>AGI</b>	Acute gastroenteritis
<b>BOD</b>	Burden of Disease
<b>BRAFO</b>	Benefit-Risk Analysis of Foods
<b>BSE</b>	Bovine Spongiform Encephalopathy
<b>CDC</b>	Centers for Disease Control and Prevention (USA)
<b>CSPI</b>	Center for Science in the Public Interest
<b>DALY</b>	Disability-Adjusted Life Year(s)
<b>DDT</b>	Dichloro-Diphenyl-Trichloroethane
<b>DG</b>	Director-General
<b>DSP</b>	Toxins associated with <i>Dinophysis spp.</i> and <i>Prorocentrum spp.</i>
<b>EAggEC</b>	Enterogaagervative <i>E. coli</i>
<b>ECDC</b>	European Centre for Disease Prevention and Control
<b>EPEC</b>	Enteropathogenic <i>E. coli</i>
<b>ETEC</b>	Enterotoxigenic <i>E. coli</i>
<b>ETPGAH</b>	European Technology Platform for Global Animal Health
<b>EU</b>	European Union
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FBD</b>	Foodborne diseases
<b>FERG</b>	Foodborne Disease Burden Epidemiology Reference Group
<b>FERG 1</b>	First formal meeting of the FERG (November 2007)
<b>FERG 2</b>	Second formal meeting of the FERG (November 2008)
<b>FOS</b>	Department of Food Safety, Zoonoses and Foodborne Diseases
<b>FOSIE</b>	Food Safety in Europe
<b>GBD</b>	Global Burden of Disease
<b>GIS</b>	Geographical Information Systems
<b>GSS</b>	Global Salm-Surv
<b>HSE</b>	Health Security and the Environment
<b>IAFoST</b>	International Academy of Food Science and Technology
<b>IARC</b>	International Agency for Research on Cancer
<b>ICD</b>	International Classification of Diseases
<b>ICEBOIS</b>	International Collaboration on Enteric Burden of Illness Studies
<b>IFAH</b>	International Federation for Animal Health
<b>IHME</b>	Institute for Health Metrics and Evaluation
<b>ILSI</b>	International Life Sciences Institute
<b>IUFoST</b>	International Union of Food Science and Technology
<b>MDG</b>	Millennium Development Goal(s)
<b>NGO</b>	Non-Governmental Organization(s)





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<b>NIH</b>	National Institutes for Health (USA)
<b>OIE</b>	World Organisation for Animal Health
<b>PAH</b>	Polycyclic Aromatic Hydrocarbons
<b>PAHO</b>	Pan American Health Organization
<b>PCB</b>	Polychlorinated Biphenyls
<b>PSP</b>	Paralytic Shellfish Poisoning
<b>RIVM</b>	National Institute for Public Health and the Environment of The Netherlands
<b>STEC</b>	Shiga-toxin producing <i>E. coli</i>
<b>TF</b>	Task Force(s)
<b>UN</b>	United Nations
<b>UNEP</b>	United Nations Environment Programme
<b>USA</b>	United States of America
<b>USDA</b>	United States Department of Agriculture
<b>USFDA</b>	United States Food and Drug Administration
<b>vCJD</b>	Variant Creutzfeldt-Jakob Disease
<b>VR</b>	Vital Registration
<b>WHO</b>	World Health Organization
<b>WP</b>	Work Package(s)
<b>YLL</b>	Year(s) of Life Lost
<b>YLD</b>	Year(s) Lived with Disability



## Executive summary

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Foodborne diseases (FBD) are an important cause of morbidity and mortality worldwide but the full extent and cost of unsafe food, and especially the burden arising from chemical and parasitic contaminants in food, is currently still unknown. Precise information on the burden of FBD is, however, needed to adequately inform policy-makers and allocate appropriate resources for food safety control and intervention efforts.

In September 2006, the Department of Food Safety Zoonoses and Foodborne Diseases (FOS) at the World Health Organization (WHO) therefore launched the Initiative to Estimate the Global Burden of Foodborne Diseases at an international consultation attended by over 50 international experts. This consultation provided the strategic framework for the assessment of FBD burden and mandated WHO to establish a Foodborne Disease Burden Epidemiology Reference Group (FERG) which engages in:

- Assembling, appraising and reporting on currently existing burden of foodborne disease estimates;
- Conducting epidemiological reviews for mortality, morbidity and disability in each of the major FBD;
- Providing models for the estimation of FBD burden where data are lacking;
- Developing cause and source attribution models to estimate the proportion of diseases that are foodborne, and
- Developing user-friendly tools for burden of FBD studies at country level.

Following a public call for advisers in the scientific press the WHO Director-General (DG) appointed the FERG members who met for the first time in November 2007. This multi-disciplinary meeting - which is the subject of this report - commenced with a stakeholder consultation that informed the technical discussions of FERG. The meeting saw the establishment of the FERG Core or Steering Group (coordinating and overseeing the burden work) as well as several thematic Task Forces (TF) which advance the work in specific areas, including:

- Parasitic diseases;
- Chemicals and Toxins; and
- Enteric diseases.

In their respective areas, the TF provided (a) priority lists of causative agents for which burden assessments should be conducted, (b) developed concrete and very detailed workplans to commission the individual burden work, and (c) agreed on the logistic and technical steps to be taken by the FERG over the next year. The execution of the plan rests now with the WHO Secretariat; it will lead to a first set of preliminary burden of disease estimates in the area of diarrhoeal diseases, and some parasitic and chemical causes of FBD for the next FERG meeting in November 2008.



# 1

## Introduction

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The meeting was opened by Dr David Heymann, Assistant Director-General (ADG), Health Security and the Environment (HSE) of the World Health Organization (WHO).

Dr Claudia Stein welcomed participants on behalf of WHO's Department of Food Safety, Zoonoses and Foodborne Diseases (FOS), presented the draft agenda for the meeting, and explained procedural issues and the roles of the participants for the meeting.

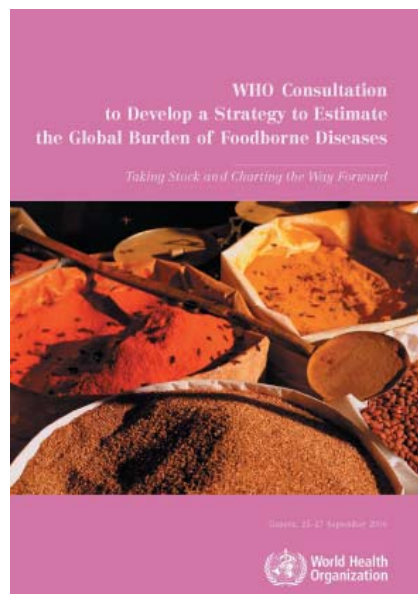
The FERG Core (or Steering) Group membership was proposed and approved. The members and their areas of expertise are Professor Arie Havelaar (Burden of Disease), Professor Nilanthi de Silva (Parasitic Diseases), Dr Fred Angulo (Enteric Diseases), Professor David Bellinger (Chemicals & Toxins), and Dr Tine Hald (Source Attribution). The Food and Agricultural Organization of the United Nations (FAO) is a member of the Core Group.

Professor Arie Havelaar, of the National Institute for Public Health and the Environment (RIVM) of The Netherlands, and Professor Nilanthi de Silva, of the University of Kelaniya, Sri Lanka, were elected as Chair and Vice-Chair, respectively. Dr Olga Henao, of the Centers for Disease Control and Prevention (CDC) of the United States of America, was elected as Rapporteur.

## 2

## Meeting objectives

This first formal meeting of the FERG (FERG 1) was convened following the recommendations of a WHO consultation held in September 2006, which developed a Strategy to Estimate the Global Burden of Foodborne Diseases<sup>1</sup> (Figure 1).



The 2006 consultation provided the *strategic framework* for the assessment of burden of foodborne diseases as well as a *time frame* outlining the necessary activities. One of the major recommendations was to mandate WHO to establish the Foodborne Disease Burden Epidemiology Reference Group (FERG) to take the strategy forward. This recommendation was effected by WHO in 2007 and is the subject of this report.

**Figure 1: WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases**

[http://whqlibdoc.who.int/publications/2007/9789241595292\\_eng.pdf](http://whqlibdoc.who.int/publications/2007/9789241595292_eng.pdf)

The FERG 1 meeting reported on in this document was convened with the following objectives:

- Formally approve the membership of the group and its Task Forces, as well as elect the Core (or Steering) Group for the FERG;
- Formally approve the working procedures of FERG;
- Agree on a priority list of causative agents (parasitic, chemical and microbiological) for which burden of disease should be assessed;
- Provide detailed workplans to execute the burden of disease assessments for the priority causes;
- Agree on a time frame and next steps for the group.

<sup>1</sup> WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases. WHO, Geneva, 2007.



# 3

## Background

### 3.1 Rationale for the WHO Initiative

Foodborne diseases result from the ingestion of contaminated foods and food products and include a broad group of illnesses caused by parasites, chemicals and pathogens which contaminate food at different points in the food production and preparation process. Globally, increases in the incidence of foodborne illnesses continue to be reported, often associated with outbreaks and food contamination that raise international concern. These reports, however, are largely ad hoc and data from developing countries where populations are particularly exposed to contaminated environments, are scarce. In the absence of a systematic and comprehensive global assessment, the true burden of foodborne diseases remains unclear.

#### *Foodborne diseases threaten global public health security*

Growing international trade, migration and travel increase the spread of dangerous pathogens and contaminants in food. In today's interconnected and interdependent world, local foodborne disease outbreaks have become a potential threat to the entire globe. In 1991, cholera which was thought to have originated from contaminated seafood harvested off the coast of Peru, rapidly spread across Latin America resulting in approximately 400 000 reported cases and more than 4000 deaths in several countries<sup>2</sup>.

Through the globalization of food marketing and distribution, both accidentally and deliberately contaminated food products can affect the health of people in numerous countries at the same time. The identification of one single contaminated food ingredient can lead to the recall of tonnes of food products, to considerable economic losses in production and from trade embargoes, as well as damage to the tourist industry. In early 2008, an outbreak of avian influenza in Bangalore, India, led to an import ban of Indian poultry products in the Middle East, resulting in losses totalling hundreds of thousands of US Dollars to the Indian economy<sup>3</sup>.

