Global surveillance of foodborne disease: Developing a strategy and its interaction with risk analysis

Report of a WHO consultation

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Chapter 1. Introduction

A World Health Organization (WHO) Consultation on Developing a Strategy for Global Surveillance of Foodborne Diseases and its Interaction with Risk Analysis was held in Geneva (Switzerland) from 26 to 29 November 2001. It was jointly organized by the Emerging Public Health Risks including Drug Resistance Team (Department of Communicable Diseases Surveillance and Response) and the Food Safety Programme (Department of the Protection of Human Environment) with the technical collaboration of the Food Quality and Standards Service (Food and Nutrition Division) of FAO (Food and Agriculture Organization of the United Nations). A total of 55 experts, including secretariat, participated in the consultation.

The Consultation was opened by Dr G. Rodier, Director, Department of Communicable Disease Surveillance and Response (CSR) and Dr Jörgen Schlundt, Coordinator, Food Safety Programme (FOS), Protection of the Human Environment (PHE). Dr Rodier opened the consultation on behalf of the Director-General of WHO and the Executive Director of the Department of Communicable Diseases (CDS). In his statement, Dr Rodier noted that there was a need to strengthen WHO's abilities to assess the magnitude of the foodborne disease problem and improve the capacity to determine the sources and causes of foodborne diseases.

Dr G. Rodier stressed that the problem is multifactorial and that strategies for prevention and control consequently require a multidisciplinary and intersectoral approach through the participation and collaboration of multiple partners at both the levels of the decision makers and experts (in medicine, food science and veterinary sciences).

Reminding the participants of the World Health Assembly (WHA) resolution (WHA) 53.15 that encourages the Member States “to implement and keep national and, when appropriate, regional mechanisms for foodborne disease surveillance”, Dr Rodier noted that a “network-of-networks” could facilitate and support the development of national systems for the detection and response to foodborne diseases as an integral part of their overall national public health surveillance systems.

In his welcoming address Dr J. Schlundt, on behalf of Executive Director of Sustainable Development and Health (SDE), drew attention to the fact that we must improve our abilities to link pathogens in food to disease in humans. This can be achieved through the enhancement of surveillance not only of human disease but also of pathogens throughout the food production chain and by systematic microbiological risk assessment. The latter being especially helpful in the ranking of risks and in setting priorities. Also there is a need to facilitate the linking of patient data and food chain data.
A farm-to-fork perspective should be ensured in the development of strategies to prevent and control the major problems of foodborne disease. The interaction between risk assessors and surveillance epidemiologists should be enhanced to improve the use of surveillance data in risk assessment and to improve surveillance programmes to better address risk assessment needs.

The consultation elected Dr K Wachsmuth as chairperson and Dr H. Wegener as rapporteur. The consultation also appointed a chairperson for each working group. Dr A. Reilly and Dr A. Ellis were nominated chairperson and rapporteur respectively for the working group on the Network of Networks. Dr E. Esteban and Dr A. Lammerding were nominated chairperson and rapporteur respectively for the working group on Risk Analysis. The detailed agenda is included as Annex 1, the list of participants as Annex 2.
Chapter 2. Background

Foodborne diseases represent an important public health problem, significantly affecting peoples' health and with economic consequences. Numerous outbreaks of foodborne diseases attract media attention and raise consumer concern. It is expected that the problem will increase in the 21st century especially as several global changes including population growth, poverty, international trade in food and animal feed will continue to influence the safety of food and drinking water. In addition, the threat of deliberate contamination of food has implications for international food security. Rapid identification of a problem in one country could prevent further illness in another if the incident is communicated quickly through an organized system.

As most of the cases of foodborne disease are not reported, the true dimension of the problem is unknown. The absence of reliable data on the burden of foodborne disease impedes understanding about its public health importance and prevents the development of risk-based solutions to its management. Concerned by this, the 53rd WHA adopted a resolution to recognize food safety as an essential public health function and called for the development of a Global Strategy for reduction of the burden of foodborne disease.

In general terms foodborne disease surveillance is essential for:
• Estimating the burden of foodborne diseases, and monitoring trends,
• Identifying priorities and setting policy in the control and prevention of foodborne diseases,
• Detecting, controlling, and preventing foodborne disease outbreaks,
• Identifying emerging food safety issues and,
• Evaluating foodborne disease prevention and control strategies.

At the global level foodborne disease surveillance is complex because numerous methodologies for determining the health impact of foodborne diseases and for creating data for public health action have been undertaken at national, regional and global levels.