Foodborne diseases cannot only spread faster, they appear to be emerging more rapidly than ever before and are able to circumvent conventional control measures. The growing industrialization of food production catalyses the appearance and spread of new or antibiotic-resistant pathogens, as was the case for prions associated with bovine spongiform encephalopathy (BSE) and leading to new variant Creutzfeldt-Jakob disease (vCJD) in humans in the United Kingdom during the 1990s.

Rapid detection and detailed knowledge of foodborne disease burden will reduce the risk of spread of disease and demonstrate the real impact of unsafe food on economic growth and development.

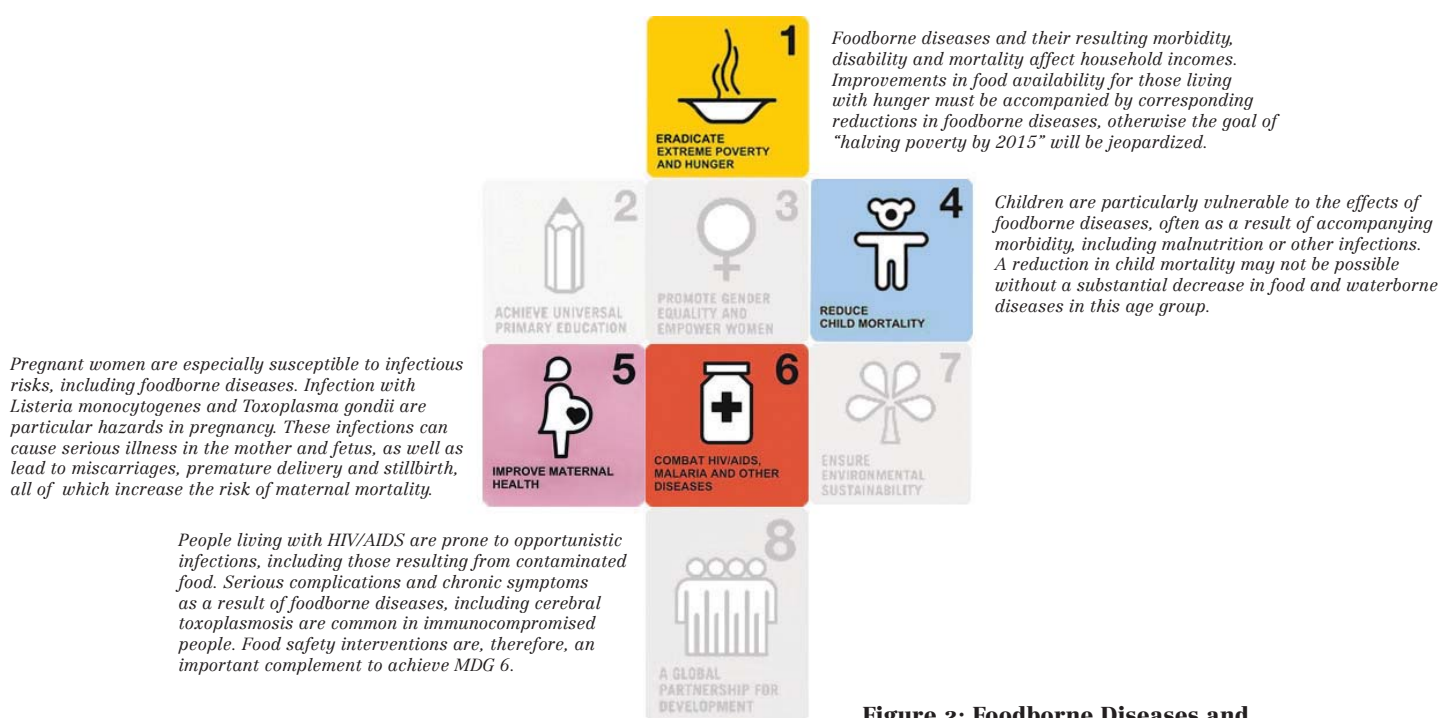
<sup>2</sup> Cholera in the Americas. *Epidemiological Bulletin of the Pan American Health Organization*, 1995, 16 (2) [http://www.paho.org/english/sha/epibul\\_95-98/be952choleraam.htm](http://www.paho.org/english/sha/epibul_95-98/be952choleraam.htm), accessed 11 April 2007).

<sup>3</sup> INFOSAN communication dated 25 January 2008.

### Foodborne diseases are linked to poverty and development

The achievement of the internationally agreed Millennium Development Goals (MDG), including the overarching goal of poverty reduction, will in part depend on a successful reduction of the burden of foodborne diseases, particularly among vulnerable groups as illustrated in Figure 2.

Without reliable information on disease burden, policy-makers cannot assess the effectiveness of their investment in foodborne disease prevention and control, nor reduce the burden of foodborne diseases. Without the latter, however, international efforts to achieve the MDG will be jeopardized, especially those goals relating to children and the poor.



**Figure 2: Foodborne Diseases and the Millennium Development Goals (MDG)**

### 3.2 WHO Strategy to Estimate the Global Burden of Foodborne Diseases

In September 2006, WHO convened a group of international scientists at the “WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Disease”<sup>4</sup>. The consultation provided the strategic framework for the assessment of burden of foodborne diseases, including a roadmap for assembling existing information on the disease burden and a time frame outlining the individual strategic activities. The consultation marked the formal launch of the Initiative to Estimate the Global Burden of Foodborne Diseases from all major causes using summary health metrics that combine morbidity, mortality and disability in the form of the Disability Adjusted Life Year (DALY).

<sup>4</sup> WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases. WHO, Geneva, 2007.



### Textbox 1 - The Global Burden of Disease 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 coexisting 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 Global Burden of Disease (GBD) Study<sup>a</sup> approach 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 multiple 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.

<sup>a</sup>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.

The WHO officially adopted the Burden of Disease and DALY approach for reporting on health information in the late 1990s (Textbox 1). Soon individual technical units and programmes within WHO used and further developed the method and built collaborations with external experts to publish disease burden estimates. The Initiative described in this report is one of the most recent examples in this area.

### *The Foodborne Disease Burden Epidemiology Reference Group (FERG)*

One of the major recommendations of the 2006 consultation was the establishment of the Foodborne Disease Burden Epidemiology Reference Group (FERG) which is charged with implementing the recommendations of the consultation and estimating the global burden of foodborne diseases. Following a public call for advisers in the scientific press and a transparent selection process, the WHO Director-General (DG) appointed the FERG members from a large pool of applicants.

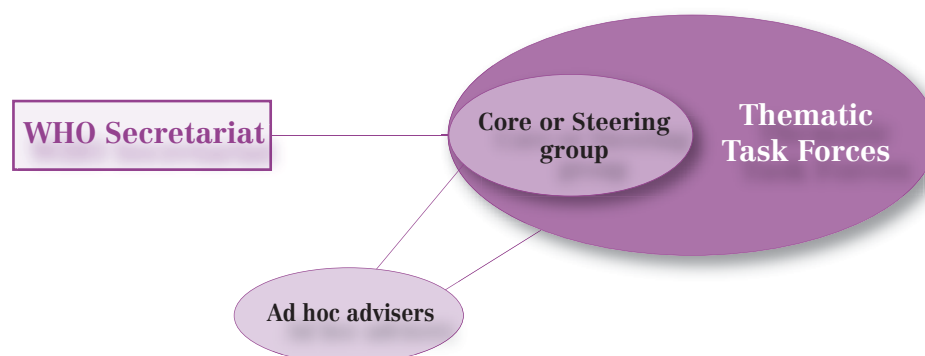
The members of the FERG engage in:

- Assembling, appraising and reporting on currently existing burden of foodborne disease estimates;
- Conducting epidemiological reviews for mortality, morbidity and disability in each of the major FBD;
- Providing models for the estimation of FBD burden where data are lacking;
- Developing cause and source attribution models to estimate the proportion of diseases that are foodborne; and
- Developing user-friendly tools for burden of FBD studies at country level.

Due to the multi-factorial nature of foodborne diseases, the FERG is highly multidisciplinary and includes a large number of members. It operates through a Core (or Steering) Group as well as a number of different Task Forces (Figure 3).



**Figure 3: Composition and structure of the Foodborne Disease Burden Epidemiology Reference Group (FERG)**



The Core Group functions as a steering committee and consists of scientists from each of the areas outlined in the Task Forces. It is charged with monitoring and appraising the technical and epidemiological work of all Task Forces. The Core Group is chaired by a scientist with extensive international experience in both foodborne diseases and burden of disease methodology. Additional external experts can be called upon to join the FERG on an ad hoc basis to supplement the skills required.

FERG Task Forces are the executing arm of the FERG and conduct burden of disease work in the following areas:

- Task Force 1: Infectious Diseases (sub-groups on enteric & parasitic diseases)
- Task Force 2: Chemicals and Toxins
- Task Force 3: Source Attribution
- Task Force 4: Country Burden of Disease Protocols

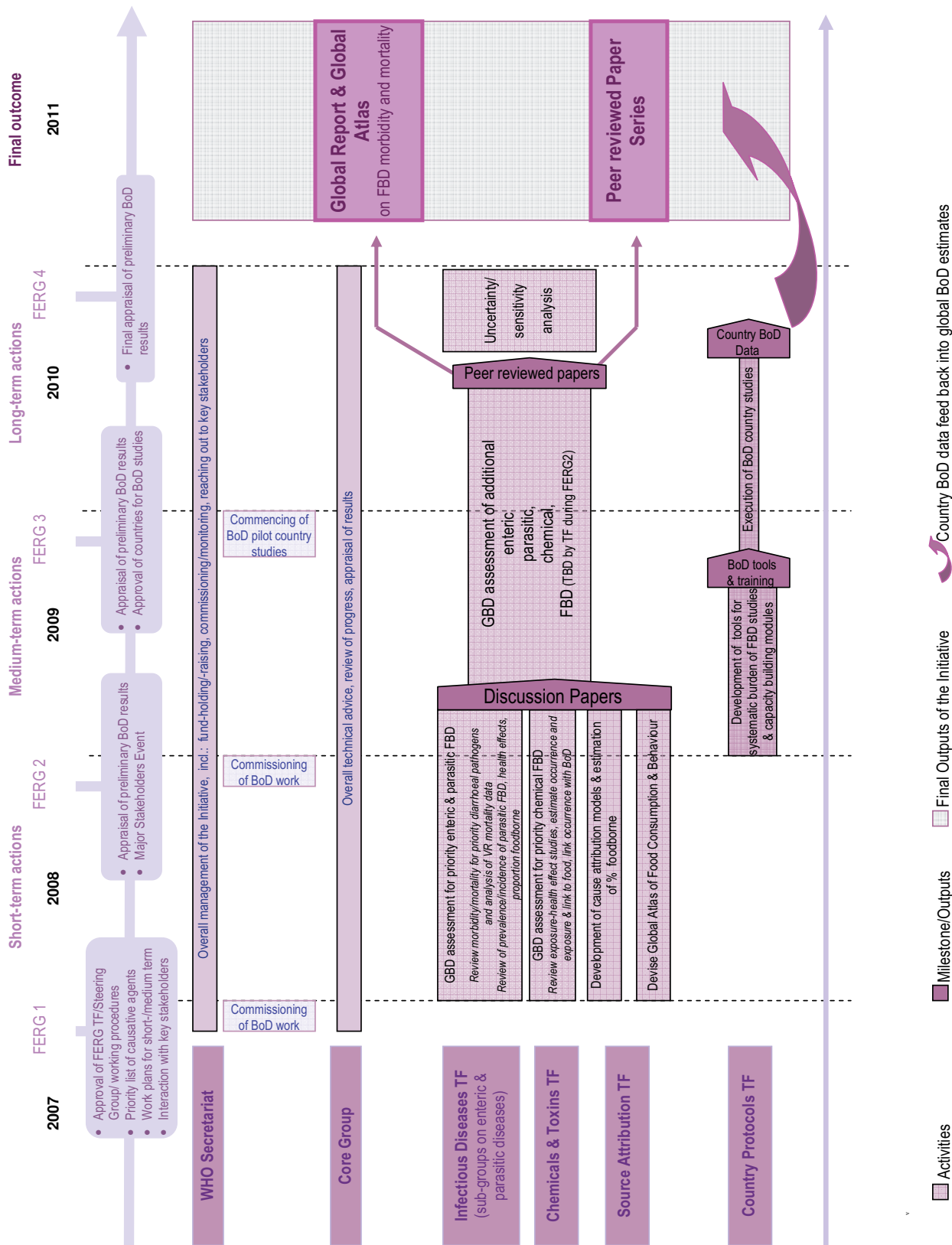
The Task Force on 'Source Attribution' is charged with identifying the proportion of disease burden that is directly due to food contamination and will aim to isolate the specific food sources responsible. A specific Task Force on Country Burden of Disease protocols will develop user-friendly tools for countries to conduct their own burden of foodborne disease studies thus enabling them to monitor progress of their food safety interventions.

The Secretariat carries out a logistic, administrative and technical support function and is composed of staff from eight areas of work within WHO.

The FERG is following the strategic framework developed in 2006 (Figure 4) and is expected to provide a Global Report and Atlas on the Burden of Foodborne Diseases as well as a series of journal papers. These products will be peer-reviewed by scientists outside FERG to ensure highest quality and policy impact.



Figure 4: Strategic framework for the Initiative to Estimate the Global Burden of Foodborne Diseases



A detailed communication strategy has been developed that covers internal and external information sharing, mechanisms for accountability as well as all aspects of advocacy for FERG. Accordingly, key stakeholders (including consumer groups, NGOs, donors and industry) were invited to provide input at the first formal meeting of FERG summarized in this report. A more comprehensive dedicated stakeholder meeting is planned for November 2008. Internally, timely feedback is provided via face to face meetings, regular teleconferences, mailings and the FERG SharePoint. External bi-directional communication continues between FERG/WHO Secretariat and the stakeholder community. This communication increases the global visibility and profile of the Initiative, creates a positive perception, solicits international commitment and technical/financial support and raises awareness of FBD as a major public health and development issue.

### *Alliances and partnerships of the Initiative to Estimate the Global Burden of FBD*

The Initiative relies on an alliance of collaborators and partners who provide financial support, technical expertise, information sharing platforms and/or networking possibilities. Collaborating partners include agencies of the United Nations (UN) and other international organizations, governmental and non-governmental agencies, academia, consumer groups and industry (Textbox 2).

#### **Textbox 2 - Alliances and partners of the Initiative to Estimate the Global Burden of FBD**

The WHO has made a major resource investment in the FBD Burden Initiative but is nevertheless reliant on the collaboration and support of an alliance of partners. The Centers for Disease Control and Prevention (CDC), Atlanta, USA, have supported the Initiative from its inception financially, and through technical expertise and its networking capacity. The Ministry of Health, Welfare and Sport of The Netherlands, as well as the Japanese Ministry of Health, Labour and Welfare have both provided sizeable funding, while the Department of Health of the United Kingdom has made an in-kind contribution through a secondment of an experienced staff member to the Initiative.

Technical partners of the FERG comprise agencies of the United Nations (UN) and other international organizations, governmental and non-governmental agencies, academia, consumer groups and industry:

- Numerous departments and areas of work within WHO which form the Secretariat and include the areas of child health, environmental health, neglected tropical diseases, vaccines and immunization, health information and statistics, and nutrition, among others.
- UN Organizations and Programmes: the Food and Agricultural Organization of the United Nations (FAO), the United Nations Environment Programme (UNEP) - Chemicals, the International Agency for Research on Cancer (IARC) and the World Bank.
- Other international organizations: the European Centre for Disease Prevention and Control (ECDC), the World Organisation for Animal Health (OIE), and the European Union (EU).
- Governmental organizations (in addition to those listed above): The Dutch National Institute for Public Health and the Environment (RIVM), the Australian Department of Health and Ageing, the China Centers for Disease Control and Prevention (China CDC), the Public Health Agency of Canada, the US Department of Agriculture (USDA), the US Food and Drugs Administration (US FDA), the US National Institutes of Health (NIH), the National Institute for Communicable Diseases, South Africa, the Danish National Food Institute, and the French National Institute for Agricultural Research.
- Academic institutions from all WHO regions are collaborating either through their direct expertise in FERG membership or ad hoc technical input, including the Institute for Health Metrics and Evaluation (IHME) at the University of Washington, Seattle, Harvard Medical School, the Johns Hopkins University (all United States); Mahidol University, Bangkok, Thailand; Makerere University, Kampala, Uganda; the University of Kelaniya, Sri Lanka; the Nutritional Research Institute, Lima, Peru; Wageningen University, The Netherlands; the Australian National University, Canberra; the University of Zurich, Switzerland; and the University of Copenhagen, Denmark.
- Technical networks: WHO Global Salm-Surv, the International Collaboration on Enteric Burden of Illness Studies, and the EU-led Med-Vet-Net.
- Stakeholders from consumer groups, non-governmental organizations and industry who provide feedback to the FERG (expanded upon in Textbox 5).



WHO has, and continues to bring together, an alliance of funding agencies and in-kind supporters for FERG, thus ensuring that no individual institution, foundation or government may exert undue influence on this Initiative. Although WHO continues to make considerable financial investments in FERG, the Organization is currently discussing additional funding options with a number of governmental and non-governmental donors as it will require approximately US\$ 6 million over 5 years to complete the work.

**Figure 5: International alliances and partnerships will make our food safer**



# 4

## Deliberations and outputs of the first meeting of the FERG

This report summarizes the deliberations, results, recommendations and products arising from the first meeting of the FERG held on 26–28 November 2007 at WHO headquarters in Geneva, Switzerland.

### 4.1 Meeting participants

Present at this meeting were the members of the Core Group of the FERG, FERG members appointed by the Director-General (DG) for the thematic Task Forces of FERG, resource experts serving in the capacity of ad hoc technical advisers, observers, stakeholders, and the WHO Secretariat. (See Textbox 3 for roles of participants). The full list of participants is available in Appendix A.

#### Textbox 3 - FERG membership and roles

##### FERG members

- Formally appointed by the WHO Director-General (DG), following selection procedure
- Allocation to Core Group and Task Forces
- Full participation in all technical discussions

##### Resource/ad hoc advisers

- Not formally appointed by the DG
- Allocation to Task Forces on ad hoc basis (as required)
- Full participation in technical discussions

##### WHO Secretariat and other UN Organizations

- Full participation in technical discussions
- Allocation to Task Forces on ad hoc basis

##### Observers

- Nominated by FERG members (one per member)
- No 'formal' right of intervention in plenary
- Participation in Task Forces, as appropriate

##### Stakeholders

- Invited by WHO to designated sessions
- Formal right of intervention in designated sessions
- No participation in technical discussions to avoid conflicts of interest

The meeting objectives (elaborated on above) were to initiate efforts to assemble, appraise and report on currently existing burden of foodborne disease estimates. This required: 1) the development of a list of priority causes of parasitic, chemical and enteric agents of interest; 2) the identification of research and study priorities with selection of specific tasks to be completed and 3) the determination of the time line for completion of such tasks.



## 4.2 Definitions, principles and preliminary considerations for FERG

### 4.2.1 Definition of Burden of Disease

The term 'Burden of Disease' is widely used to describe a variety of efforts quantifying health outcomes. The description of 'burden' in the context of this Initiative follows the principles of the Global Burden of Disease Study (Textbox 1), and includes the quantification of morbidity, all disabling complications as well as mortality in a single summary measure (DALY). The information obtained to construct this summary measure can be used to describe disease and/or syndrome occurrence, distribution of causative agents, magnitude of risk factors and economic or cost burden.

### 4.2.2 Definition of foodborne diseases

Foodborne diseases (FBD) can be defined as those conditions that are commonly transmitted through ingested food. FBD comprise a broad group of illnesses caused by enteric pathogens, parasites, chemical contaminants and biotoxins. Two methodological approaches for foodborne disease burden estimation exist. Firstly, the etiologic agent (or risk assessment) approach which commences with the exposure and identifies the exposure levels of agents commonly transmitted through food, which is followed by determining the proportion that is foodborne. Secondly, the syndromic (or epidemiological) approach, which commences with the outcome and estimates incidence of disease syndromes (e.g. gastroenteritis or chemically-induced anaphylaxis), followed by attributing a proportion to foodborne agents. A comprehensive burden of disease assessment will require a **combination of both approaches**. In this meeting, the FERG Task Forces therefore **prioritized the list of causative agents and syndromes** to be considered in the burden estimation (detailed information provided under 4.5, page 21).