Global foodborne disease surveillance is important for:
• Detection of regional and global epidemics,
• Detection of new and emerging foodborne pathogens,
• Detection of food contamination and disease caused by intentional contamination of food,
• Evaluating global trends,
• Building communication networks.
At this time there are a number of recognized regional surveillance systems for foodborne diseases, parallel surveillance systems for diarrhoeal diseases and multiple public health surveillance systems for communicable diseases including outbreak identification. These different surveillance systems have different foci within the realm of foodborne diseases, from anti-microbial resistance to outbreak identification and management. They use different surveillance methods, and actually overlap in geographical coverage. The methods vary from laboratory-based sentinel surveillance (WHO Global Salm-Surv) to search for global patterns, to intensive epidemiological investigations involving mature public health surveillance (EnterNet) combined with targeted population based epidemiological studies (FoodNet). Others involve public health based surveillance of populations through diarrhoeal syndrome surveillance (Sistema Regional de Información para la Vigilancia de las Enfermedades Transmitidas por Alimentos - SIRVETA) or lab based surveillance including outbreak investigation (WHO Surveillance Programme for control of foodborne infections and intoxications in Europe). Some countries participate in a number of the surveillance networks.

There is no clear ‘best-method’ used in any of these surveillance systems – each system has evolved in accordance with the needs and resources of the geographical area involved, sometimes associated with particular initiatives (such as anti-microbial resistance) related to training and laboratory diagnostics, sometimes operating strictly within national public health capacities or with regional support. There are no published surveillance system evaluations for foodborne diseases indicating advantages of any one system over another. Regardless, it can be anticipated that the maturity of these surveillance systems is such that no one system is likely to be abandoned in favor of another.

Linking existing foodborne disease surveillance networks in a "network-of-networks" should enable rapid dissemination of information on urgent matters, such as outbreak alerts, as well as facilitate exchange of information on technical and methodological matters between networks. This could potentially lead to increased harmonization of surveillance systems and enhanced comparability of surveillance data from different regions. Comparable data on incidence of foodborne disease and prevalence of foodborne pathogens in food, animals and in the environment is a prerequisite for microbiological risk assessment.
Risk analysis is widely recognized as the fundamental methodology underlying the development of food safety standards. It is a process composed of three parts: risk assessment, risk management and risk communication. This new framework was initially defined by WHO, FAO, and the Codex Alimentarius Commission. Risk assessment, the scientific part of risk analysis, was further promoted by the World Trade Organization in 1995 with the ratification of the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement). It requires that any measures applied to protect human, animal and plant health are developed using a scientific and transparent approach. In addition, international concern and increased consumer interest in public health problems associated with foodborne disease have strengthened the need for more science-based decisions at the national level.

The overall goal of strengthening foodborne disease surveillance is to provide countries with the necessary data to reduce the foodborne disease burden by providing information, which allows the food safety system to be improved. To design public health policies and identify appropriate food safety measures, data from foodborne disease surveillance need to be analysed together with data from food monitoring systems. The risk assessment framework currently provides a structured and scientific approach to evaluate the complex issues associated with food hygiene, taking into account the full picture on the extent of foodborne diseases. The overall objective of risk assessment is to provide estimates on the probability of disease occurrence using a well structured approach based on four steps: hazard identification, hazard characterization (dose-response), exposure assessment and risk characterization.

Risk assessment of microbiological hazards in foods has largely evolved within academia and the food safety regulatory agencies of a few developed countries during the past few years. It has also been identified as a priority area of work for the Codex Alimentarius Commission. At its 32nd session, the Codex Committee on Food Hygiene (CCFH) identified a list of pathogen-food commodity combinations for which it requires expert risk assessment advice. In response to this and the needs of their member countries, FAO and WHO jointly launched a programme of work with the objective of providing expert advice on risk assessment of microbiological hazards in foods.


FAO and WHO subsequently selected and initiated work on *Salmonella* spp. in broilers and eggs, *Listeria monocytogenes* in ready-to-eat foods, *Vibrios* spp. in seafood, and *Campylobacter* spp. in broiler chickens. The experts who are preparing these risk assessments, the expert consultations convened to review the assessments as well as the last meeting of the CCFH (34th) all have identified gaps in the data and current knowledge and stressed the strong need for additional information, especially from surveillance, since along with food monitoring and research it is one of the three main sources of data for risk assessment. Filling some of the identified data gaps is crucial to reduce the present uncertainties associated with risk assessment.