#### Textbox 4 - Example of standard case definition for acute gastroenteritis<sup>a</sup>

Potential standard definition for gastroenteritis:

- Individuals who report three or more loose stools, or any vomiting, in 24 hours;
- But excluding<sup>b</sup> those:
  - with cancer of the bowel, irritable bowel syndrome, Crohn's disease, ulcerative colitis, cystic fibrosis, coeliac disease or another chronic illness with symptoms of diarrhoea or vomiting;
  - who report their symptoms were due to drugs, alcohol or pregnancy.

Minimum results to be reported:

- Incidence per person-year, with 95% confidence interval;
- Incidence per-person-year in males and females;
- Mean age of cases;
- Mean duration of illness<sup>c</sup>;
- % of cases with bloody diarrhoea;
- % of cases who saw a physician;
- % of cases who submitted a stool sample for testing;
- % of cases with respiratory symptoms (coughing, sneezing, sore throat, runny nose);
- % of cases who had symptoms at the time of data collection (for retrospective studies).

<sup>a</sup>Majowicz SE, Hall G, Scallan E, Adak GK, Gauci C, Jones TF, O'Brien S, Henao O, Sockett PN; for the International Collaboration on Enteric Disease Burden of Illness Studies. A common, symptom-based case definition for gastroenteritis. *Epidemiol Infect.* 2007 Aug 9; 1-9.

<sup>b</sup>Individuals meeting the exclusion criteria should be retained in the non-case group.

<sup>c</sup>Mean duration calculated by averaging the duration of illness for all cases, regardless of whether they are still ongoing at the time of data collection (for retrospective studies).





Figure 6: Fascioliasis life-cycle

One of the most common syndromes to be studied in the context of foodborne disease burden is acute gastroenteritis (AGI). Many countries have conducted such studies but definitions vary to such an extent that they impact on incidence. An analysis of data from the United States has shown considerable variation in incidence of acute gastroenteritis when alternative case definitions used in other countries have been applied<sup>5</sup>. The **FERG** highlighted the need to consider the **use of a standard case definition of acute gastroenteritis (AGI)** in burden estimation, such as the one proposed by Majowicz et al. (Textbox 4). It also discussed the importance of including mucus in stool as part of the case definition.

#### 4.2.3 Determination of proportion of burden that is foodborne

Human illness attribution can be defined as the partitioning of the burden of human illness to specific sources. It can be conducted at various points along the food distribution chain, including at the animal reservoir and at the point of consumption (point-of-exposure). Human illness source attribution is increasingly used to support risk management strategies. The choice of method used for attribution largely depends on the risk management questions and availability of data, with combined approaches normally increasing confidence in the results.

The delineation of diseases caused by contaminated food from those arising from other sources, including drinking water and person-to-person spread is problematic. The **FERG** agreed that while its **remit is restricted to estimating disease burden from food contamination** it must engage in discussion with groups dealing with alternative contamination sources, including water and sanitation. The **burden of disease arising from deliberate contamination of food** (including terrorist activity) is likely to be low, and will **not be estimated by FERG as a first priority**.

Different methods exist for the determination of the proportion of disease that is foodborne. The choice of method to be applied depends to a large extent on the causative agent (which could be a pathogen or chemical) and the exact question(s) to be answered. For pathogens, current methods used to determine the proportion that is foodborne include use of outbreak data, results from case-control studies of sporadic infection and expert opinion. Each of these methods has inherent limitations. Outbreak data can be influenced by the bias in detection and reporting, and by the pathogen involved in the outbreak (i.e. differences in reporting of pathogens that are always considered foodborne versus those that may be but are not predominantly foodborne). Moreover, some pathogens may cause sporadic infections but few outbreaks (e.g. *Yersinia enterocolitica*). Limitations of case-control studies of sporadic infections include difficulties in recalling all exposures prior to interview, while expert opinion can be subjective.

<sup>5</sup> Majowicz SE, Hall G, Scallan E, Adak GK, Gauci C, Jones TF, O'Brien S, Henao O, Sockett PN; for the International Collaboration on Enteric Disease Burden of Illness Studies. A common, symptom-based case definition for gastroenteritis. *Epidemiol Infect.* 2007 Aug 9::1-9.





Source attribution methods have been effectively applied in Denmark<sup>6</sup> and The Netherlands<sup>7</sup> for identifying sources of human salmonellosis for the last 15 years. Source attribution can identify the most important reservoirs for a pathogen of interest and to set priorities to focus control strategies. Microbial source attribution can also be used to evaluate the effect of implemented control strategies. However this method requires regular monitoring of all important sources and typing of thousands of isolates annually.

Attribution at the exposure level can use data from comparative exposure assessments, from outbreaks and from case-control studies. Data from comparative exposure assessment have inherent variation but allow for the attribution of human illness to source(s) of exposure while taking into account different transmission routes. Data from case-control studies of sporadic infections have their limitations in that the importance of frequent exposures may be underestimated. Another source of exposure data is from outbreaks and for many pathogens and/or countries it is the only method available. A limitation of outbreak data is that information will be lacking for pathogens that may be high in incidence but do not result in many documented outbreaks (e.g. *Campylobacter* in developed countries).

Attribution for chemical exposures can be determined if both the amounts and frequency of foods and beverages consumed and the levels of contaminants in those foods are known. The challenges in doing so are, however, considerable. The consumption of different food items and the amount consumed varies across age, ethnic background and external conditions, including famines (e.g. improperly processed cassava is more commonly consumed when food is scarce). Moreover, concentrations of the chemicals/toxins also vary within food groups (e.g. the concentration of methylmercury varies according to the type of fish consumed). The source attribution strategies employed in the area of chemicals will therefore differ for the evaluation of acute and long-term exposures. Important data sources for these assessments will include the availability of market basket surveys, age-specific food consumption surveys and biomarker data.

**Synergy and integration of attribution methods should be sought in order to improve the confidence in the results.** Efforts should be made to blend the data when appropriate from sporadic case-control studies, case-control studies with microbial subtyping data and microbial data with exposure assessment information. Such efforts require collaboration between experts in the whole food production chain, especially between natural scientists and epidemiologists across veterinary and public health borders and between risk assessors and risk managers.

#### Summary points: Principles, definitions and preliminary considerations for FERG

- o FERG burden assessments will require a combination of exposure as well as outcome based approaches
- o FERG needs to agree on a standard case definition for acute gastroenteritis in burden estimation
- o FERG remit is restricted to estimating disease burden from food contamination but will consider delineation with alternative contamination sources, including water and person-to-person spread
- o Deliberate (including terrorists') contamination of food will not be estimated by FERG as a first priority
- o Synergy and integration of source attribution methods are required to improve confidence in the results

<sup>6</sup> Hald T, Vose D, Wegener H.C, Koupeev T. A Bayesian Approach to Quantify the Contribution of Animal-Food Sources to Human Salmonellosis. *Risk Analysis*, 2004; 24, 255-269.

<sup>7</sup> Van Pelt W, Van De Giessen AW, Van Leeuwen WJ, Wannet W, Henken AM, Evers EG, et al. Oorsprong, omvang en kosten van humane salmonellose. Deel 1. Oorsprong van humane salmonellose met betrekking tot varken, rund, kip, ei en overige bronnen. [*Origin, extent and costs of human salmonellosis. Part 1. Origin of human salmonellosis in relation to pigs, cattle, chicken, eggs and other sources*]. *Infectieziekten Bulletin* 1999;10:240-3.

### 4.3 Enter the stakeholder - contributions to FERG 1

The stakeholder community of the Initiative includes all constituencies with an interest in using foodborne disease burden data for decision making, research purposes, and advocacy. These are WHO Member States, bi- and multilateral organizations, UN and other international organizations, foundations, scientific networks, research institutions (including think tanks), consumer groups, food industry, and the media.

Stakeholders and their umbrella organizations were invited to the meeting to provide insights and inputs which were considered in the technical deliberations of FERG. All stakeholders attending the meeting expressly welcomed the Initiative and provided comments on the relevance of FERG to their work, on the extent to which they wish to engage with WHO and on aspects of direct contributions to the Initiative (given their mandate and resources). Four stakeholders made detailed statements which are outlined below (for quotes see also Textbox 5).

#### Textbox 5 – Over to the stakeholders

##### International Life Sciences Institute (ILSI)

“We are pleased to note that this WHO Initiative is covering the whole area of foodborne diseases, going beyond enteric agents and including important parasitic and chemical causes”.

*Dr Nico van Belzen, Executive Director, ILSI Europe*



##### Center for Science in the Public Interest (CSPI)

“As governments and industries work together to tackle diarrhoeal diseases and to achieve other Millennium Development Goals, consumer groups have also stepped up to the challenge to contribute research and information.”

*Ms Caroline Smith de Waal, Director, Food Safety, CSPI*



##### International Union of Food Science and Technology (IUFoST)

“We appreciate the scope of this Initiative and invite FERG to draw on our wide global network of scientist and communication platforms.”

*Dr Geoffrey Campbell-Platt, President Elect, IUFoST*



##### International Federation for Animal Health (IFAH)

“Although some vaccines have been proven to be very effective - like those against Salmonella - other pathogens causing potentially high burden of disease have been neglected. FERG will be able to redress this imbalance.”

*Dr Dieter Schillinger, Chair, Food Chain Committee, IFAH*





**The International Life Sciences Institute (ILSI)** was founded in 1978 and is a non-profit international foundation seeking to promote the well-being of people worldwide through increasing understanding and resolution of scientific issues related to nutrition, food safety, toxicology, risk assessment, and the environment. By applying a “tripartite” structure ILSI brings together scientists from academia, government, and industry and aims to:

- Play a catalytic role in identifying and addressing critical scientific issues which are of mutual concern to industry, government and academia; and
- Publish and disseminate scientific information to the broadest possible audience including the scientific community, international organizations and regulatory agencies.

Dr Nico van Belzen who attended the first FERG meeting in his function as Executive Director, ILSI Europe, outlined his organization’s experience and expertise in several areas that could support FERG through technical peer review and/or data:

- Emerging foodborne pathogens and mycotoxins;
- Microbiological risk assessment;
- Chemical risk assessment (e.g. the project Food Safety in Europe: Risk Assessment of Chemicals in the Food and Diet, FOSIE, and the Threshold of Toxicological Concern project); and
- Risk/benefit analyses (e.g. the Benefit-Risk Analysis of Foods project (BRAFO)).

ILSI emphasized the need for FERG to include risk/benefit analyses in the estimation of FBD.

Since its establishment in 1971, the **Center for Science in the Public Interest (CSPI)** engages in the areas of nutrition, food safety, policy on alcohol consumption, and the promotion of sound science. As a consumer advocate and independent science-based organization, CSPI represents some 900 000 members in North America and Canada. The organization’s aims are to:

- Provide useful and objective scientific information to the public and policy-makers;
- Conduct research on food, alcohol, health, the environment, and other issues related to science and technology;
- Represent citizens’ interests before regulatory, judicial and legislative bodies on food, alcohol, health, the environment, and other issues;
- Ensure that science and technology are used for the public good; and
- Encourage scientists to engage in public-interest activities.

Ms Caroline Smith DeWaal, Director of Food Safety at CSPI, emphasized the need for accurate burden of disease information when communicating with the public, policy-makers and regulators and outlined the increasing role of consumer groups in food safety research and communication. She drew particular attention to CSPI’s widely used Outbreak Alert database which has encouraged global information sharing through the Safe Food International platform, and urged FERG to consider such databases as sources for the estimation of foodborne disease burden. Moreover, with its well established outreach to the public, policy-makers and regulators, CSPI identified itself as an important and well positioned partner in the communication and dissemination of FERG’s results.

The **International Union of Food Science and Technology (IUFoST)** is a non-profit federation of national food science organizations linking food scientists and technologists across the world. IUFoST aims to foster a global exchange of scientific knowledge and ideas in relation to the expansion, improvement, distribution and conservation of the world's food supply.

Dr Geoffrey Campbell-Platt, President Elect of IUFoST described possible ways of his organization's collaboration with FERG, including the:

- FERG participation in IUFoST's global information sharing platforms (e.g. the biennial IUFoST World Congress of Food Science and Technology, publications in IUFoST's various periodicals and information bulletins); and
- Provision of IUFoST expertise to FERG through its wide network of internationally renowned scientist, particularly through IAFoST, the International Academy of Food Science and Technology.

IUFoST drew particular attention to the need for FERG to examine toxicological concerns leading to foodborne diseases.

The **International Federation for Animal Health (IFAH)** represents manufacturers of animal health products across the world, both in developed and developing countries. IFAH's mission is to supply safe, efficient, and cost effective veterinary medicinal products to increase animal health and ensure a safe food supply.

Dr Bernd Halling, Communications Director, IFAH, and Dr Dieter Schillinger, Chair of the Food Chain Committee of IFAH Europe, stressed that the data generated by the Initiative would enable the animal health industry to better focus its research activities and investments on innovative veterinary medicines and vaccines for the purpose of preventing zoonotic FBD. The expected results of FERG were considered a valuable contribution to the European Technology Platform for Global Animal Health (ETPGAH, chaired by IFAH Europe), which aims to identify and foster a research agenda capable of promoting the development of effective tools and instruments for the control of veterinary diseases. IFAH recommended that the WHO Secretariat broadens the range of stakeholders and strengthens interaction with industrial players. The IFAH representatives offered to share both the Federation's scientific expertise (including peer-review) as well as data which may not normally be accessible to entities outside IFAH.

#### Summary points: Enter the stakeholders - contributions to FERG 1

- o All stakeholders welcomed the WHO Initiative and stressed its importance for the improvement of global food safety
- o Stakeholders appreciated their early involvement in the Initiative and offered to share technical expertise, their communication platforms and/or data with FERG
- o FERG was urged to consider data from all available sources, including those from consumer groups and data outside the public domain (taken up by FERG)
- o Stakeholders emphasized the need to consider the estimation of FBD arising from contamination with chemicals and toxins (taken up by FERG)
- o FERG was urged to consider risk-benefit analyses in their estimation of burden of disease (under discussion in FERG)



#### 4.4 Preparatory work for FERG 1

##### 4.4.1 Connecting with relevant networks

###### *International Collaboration of Enteric Burden of Illness Studies (ICEBOIS)*

The International Collaboration on Enteric Burden of Illness Studies was established in 2004 under the auspices of the World Health Organization and includes participants from over 30 countries. The main aims of the collaboration are to foster communication between people researching the burden of enteric diseases and share study designs and results. To date, the Collaboration has guided Burden of Enteric Illness Studies in several non-industrialized countries, including Jordan, Cuba and Viet Nam. The **Collaboration has joined forces with the WHO Global Burden of Foodborne Disease Initiative** since its inception in 2006 through a **sharing of information and experts.**

###### *Med-Vet-Net*

Med-Vet-Net is a Network of Excellence created in September 2004, which facilitates research in the field of food safety at the European level. The goal of the network is to foster collaboration among veterinary, medical and food sciences experts to improve research on the prevention and control of zoonoses, including foodborne diseases, while taking into account the public health concerns of consumers and other stakeholders. At present, the network comprises 10 European Union (EU) countries, with almost 300 scientists including physicians, veterinarians, epidemiologists, risk analysts, statisticians, immunologists, microbiologists, food scientists and molecular geneticists. The network operates through work packages (WP), of which WP 23 ('Prioritizing foodborne and zoonotic hazards at the EU level') is the most relevant in the context of FERG.

To achieve its goal, Med-Vet-Net has set forth the following objectives which align with the purposes of FERG:

- To agree criteria and methods for priority setting of foodborne and zoonotic hazards, including emerging and re-emerging pathogens;
- To collect and evaluate existing data on the incidence, health outcomes and costs of foodborne and zoonotic illness;
- To produce a preliminary estimate of the current disease burden and cost of illness of (selected) foodborne and zoonotic pathogens in Europe;
- To identify the major uncertainties in the data used to produce these disease estimates;
- To recommend additional studies and to prepare projects for additional funding; and
- To develop a software application for integrating, presenting and analyzing European data on disease burden and cost of illness from zoonotic pathogens; and
- To apply, compare and discuss different methods for source attribution and produce national estimates for the contribution of different sources to human salmonellosis and campylobacteriosis.

As with the ICEBOIS, **Med-Vet-Net WP 23 is partnering with the WHO Burden of Foodborne Disease Initiative through the exchange of information and scientific expertise.** This will avoid duplication and ensure synergy in the scientific activities.

### **The Institute for Health Metrics and Evaluation (IHME)**

The Institute for Health Metrics and Evaluation at the University of Washington, Seattle, USA, aims to monitor global health conditions and health systems and evaluate health interventions, initiatives, and reforms. Led by Professor Christopher Murray and funded by the Bill and Melinda Gates Foundation, a consortium consisting of the IHME, the World Health Organization, the University of Queensland, Johns Hopkins University and Harvard University is coordinating a complete revision of the GBD for the years 1990 and 2005 (GBD 2005). This effort is estimated to take at least 3 years, and aims to produce new burden of disease estimates for more than 100 diseases and injuries and more than 25 risk factors for 20 regions of the world. **FERG collaborates with the GBD efforts initiated by IHME** through both its formal WHO liaison as well as scientific advisers who serve on both initiatives.

#### **4.4.2 Mortality from potentially foodborne diseases: An analysis of vital registration data from the WHO database**

WHO accommodates the largest database of cause of death registration data in the world. Since the 1950s countries have been providing WHO with their annual cause of death data, resulting in a coverage of over 130 countries to date<sup>8</sup>. The quality and completeness of these data vary but time series are available for both developed and developing countries which permit a detailed analysis of causes classified according to the International Classification of Diseases (ICD).

A group of young statisticians supervised by Professor Julie Legler at St Olaf College, Minnesota, USA (see Textbox 6) has been charged with the analysis of cause of death data for all diarrhoeal diseases and other diseases that are potentially foodborne to describe the mortality burden. As the analysis is still ongoing, the final results are not presented here. Instead, this section describes the methods and progress to date and focuses on the limitations and potential yield of the data. The analysis includes largely infectious causes of death (Table 1), including an analysis of intestinal ulcer which may be caused by *Helicobacter pylori*.

**Table 1: Causes of death according to the ICD 10 examined in the analysis**

ICD 10 Code	Disease
A00	Cholera
A01	Typhoid/Paratyphoid fever
A02	Other salmonella infections
A03	Shigellosis
A04	Other bacterial intestinal infections (incl. <i>E. Coli</i> , <i>Campylobacter sp.</i> )
A05	Other bacterial foodborne intoxications
A06	Amoebiasis
A07	Other protozoal intestinal diseases
A08	Viral and other specified intestinal infections (Rotavirus, Norwalk, etc.)
A09	Diarrhoea and gastroenteritis of presumed infectious origin
A23	Brucellosis
A27	Leptospirosis
A32	Listeriosis
B15	Hepatitis A
B17.2	Hepatitis E
B58	Toxoplasmosis (acquired)
B66	Other fluke infections
B67	Echinococcosis
B68	Taeniasis
B69	Cysticercosis
P37	Toxoplasmosis (congenital)



The aims of this analysis were to:

1. Assess and describe the usefulness of the data for the estimation of foodborne mortality;
2. Describe foodborne disease mortality for countries where population coverage was near-complete;
3. Build a statistical model to estimate death rates for counties where data was not available; and
4. Explore and identify regional areas associated with high incidence of foodborne mortality.

In recognition of temporal time trends in diarrhoeal disease mortality (which has decreased while morbidity has remained largely unchanged) only data from the year 2000 onwards were analyzed. Of all 130 countries supplying WHO with cause of death statistics, 57 countries had covered at least 75% of their population with vital registration and a further 26 had a coverage of 60-74%. To ensure a minimum of population representativeness, only the data from such countries were entered into the analysis. Close examination of the data showed a generally high proportion of ill-defined causes of death, particularly in ICD codes relating to diarrhoeal diseases. This is an indication of misclassification and required a re-distribution across well-defined causes. Moreover, in countries where HIV/AIDS prevalence is high, deaths tended to be misclassified into other categories, particularly ill-defined diarrhoeal diseases; where this was the case, a proportion of ill-defined diarrhoeal deaths was removed according to a published protocol<sup>9</sup>.

A number of different modelling were and continue to be explored to provide estimates for countries where data are missing. These include negative-binomial regression models using explanatory variables, including health, social and economic indicators to predict mortality from potentially foodborne origins.