There is an urgent need to develop an interdisciplinary approach acknowledging the need for direct interaction between surveillance and risk assessment in foodborne disease prevention (Figure 1). In particular, there is a need for risk assessors to acknowledge the unique role of each of the disciplines in the formulation of risk management strategies. Risk managers should be aware of the strengths and limitations in each discipline in order to know which decision support tool is appropriate to a given situation.

Data from surveillance are of paramount importance for all steps of risk analysis namely risk profiling, risk assessment, risk management and risk communication. Improving data on surveillance on human foodborne diseases will greatly help in identifying the priorities issues to be addressed using the risk assessment approach, reducing uncertainties in risk assessment, thus allowing a more accurate selection of prevention and control strategies by risk managers and evaluating the efficacy of such decisions.

The development of an interdisciplinary approach acknowledging the need for direct interaction between surveillance and risk analysis systems is new in foodborne disease prevention in all countries. However, the current situation regarding foodborne disease in all countries, especially developing countries warrants a timely development of this new direction. Most developing countries cannot afford to develop separate systems and therefore need to move forward beyond the situation of non-collaboration between the various relevant disciplines towards the development of new integrated systems. At the international level such systems should be developed with the needs of both developing and industrialised countries in mind, taking advantage of the experience amassed to date in certain developed countries.

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To participate in the prevention of foodborne diseases, WHO's goal is therefore two-fold:
- To strengthen national, regional and global foodborne disease surveillance systems
- To promote risk analysis as the unique tool which allows presently identification
- To select, implement and evaluate mitigation strategies on the scientific basis of risk assessment in a context of efficient communication of information and opinion on risks.

![Figure 1. Cycle of public health protection based on surveillance and risk assessment. Whether a formal risk assessment is required depends on local national or international food safety policies](image)

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Chapter 3. Meeting objectives

The goal of the consultation was to develop surveillance capacity for foodborne diseases and focused on the feasibility of a network-of-networks for foodborne disease surveillance and the interactions between surveillance and risk-analysis.

The specific objectives of the consultation were:

- to identify existing international foodborne disease surveillance networks,
- to identify the membership to participate in network-of-networks and
- to identify the audience of the network-of-networks,
- to design strategies to strengthen national capabilities, particularly in developing countries, for a global foodborne disease surveillance network,
- to build capability for surveillance and response of foodborne disease outbreaks,
- to identify the needs in terms of surveillance data of risk analysis, especially for risk assessment,
- to determine the various ways to collect the data necessary for risk analysis,
- to elaborate a framework of interactions between risk assessors, risk managers, risk communicators and epidemiologists.
Chapter 4. Foodborne disease surveillance – Network-of-Networks

4.1. Introduction

For the purpose of this meeting the following definition for foodborne disease surveillance is agreed. Foodborne disease surveillance refers to the ongoing systematic collection, collation, analysis, interpretation and use of information relevant to assessment, prevention and control of foodborne disease. This includes epidemiological and microbiological information about health outcomes, which are sometimes referred to as public health surveillance, and information about pathogens and toxins in food animals and foods, sometimes referred to as monitoring.

Food and water are major routes of transmission for many pathogens and toxins. Pathogens can also be transmitted through direct contact with animals and from person to person. A clear separation between foodborne and waterborne diseases is sometimes difficult to make as water is often a constituent of food and many foodborne pathogens are also waterborne. Since foodborne and waterborne diseases are usually controlled and prevented by distinct regulatory structures, they are often considered separately. In this case foodborne diseases are regarded as diseases caused by pathogens that are commonly foodborne even though these diseases may also be carried by other vectors or routes such as water.

It is noted that WHO should continue to work with other international organizations such as Food and Agriculture Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE) in achieving the goals of reducing the risks to consumer health caused by foodborne diseases. It is also noted that the basic mechanisms for conducting foodborne disease surveillance and outbreak management are well-understood, but that there is no ‘right’ way to conduct surveillance. This is because issues such as national needs, national capacity, surveillance requirements for trade, and the comparative importance of foodborne diseases in relation to other diseases may oblige the development of unique systems, particularly at a regional level.

4.2. Global association of networks (Network-of-Networks)

Presentations by the major foodborne disease surveillance networks currently active at an international level were reviewed. Globally and nationally, the associations created within existing networks demonstrated considerable value, leading to improved detection and management of foodborne diseases in the countries and regions where they were functioning. However, it is clear that no single network could be simply adopted globally as the different networks heavily invested in different operating procedures already.
In addition, it is recognized that the existing networks could not simply amalgamate due to differences in operational mechanisms, language, mandate, and legal framework. Establishing links between current networks that are involved in foodborne disease surveillance is considered as valuable. Linking current networks would add value and is desirable. It is recommended that WHO should take the lead in establishing a network-of-networks, for which the name FoodWeb is suggested.