While further modeling is currently ongoing to predict estimates specific to the different regions of the world and final results are not expected until late 2008, the limitations of this approach are already apparent. First, there will be inherent uncertainty of the results obtained which will be described in detail. Second, as deaths caused by chemical contamination of food cannot currently be explicitly coded in the ICD, these cannot be described in this exercise, leading to a considerable underestimate of foodborne mortality. The FERG Secretariat is working actively with the relevant programme in WHO to improve the classification of foodborne diseases in the new revision of the ICD 11.

<sup>8</sup> Mathers CD, Bernard C, Moesgaard Iburg K, Inoue M, Ma Fat D, Shibuya K, Stein C, Tomijima N, Xu H *Global Burden of Disease in 2002: data sources, methods and results*. WHO, Geneva, 2004. <http://www.who.int/healthinfo/paper54.pdf>

<sup>9</sup> Chapman G, Hansen KS, Jelsma J, Ndhlovu C, Piotti B, Byskov J, Vos T. The burden of disease in Zimbabwe in 1997 as measured by disability-adjusted life years lost. *Tropical Medicine and International Health*, 2006; 11 (5): 660–671.



This analysis is the **first to explore and analyse routinely collected cause of death registration data** in such detail **for diarrhoeal and other potentially foodborne diseases** and to explore the data's usefulness in estimating the mortality burden of foodborne diseases. The results obtained from this analysis will inform comparisons with results from community-based studies and other modelling techniques. It is envisaged that they will be used in the triangulation of different approaches that will lead to the final foodborne disease mortality estimate of FERG.

This project is unique in that it is conducted by a group of exceptionally talented undergraduate students of statistics, and highlights the additional role of FERG as a forum for capacity building (Textbox 6).

#### Textbox 6 – FERG: Blending young stars in science with the world's leading experts

FERG's world experts in the area of foodborne diseases are fostering the next generation of top scientists. A group of young statistics undergraduates supervised by Professor of Statistics Julie Legler at St Olaf College, Minnesota, USA, is analysing cause of death data from the WHO database for all diseases which are potentially foodborne. The purpose of this study is to (a) assess the usefulness of the data for the estimation of foodborne mortality, (b) describe foodborne disease mortality for countries where population coverage was near-complete, (c) build statistical models to estimate death rates for countries where data are missing, and (d) identify particular regions of the world associated with high incidence of foodborne disease mortality.

Students Laura Boehm, Brianna Hirst and Sommer Wild (photo) from St Olaf College presented their interim results to the first FERG meeting and received a detailed review of their work from the experts. The students are now including this feedback in their statistical modelling and report back in November 2008. The trio began researching foodborne disease mortality for their project on the Global Health and Biostatistics Interim course with Professor Legler. "While students have worked with scientists at WHO in the past, this is the first time students have presented the information at a high-level WHO expert forum. This speaks volumes for the students' ability, commitment and the quality of their work", says Dr Jørgen Schlundt, Director of Food Safety, Zoonoses and Foodborne Diseases at WHO.

The experience has also been invaluable for the students. "Through this I have been inspired to learn more about global health and the quantification of disease - it encouraged me to continue my studies in statistics", says Brianna. Laura felt that "presenting our research at the FERG meeting was both intimidating and rewarding, and I hope the work we have done will make a contribution to the body of research on foodborne diseases". Sommer commented that this work had exposed her to "a new realm of health and medicine and I hope to continue my studies in both the medical and public health fields".

WHO through FERG is committed to bringing together the world's best expertise and available evidence in the area of foodborne diseases; in doing so it engages in capacity building at every professional level and harnesses and fosters the talents of the next generation of scientists.



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### Summary points: Preparatory work for FERG

- o FERG is collaborating closely with major burden of disease networks and activities, including the International Collaboration of Enteric Burden of Illness Studies, Med-Vet-Net and the Institute for Health Metrics and Evaluation; these collaborations comprise the sharing of information and scientific expertise
- o Causes of death data from routine vital registration systems are analysed for the first time for potentially foodborne diseases
- o Results from the cause of death analysis can be used for triangulation of different modelling approaches leading to final mortality estimate of FERG

## 4.5 Summary findings, recommendations and products of FERG 1

### 4.5.1 Plenary discussions and summary findings

During the three days of the FERG 1 meeting, an ambitious agenda delivered outcomes and products which are both logistic and technical in nature. The logistic outputs centre around the establishment of three Task Forces and the planning for the 2008 activities of the group. The technical outputs included the development of priority lists of causative agents for which burden of disease estimates will be provided, and detailed technical workplans (including research to be commissioned) for all Task Forces. A summary of all recommendations and outputs is given in Textbox 7 and Table 4.

The FERG discussed and agreed upon a number of general issues that are relevant for all Task Forces, including:

- (a) the need for a standardized review protocol for commissioned literature reviews.

A draft protocol developed by the WHO Secretariat outlining possible inclusion and exclusion criteria was discussed for general use. It was agreed that while such a framework was helpful, **individual scientists performing the review** work will need to **provide their additional input for each separate task** in the areas of types and quality of studies to be considered.

- (b) the need for a standardized age stratification and year of reference for burden of disease estimates.

It was agreed that - where possible - the **FERG burden estimates should be compatible with other Burden of Disease efforts**, notably those of IHME. This would require reporting burden estimates for the year **2005**, reporting for both sexes separately and using the age-groups outlined below:

- < 1 month
- 1 – 11 months
- 1 – 4 years
- 5 – 14 years
- 15 – 24 years
- 25 – 34 years
- 35 – 44 years
- 45 – 54 years
- 55 – 64 years
- 65 – 74 years
- 75 – 84 years
- 85+ years

In relation to reporting on burden of disease for the year 2005, FERG recommended that a technical **background paper** be provided outlining the **methodological issues arising from burden estimations that are either based on previous or current exposure levels**. This distinction is important and requires resolution, as describing current (2005) burden of disease would require the consideration of previous exposures (that may have changed drastically) while basing burden calculations on current (2005) exposures would result in estimates that may differ substantially from the actual (2005) observed burden.

- (c) the need for a review and detailed analysis of how co-morbidity (including malnutrition and immunosuppression) will be considered in the burden of disease estimates.

It was agreed that the **WHO Secretariat** together with the **FERG Core Group** and Task Force Chairs should **provide a draft plan** for the above activity.

- (d) the need to perform extensive data searches that include **data beyond the peer-review literature and outside the public domain**.
- (e) the need for continued close communication and collaboration with stakeholders as well as other relevant WHO groups working in the area of burden of disease.

It was agreed that the WHO Secretariat would continue its **collaboration with stakeholders and other WHO groups** already involved (including child & adolescent health, nutrition, environmental health, neglected tropical diseases, vaccines & biologicals) and **establish new links**, including those with HIV/AIDS and pharmaceuticals.

#### Summary points: FERG plenary discussions and summary findings

- o The draft standardized review protocol proposed by the WHO Secretariat should be adapted by scientists commissioned to perform literature reviews
- o The FERG should use the age stratification of the GBD 2005 project and use 2005 as its reference year for burden estimation
- o A background paper outlining methodological approaches for the use of previous or current exposures to estimate burden of disease should be provided
- o The FERG Core Group and Secretariat will provide a draft plan to assess the implications of co-morbidity in burden assessments
- o Scientists performing work for FERG must make specific efforts to identify data outside the peer-reviewed literature and public domain
- o The WHO Secretariat should continue its stakeholder and current in-house collaborations and forge new links where required



#### **4.5.2 Establishment of Task Forces**

The FERG established three immediately operative Task Forces (TF):

- Parasitic diseases TF;
- Chemicals and Toxins TF;
- Enteric diseases TF.

All TF were assigned a Chair who serves for a minimum of one year and reports to the Core Group and the WHO Secretariat. All three TF convened for 2 days of the FERG 1 to provide the technical outputs described in this chapter.

#### **4.5.3 FERG lists of causative agents**

Each TF agreed upon a comprehensive list of causative agents for which burden of disease estimates should be derived over the 5 years of FERG. The criteria on which this selection was based are as follows:

- Proportion of foodborne transmission;
- Severity of illness and/or sequelae caused;
- Frequency of illness and/or sequelae caused;
- Global relevance;
- Particular regional relevance;
- Propensity to cause outbreaks (infectious causes); and
- Already existing evidence to derive burden estimates.

**Table 2: List of causative agents for which burden of disease estimates are to be derived according to Task Force**

Parasites	Enteric pathogen	Chemicals and Toxins
<i>Ancylostoma duodenale</i>	Adenovirus	<b>Elementals contaminants</b> Lead, mercury, cadmium, manganese, arsenic
<i>Angiostrongylus cantonensis</i>	<i>Aeromonas</i> spp.	
<i>Angiostrongylus costaricensis</i>	Astrovirus	<b>Mycotoxins</b> Aflatoxins, ochratoxin, fumonisin, trichothocenes
<i>Anisakis simplex</i>	Bacterial toxins ( <i>B. cereus</i> )	<b>Food additives</b> Sulphites, nitrites/nitrates, benzoic acid
<i>Ascaris lumbricoides</i>	Bacterial toxins ( <i>C. perfringens</i> )	<b>Pesticides</b> Organophosphates, carbamates, DDT, pyrethrins
<i>Blastocystis hominis</i>	Bacterial toxins ( <i>S. aureus</i> )	<b>Organic industrial contaminants</b> Persistent organic pollutants
<i>Capillaria philippinensis</i>	<i>Brucella</i> sp.	<b>Veterinary drugs/residues</b> Antibiotics, hormones - but not antimicrobial residues
<i>Clonorchis sinensis</i>	<i>Campylobacter</i> sp.	<b>Seafood toxins</b> Tetrodotoxin, ciguatera, shellfish toxins, DSPs, PSPs, histamines
<i>Cryptosporidium</i> spp.	<i>Clostridium botulinum</i>	<b>Process contaminants</b> Acrylamide, PAHs, choropropanol
<i>Cyclospora</i> spp.	Enteropathogenic <i>E. coli</i> (EAggEC)	<b>Allergens</b> Peanuts
<i>Dicrocoelium dendriticum</i>	Enteropathogenic <i>E. coli</i> (EPEC)	<b>Natural toxicants</b> Cyanide in cassava, aminoglycosides
<i>Dientamoeba fragilis</i>	Enterotoxigenic <i>E. coli</i> (ETEC)	<b>Radionuclides and depleted uranium</b>
<i>Diphyllobothrium latum</i>	Enterovirus	
<i>Echinococcus</i> spp.	<i>Helicobacter pylori</i>	
<i>Echinostoma</i> spp.	Hepatitis A virus	
<i>Entamoeba histolytica</i>	Hepatitis E virus	
<i>Fasciola</i> spp.	<i>Leptospira</i> sp.	
<i>Fasciolopsis buski</i>	<i>Listeria monocytogenes</i>	
<i>Gastrodiscoides hominis</i>	<i>Mycobacterium bovis</i>	
<i>Giardia intestinalis</i>	Non cholera Vibrios	
<i>Gnathostoma spinigerum</i>	Norovirus	
<i>Heterophyes heterophyes</i>	Prions	
<i>Hymenolepis nana</i>	Rotavirus	
<i>Isoospora belli</i>	<i>Salmonella</i> (non-typhoidal) sp.	
<i>Linguatula serata</i>	<i>Salmonella</i> (typhoid) sp.	
<i>Metagonimus yokogawai</i>	Shiga-toxin producing <i>E. coli</i> (STEC)	
<i>Nanophytes salmincola</i>	<i>Shigella</i> sp.	
<i>Opisthorchis felinus</i>	<i>Vibrio cholerae</i> 01/0139	
<i>Opisthorchis viverrini</i>	<i>Yersinia</i> sp.	
<i>Paragonimus</i> spp.		
<i>Sarcocystis hominis</i>		
<i>Taenia saginata</i>		
<i>Taenia solium</i>		
<i>Toxocara</i> spp.		
<i>Toxoplasma gondii</i>		
<i>Trichinella</i> spp.		
<i>Trichostrongylus</i> spp.		
<i>Trichuris trichiura</i>		



#### 4.5.4 Task Force workplans for 2008-2009

Each Task Force (TF) distilled the list of causative agents and agreed on a priority list of causes for which work was to be commissioned immediately (with a view to presenting interim results at the second meeting of the FERG in November 2008, FERG 2). This list was constructed on the basis of perceived high level of burden and practical considerations, including already existing work in the area of burden of disease or exposure, knowledge of currently ongoing work etc.

The workplans (Table 3) were compiled adhering to a common format and include:

- Priority ranking of causative agent;
- Detailed description of burden activity (e.g. commissioning of systematic review);
- Proposals of scientists and/or institutions to conduct the commissioned work;
- Nomination of specific TF member to follow up on each activity;
- Type of output expected from activity (e.g. database of literature, regional BoD estimates etc); and
- Time frame for delivery of the commissioned work.

The Task Force specific issues and discussions are described in the following sections.

##### (i) Parasitic Diseases Task Force

The Parasitic Diseases TF discussed and specifically recommended the creation of an **interactive burden map** or atlas, which is based upon the use of **Geographical Information Systems (GIS)**. The TF also advised that literature reviews conducted under the auspices of FERG should be **limited to literature published since 1990** (when assessing incidence and/or prevalence) and that data searches be multilingual, including at a minimum English, French, Spanish, Russian and Chinese, and other regional languages, where appropriate. The WHO should assist with access to full text of publications to commissioned scientists.

##### (ii) Chemicals & Toxins Task Force

This TF based its priority ranking on the severity of potential health effects, the size of the population vulnerable to exposure and the current availability of data. The workplan proposed includes the estimation of the global burden for the seven priority chemicals (Table 3) by summarizing exposure data (including drawing inferences from existing biomarker studies to determine exposure) and quantifying their respective health impact. Studies examining dose-response relationships in humans will need to be analysed. If data from such studies are insufficient, relevant animal studies describing biomarkers and dose-response relationships will need to be assessed for their suitability of modelling for humans.

##### (iii) Enteric Diseases Task Force

The Enteric Diseases TF took a different and generally more holistic approach to its work planning and defined comprehensive and conceptual pieces to be commissioned. This includes the determination of an 'envelope' of diarrhoeal diseases considering all age groups and all relevant pathogens described in the literature. The TF also lay the **foundation for the work of the future Source Attribution Task Force**, outlined the steps for this new TF to commence its work (including the examination of evidence from research groups using molecular

**Table 3: 2008-2009 workplans for FERG Task Forces**

Causative agent/s	Commissioned activities	Time frame	Output type/s
<b>PARASITIC DISEASES</b>			
Intestinal protozoa ( <i>Giardia</i> , <i>E. histolytica</i> <i>Cryptosporidium</i> )	<ul style="list-style-type: none"> <li>Literature review of incidence and prevalence</li> <li>Literature review of all health effects resulting from causative agents</li> <li>Literature review of proportion of disease transmitted by food</li> </ul>	1 year	<ul style="list-style-type: none"> <li>Databases of relevant literature</li> <li>Estimates of global prevalence and incidence of health outcomes</li> </ul>
<i>Fasciola spp.</i>		1 year	
<i>Trichinella spp.</i>		8 months	
<i>Toxoplasma gondii</i>		1 year	
<i>Echinococcus</i>		1 year	
<i>Opisthorchis viverrini</i>		8 months	
<i>Taenia solium</i>		1 year	
<i>Anisakis simplex</i>		8 months	
<i>Ascaris lumbricoides</i>		1 year	
<b>CHEMICALS &amp; TOXINS</b>			
Aflatoxin	<ul style="list-style-type: none"> <li>Literature review of studies describing health effects from causative agents and linking to exposure</li> <li>Literature review of dose-response relationships, including relevant animal studies where needed</li> <li>Summarize occurrence and exposure data, identify key food vectors and estimate population at risk</li> <li>Draw inferences from existing biomarker studies linking them to exposure data to estimate burden of disease</li> </ul>	1 year	<ul style="list-style-type: none"> <li>Estimates of global prevalence and incidence of health outcomes</li> <li>Databases of relevant literature</li> </ul>
Cassava cyanide		1.5 years	
Peanut allergens		2 years	
Dioxins, furans, dioxin like polychlorinated biphenyls (PCB)		9 months	
Methylmercury		1 year	
Lead		1.5 years	
Organophosphates		6 months	
<b>ENTERIC DISEASES</b>			
Pathogen-specific diarrhoeal disease burden for all age groups	<ul style="list-style-type: none"> <li>Literature review of incidence and mortality of diarrhoeal diseases according to enteric pathogen</li> <li>Literature review of all sequelae resulting from causative agents</li> </ul>	1.5 years	<ul style="list-style-type: none"> <li>Databases of relevant literature</li> <li>Estimates of global incidence and mortality of pathogen-specific diarrhoeal diseases</li> <li>Estimates of global incidence and mortality of sequelae of each relevant pathogen</li> </ul>
Global Atlas of Food Consumption	<ul style="list-style-type: none"> <li>Literature review and assessment of all data sources &amp; their methodologies</li> </ul>	1.5 years	<ul style="list-style-type: none"> <li>Global atlas of food consumption and knowledge, attitude and behavioural practices</li> </ul>
Source Attribution	<ul style="list-style-type: none"> <li>Establish Task Force</li> </ul>	6 months	<ul style="list-style-type: none"> <li>Task Force meeting</li> <li>Task Force workplan</li> </ul>
Economic impact assessment	<ul style="list-style-type: none"> <li>Literature review on economic methods used in the impact of FBD</li> <li>Conceptual work to define methodology at health system, private sector and tourism industry level</li> </ul>	1.5 years	<ul style="list-style-type: none"> <li>Database of relevant literature</li> <li>Tools for economic impact assessment</li> </ul>





methods to study diseases of interest) and **recommended that WHO establish this TF at the earliest opportunity.**

Initial discussions within the Enteric Diseases TF centred on the definitions to be used and **recommended to use the WHO definition for foodborne illness** as well as the **definition for food provided by the Codex Alimentarius**<sup>10</sup> (which includes all food & bottled drinks). Discussions on whether to include breast milk as food were tabled for a later date.

The Enteric Diseases TF also further prioritized the pathogens on which FERG should concentrate initially. Those selected were:

- Bacterial toxins (*Staphylococcus aureus*, *Clostridium perfringens*, *Bacillus cereus*);
- *Brucella sp.*;
- *Campylobacter sp.*;
- *Clostridium botulinum*;
- Enteroaggressive *E. coli* (EAggEC);
- Enteropathogenic *E. coli* (EPEC);
- Enterotoxigenic *E. coli* (ETEC);
- *Helicobacter pylori*;
- Hepatitis A virus;
- Hepatitis E virus;
- *Listeria monocytogenes*;
- *Mycobacterium bovis*;
- Non-cholera *Vibrio spp.*;
- Norovirus;
- Prions;
- Rotavirus;
- *Salmonella* (non-typhoidal) *sp.*;
- *Salmonella typhi*;
- Shiga-toxin producing *E. coli* (STEC);
- *Shigella sp.*;
- *Vibrio cholerae* O1/O139; and
- *Yersinia sp.*

### Summary points: FERG Task Force discussions and outcomes

- o **Three Task Forces were established and operationalized in FERG 1: Parasitic Diseases, Chemicals & Toxins and Enteric Diseases Task Forces**
- o **All three Task Forces agreed on lists of causative agents for which FERG will estimate burden of disease (Table 2)**
- o **All three Task Forces developed detailed workplans which were approved by the FERG plenary and are effected by the WHO Secretariat (Table 3)**
- o **The FERG made a series of technical and logistic recommendations to WHO (Textbox 7)**

<sup>10</sup> Codex Alimentarius Commission, 2007. Procedural Manual.  
[ftp://ftp.fao.org/codex/Publications/ProcManuals/Manual\\_17e.pdf](ftp://ftp.fao.org/codex/Publications/ProcManuals/Manual_17e.pdf)

**Textbox 7 - FERG 1 recommendations & requests**

**Technical recommendations**

1. The WHO definition of foodborne illness and the *Codex Alimentarius* definition of food should be used
2. FERG needs to agree on a standard case definition for acute gastroenteritis
3. The WHO Secretariat's draft of literature review protocol should be used as basis for discussions with contracted scientists for further input and revision
4. The GBD 2005 age-groups and reference year for burden of disease estimation should be used, where possible
5. Scientists performing work for FERG must make specific efforts to identify data outside the peer-reviewed literature and public domain (*also stakeholder recommendation*)
6. Literature reviews conducted under the auspices of FERG should be recent (post-1990) particularly where assessing incidence and prevalence
7. The burden of disease estimates should be documented in an interactive burden atlas based upon Geographical Information Systems