Such a network-of-networks would have many advantages and it should provide a single website for:

- Sharing information on many aspects of foodborne disease surveillance, *i.e.* laboratory protocols and procedure manuals, surveillance outputs (epidemiological and statistical reports), study questionnaires, training programmes, etc.,
- Linking to information on risk assessment,
- Consulting experts in the field of foodborne diseases,
- Accessing information on operating procedures and models for establishing new or improving current networks,
- Accessing communications network for disseminating information on new and emerging issues in foodborne diseases,
- Promoting standards for foodborne disease surveillance and risk assessment,
- Encouraging harmonization of approaches to foodborne diseases and consequently of global foodborne disease surveillance.

### 4.3. Goals of a Network-of-Networks

The broad goals of the Network-of-Networks should be:

- To facilitate communication, sharing intelligence, experience and surveillance approaches between existing surveillance networks. In particular, to share the experience from countries with successful surveillance systems with countries that want to initiate or develop surveillance, in order to encourage the evolution of nascent surveillance endeavours;
- To promote and strengthen surveillance in networks, regions and countries, especially developing countries. A Network-of-Networks would assist national authorities to identify gaps in national ability to conduct surveillance and provide a mechanism to encourage improvement in surveillance capacity;
• To identify gaps in network coverage, for instance, to identify countries not part of networks and helping them join networks;
• To facilitate sharing of appropriate urgent information to the constituent networks;
• To promote interdisciplinary collaboration especially between microbiologists, risk assessors, and epidemiologists to optimize evaluations and advice to risk managers and other interested parties.

4.4. Membership and Audience of a Network-of-Networks

The issue of membership and the target audience of a network-of-networks for foodborne disease surveillance was considered. Founding members should be the existing international surveillance networks. Institutes hosting formal national networks that go beyond routine surveillance, for instance OzFoodNet and PulseNet, should also be included in the membership. In order to become members, countries should be encouraged to join or form networks. It is expected that the membership of a Network-of-Networks will evolve and issues related to potential new members should be referred to the steering committee (see Strategy to create a Network-of-Networks, Section 4.5).

Most information regarding a Network-of-Networks will be available on a web site and will be publicly accessible. It is expected the interest will come from a wide sector, such as the food industry, public health professionals, veterinarians, risk assessors and risk managers, health, food safety and agricultural agencies and the media and the general public.

While the Network-of-Networks is expected to have a global audience, WHO should inform and disseminate information to developing countries. WHO should encourage these countries to access the information provided for improving national foodborne disease surveillance and move to eventual participation.

4.5. Strategy to create a Network-of-Networks

The first steps that would be required to initiate the development of a network-of-networks for foodborne disease surveillance were considered. The broad aim would be to provide a description of existing networks with links to public reports and information. There would be potential for sharing of information as an “early warning” of potential or confirmed outbreaks through a controlled Listserve. A memorandum of understanding, such as that currently used by other networks, will be developed by a steering committee to define scope and operating procedures.
4.6. Conclusions and recommendations

It is recommended that WHO study the feasibility of setting up a network-of-networks in order to link current networks involved in foodborne disease surveillance into a global network. WHO is requested to:

1. **Facilitate communication between networks by:**
   - Negotiating with existing networks to invite them to be founding members;
   - Forming a steering group of key personnel from existing networks/members to advise WHO on the management and evaluation of the Network-of-Networks; Examining the existing networks and provide an expanded structured description of their scope, coverage and mechanisms for information sharing;
   - Creating a webpage with a description of each network, including map and list of participating countries and point of contact. Provide the electronic connection to each network by adding the websites to the Network-of-Networks’ homepage;
   - Creating Listserv of points of contact for each network;
   - Organizing regular meetings of the steering group and/or points of contact;
   - Co-ordinating and finding resources to fund the development and management of the Network-of-Networks.

2. **Promote and strengthen surveillance in networks, regions and countries, especially developing countries by:**
   - Assisting countries to recognize the importance of food safety as a public health issue;
   - Defining objectives for a foodborne disease surveillance system, by undertaking a needs assessment, including analysis of infrastructure and human resource implications. It must be recognized priority diseases will vary between countries and regions;
   - Implementing a systematic approach for outbreak investigation, including the establishment of registries of investigated outbreaks;
   - Reviewing data from surveillance systems and/or outbreak investigations in order to identify and target prevention strategies;
• Identifying and better utilizing existing data sources to avoid the duplication of data generation;

• Considering the use of sentinel site approaches;

• Strengthening collaboration between food safety and hygiene professionals, veterinarians, clinicians, epidemiologists, etc.;

• Encouraging the identification of a focal point to co-ordinate foodborne disease surveillance at national and regional levels.

**For this purpose through the Network-of-Networks WHO should:**

1. Develop guiding principles on establishing foodborne disease surveillance especially where little or no surveillance exists e.g. how to start and proceed with a foodborne disease surveillance system, infrastructure, case definitions, minimum data set, etc. These should be complemented by a decision tree for implementation.

2. Promote basic epidemiological training and provide training documents.

3. Strengthen laboratory support on regional/national level, through training in standard methods and providing standard protocols for laboratory procedures.

4. Facilitate collaboration between food safety and hygiene professionals, veterinarians, clinicians, epidemiologists, etc.

5. Support opportunities for advanced and applied epidemiological and microbiological training.

6. Support a second global consultation to share and review experiences and improve strategies.

3. **Identify gaps in surveillance capacity and network coverage by:**

   • Conducting periodic targeted surveys of network member countries/non-member countries (or by other means) regarding specific capacities along the food chain and in public health and disseminate the results through the web site.

4. **Facilitate and provide training opportunities and information by:**

   • Encouraging the dissemination of information from networks about training courses, procedure manuals, study questionnaires, training materials, laboratory protocols;
• Dissemination of information about distance training opportunities;
• Conducting a survey of critical training needs among members.

5. **Facilitate the sharing of appropriate urgent information to the constituent networks by:**
   • Enabling network members to post bulletins to one or more other networks via a closed Listserve. The steering committee will develop a memorandum of understanding for the operating procedures;
   • Providing a mechanism for interaction with WHO’s Global Outbreak Alert and Response Network.
Chapter 5. Interaction between Surveillance and Risk Analysis

Risk analysis (risk assessment, risk management and risk communication) is a recognized tool for setting public health priorities and prioritizing management of hazards in food. Microbiological risk assessment is a useful approach to organize the information and identify gaps in knowledge and infrastructure regarding infectious agents in food.

Risk assessment consists of hazard identification (what are the dangers), hazard characterization (dose-response), exposure assessment (assessment of human exposure), and a final integrative step in risk characterization (description of the nature and magnitude of human risk). At every step in this process epidemiological or surveillance data are required.

5.1. Risk Management

Codex defines risk management as “the process of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other factors relevant for the health promotion of fair trade practices, and if needed, selecting appropriate prevention and control options.”

The Codex Committee on Food Hygiene is developing Draft Principles and Guidelines for the Conduct of Microbiological Risk Management. Although the document is in a formative stage, it is clear that the risk management process relies heavily on surveillance/epidemiological data for the initial identification of food safety issues, assessing the various management options, including the decision to commission a risk assessment, and the monitoring and evaluation of the of the selected option.

Food safety programs must focus on the potential human health consequences of foodborne hazards, making the link between what is in the food and what happens to the individual. Lessons learned are:

- that control measures that are not based on risk may be worthless and that the process of basing food safety decisions on risk must be supported by quality data;
- that surveillance and epidemiological data are critical in judging the success of risk management in meeting the goals of preventing or reducing foodborne disease.

The risk management component of risk analysis relies heavily on epidemiological data to initially identify food safety issues and then to evaluate the issue in the context of broad public health concerns. To reduce or prevent foodborne disease problems, managers must determine if a reported human health problem is caused by a hazard (pathogen) in the food. The severity of the problem and the quantity and quality of available data may determine the need for (and type of) a risk assessment before a risk reduction decision is taken. This is best done in collaboration with epidemiologists and risk assessors.
The risk manager also is dependent on the use of surveillance/epidemiologic data to evaluate risk management decisions after they are implemented and, more broadly to evaluate the success of the entire food safety program.

5.2. Risk Assessment

Similar to the purpose of surveillance, risk assessment is linked to a need to take effective and efficient action. Risk assessment incorporates the results of all pertinent lines of investigation, from the level of molecular characteristics of foodborne pathogens to the human population, to inform risk managers and others, and to place the risk issue into perspective. In addition to giving an estimate of the size of the problem, the risk assessment document also serves as a database of relevant information and assumptions, and provides a description of the current knowledge and understanding.