**Technical requests**

8. Provide a technical background paper outlining the methodological issues arising from burden estimations based on either current or previous exposures
9. Provide a technical plan for the review and analysis of the consideration of co-morbidity in the burden of disease assessments
10. WHO should establish the Source Attribution Task Force as a matter of priority

**Logistic recommendations & requests**

11. The WHO Secretariat should continue its stakeholder as well as in-house collaboration and establish new links, including those with HIV/AIDS and pharmaceuticals (*also stakeholder recommendation*)
12. The WHO Secretariat should communicate regularly with FERG members on all matters arising and hold regular teleconferences with the Core Group and TF Chairs

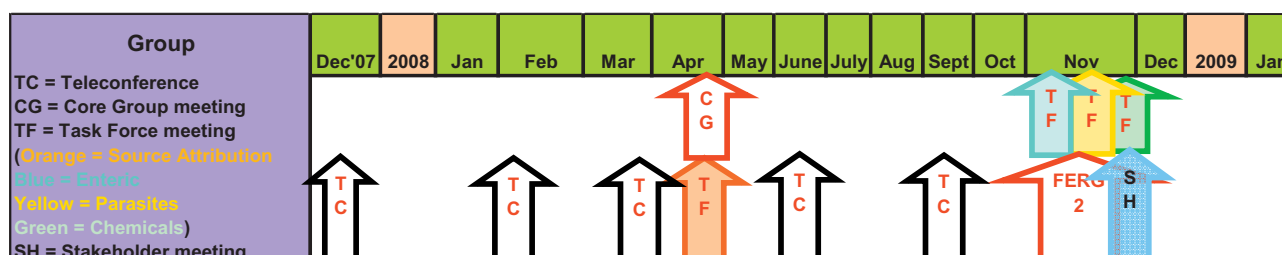
**4.5.5 FERG 2008 – activities and time line**

After detailed discussion and revision of all workplans during the plenary, the **FERG approved the workplans and recommended their immediate implementation.**

In the weeks following the FERG 1, the WHO Secretariat commenced with the execution of the workplans, including the commissioning of research work, the establishment of the Source Attribution Task Force and the development of technical background papers as requested by the FERG. The time scales for the execution of these tasks ranges from 1–24 months.

The FERG agreed that the second formal meeting of the group, **FERG 2 will be held on 17–21 November 2008** in Geneva; this meeting will include an expanded stakeholder event. It is expected that a considerable number of tasks will already be accomplished and presented at FERG 2. A teleconference with the Core Group was scheduled for December 2007 and a full Core Group meeting to review progress was scheduled for the spring of 2008 (Figure 5).

**Figure 7: Time line of FERG activities during 2008**





# 5

## Conclusions

Following the 2006 WHO Consultation to Develop a Strategy to Estimate the Global Burden of Foodborne Diseases, WHO has implemented the strategic framework, established the multidisciplinary FERG and prepared the ground for the execution of the activities outlined in the strategy.

The objectives of the FERG 1 meeting were to:

- Formally approve the membership of the group and its Task Forces, as well as elect the Core (or Steering) Group for the FERG;
- Formally approve the working procedures of FERG;
- Agree on a priority list of causative agents (microbiological, parasitic and chemical) for which burden of disease should be assessed;
- Provide detailed workplans to execute the burden of disease assessments for the priority causes;
- Agree on a time frame and next steps for the group.

All meeting objectives were met and the specific outputs and recommendations are summarized in the following sections.

### 5.1 Outputs of FERG 1

During the FERG 1 meeting, the group provided the following outputs:

- **Approval of all governance functions**, including the nomination of Chairs and Core Group members and the establishment of FERG working procedures and time frames;
- The **establishment and operationalization** of three **FERG Task Forces** in the areas of **parasitic diseases, chemicals and toxins and enteric diseases**;
- Development of **priority lists of causative agents** for all three Task Forces;
- Detailed **workplans** for all Task Forces, including detailed descriptions of the **type of burden work to be commissioned**, proposals of scientists and/or institutions to undertake the work, a definition of the **outputs expected** and **time frames for the delivery** of the products.

### 5.2 Summary of recommendations & requests made by FERG 1

Recommendations arose from the plenary discussions as well as the individual Task Force deliberations and concern both technical as well as logistic issues. Table 4 gives an overview of all suggestions.

The WHO Secretariat is now working with its partners to implement the recommendations and workplans.

This first formal meeting of the FERG took the strategy implementation to its next stage by proceeding with the execution of specific short- and medium-term activities, including the consolidation of its administrative and governance structures, the setting of technical priorities, and the development of detailed technical workplans that are now executed by the WHO Secretariat. The next FERG meeting in November 2008 will review progress made with all recommendations and specific action points arising from the FERG 1 workplans. It will be linked to a major stakeholder event where all relevant partners will be given a further opportunity to engage in the FERG efforts.

**Table 4: Overview of recommendations and requests made by FERG 1**

Area	Topic	Recommendations and requests	Actor/s
Technical	Definitions	Use the WHO definition of “foodborne illness”	FERG Enteric Diseases Task Force
		Use Codex Alimentarius definition of “food”	
		Agree on standard case definition for “acute gastroenteritis”	
	Data collection and appraisal	Use GBD 2005 age-groups and reference year for burden of disease estimation	FERG & contracted scientists
		Use current draft literature review protocol as basis for discussions with contracted scientists for further input and revision	
		Make special efforts to identify data outside the peer-reviewed literature and public domain	FERG & contracted scientists
		Literature reviews conducted under the auspices of FERG should be recent (post 1990) particularly where assessing incidence and prevalence	
	Documentation	Provide a technical background paper outlining the methodological issues arising from burden estimations based on either current or previous exposure	WHO Secretariat
		Provide a technical plan for the review and analysis of the consideration of co-morbidity in the burden of disease	FREG Core Group & contracted scientists
Document burden of disease estimates in interactive atlas based upon GIS		WHO Secretariat	
Logistic	Governance	Establish the Source Attribution Task Force as a matter of priority	WHO Secretariat
		Continue its stakeholder as well as in-house collaboration and establish new links	WHO Secretariat & FERG
		Communicate regularly with FERG members on all matters arising & hold regular teleconferences with the Core Group and TF Chairs	WHO Secretariat & FERG

The FERG is the advisory body of the WHO Initiative to Estimate the Global Burden of Foodborne Diseases. It includes the world’s leading experts in the area of food safety, and benefits from its multidisciplinary and geographically balanced composition, its extensive scientific network and the strong alliances that have and continue to be forged. The first meeting of the FERG (Figure 6) underlined the group’s commitment and expertise in assembling, appraising and reporting on the best available scientific evidence while engaging in dialogue with all stakeholders, undertaking capacity building at various levels and advancing the research agenda in food safety.



**Figure 8: FERG 1 participants, observers and WHO Secretariat**



# 6

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## Appendix 2 – Agenda

Time	Mon 26 Nov - Opening and Briefing Day	Lead	Tues 27 Nov - FERG Technical Meeting	Lead	Wed 28 Nov - FERG Technical Meeting	Lead
09:00				Dr Bab Black Dr Elaine Scallan		
09:30			Update on Global Burden of Disease 2005 Definitions of Foodborne Diseases & discussion		All Task Forces continue separate sessions : a) Agree working procedures b) Finalize evidence matrix & review protocols c) Decide on work to be commissioned d) Draft workplan	TF Chairs
10:00		Source Attribution in pathogens & discussion	Dr Tine Held			
10:30		Source Attribution in chemicals & discussion	Dr Mike Bolger			
11:00			Mortality from potentially foodborne diseases - analysis of vital registration data	Prof Julia Ledger Laura Borim Blonna Hirst Sommer Wild		
11:30			11:00 - 11:15 : Coffee break			
12:00	Meeting of provisional Core Group & WHO Secretariat (Incl. Rapporteur & TF Chairs)	WHO Secretariat	MedVetNet - update and opportunities Instructions for Task Forces	Dr Anne Havelaar WHO Secretariat	12:00 - 13:00 : Lunch	
12:30			12:30 - 13:30 : Lunch			
13:00			Enteric & Other infectious : a) Update on ICEBI b) Pathogen-specific diarrhoeal mortality in children	Enteric/other: Dr Elaine Scallan Dr Claudio Lunata Chemicals: Dr David Bellinger	Report from all Task Forces: Evidence matrices Review protocols Work to be commissioned immediately Workplans Discussion	FERG Chair
13:30						
14:00	Welcome by ADG/HSE & WHO Secretariat Election of Chairs, Core Group & Rapporteurs	Dr David Heymann WHO Secretariat	Enteric diseases Task Force: a) Agree working procedures b) Finalize evidence matrix & review protocols c) Decide on work to be commissioned d) Draft workplan	TF Chairs	Adoption of matrices, protocols & workplans	FERG Chair
14:30	Estimating the Global Burden of Disease at WHO - from GBD to FERG	WHO Secretariat				
15:00	FERG: Purpose, Procedures and Expected Outcomes		15:00 - 15:50: Coffee break			
15:30			15:30 - 15:50: Coffee break			
16:00			a) Agree working procedures b) Finalize evidence matrix & review protocols c) Decide on work to be commissioned d) Draft workplan	TF Chairs	Immediate FERG outputs Agreement on next steps TF meetings & FERG schedule 2008	FERG Chair
16:30	Role and Terms of Reference of Participants Task Forces: a. Enteric, b. Other/Infectious, c. Chemicals Work plans: Evidence matrices & review protocols	WHO Secretariat				
17:00			a) Agree working procedures b) Finalize evidence matrix & review protocols c) Decide on work to be commissioned d) Draft workplan	TF Chairs	Summary & formal closure of FERG 1	FERG Chair & WHO Secretariat
17:30	Reactions, ideas and suggestions to FERG and WHO Over to the stakeholders -	FERG Chair				
18:00	FERG Reception (WHO Restaurant)					
19:00						
20:00						
			FERG Dinner - venue TBA			

Colour coding:  
 Plenary (Salle G)  
 Task Forces working groups  
 Restricted meetings  
 Other events





ISBN 978 92 4 159676 3



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