Risk assessments can in principle be more or less detailed. However, comprehensive risk assessments are time and resource intensive, and the decision to commission a risk assessment, and to define the scope of this assessment must take into consideration practical constraints such as time, expertise, data availability and additional resources. Preliminary investigation of a food safety issue (i.e. a risk profile of an identified potential problem) may reveal that the potential risk/problem/impact is not significant or of low priority and does not warrant the conduct of a quantitative risk assessment (QRA).

Analyzing the entire farm-to-fork continuum (by integrating different types of data from diverse sources into a single model), allows the examination of the broadest range of intervention strategies. Models can then be used to test hypothetical interventions. A risk assessment also provides a document for communication, provides a focus for discussions with various stakeholders and encourages discussion and/or debate on scientific facts and evidence, rather than on subjective opinion.

5.3. Risk Communication

Stigma is a powerful shortcut that consumers may use in their evaluations of food safety risks. Well-publicized outbreaks of foodborne pathogens and the concern over agricultural biotechnology are but two current examples of stigma arising in the interactions between science, policy, and public perception.
Managing the stigma associated with food-safety issues involves the following elements:

- Effective and rapid surveillance systems,
- Effective communication about the nature of risk,
- A credible, open, and responsive regulatory system,
- Demonstrable efforts to reduce levels of uncertainty and risk,
- Evidence that actions match words.

Effective risk communication requires coordinated efforts between the food producers, processors and retailers, and local, provincial, and federal health authorities. Success of the communication depends on the interplay of three factors, the timeliness of the warning (how soon it is issued), the level of consumer compliance with the warning, and the time it takes to solve the problem. While often treated as an information issue, it is important continuously to keep in mind that risk communication is a two-way process, i.e. to put in place vehicles for such interaction.

5.4. Data needs for quantitative risk assessment

The Codex Committee for Food Hygiene has identified the most important pathogen food commodity combinations for QRA at the international level. FAO/WHO expert groups have begun to carry out a series of QRA, based on national risk assessment studies. These studies have identified data gaps in hazard characterization and exposure assessment. Table 1 lists the most critical data needs identified.

<table>
<thead>
<tr>
<th>Data need</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Pathogen Food Commodity Combinations</strong></td>
<td>The most important pathogen food commodity combinations for QRA at the international level.</td>
</tr>
<tr>
<td><strong>QRA Studies</strong></td>
<td>FAO/WHO expert groups have begun to carry out a series of QRA.</td>
</tr>
<tr>
<td><strong>Data Gaps</strong></td>
<td>Data gaps in hazard characterization and exposure assessment.</td>
</tr>
<tr>
<td><strong>Table 1</strong></td>
<td>Lists the most critical data needs identified.</td>
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Data for the different components of a risk assessment may be obtained from a variety of epidemiological sources. Risk assessors will often use epidemiological information from surveillance, outbreak investigations, surveys, and analytical studies to provide information on host characteristics, dose response, outcome of infection and patterns of exposure. Epidemiologists conduct investigations for the purpose of controlling disease, not specifically for gathering data for risk assessment. This means that the data collected for surveillance or during investigation of outbreaks are often insufficient in quality or quantity for QRA purposes.

There are three ways that epidemiologists collect data, through surveillance activities, outbreak investigations and conducting special studies.

Routine Surveillance. Surveillance of human illness provides information about illnesses possibly due to food. It is important to distinguish the relationship between exposure and infection and between exposure and illness. Public health surveillance is conducted only on persons who become ill. Routine surveillance provides information on trends in illness and therefore facilitates detection of outbreaks and the estimation of the burden of illness. Routine surveillance may also be conducted for non-infectious factors of public health importance, such as human behavior, food consumption, or environmental exposures. Another form of routine surveillance data that can be useful QRA is microbiological monitoring data of pathogens in animals, foods, and environment.
These data are often managed by a variety of institutions. As a consequence data is not easily integrated.

**Enhanced Surveillance.** An approach to more complete data for epidemiological purposes and QRA is to enhance routine surveillance of foodborne disease. Health agencies can make simple enhancements to surveillance, such as: routine follow-up of people who are infected with a foodborne pathogen to determine rates of exposure and illness outcomes. There are several examples of enhanced surveillance systems such as FoodNet in the United States and OzFoodNet in Australia. Enhanced surveillance can provide more complete information such as burden of illness with regards to hospitalization and deaths, characterization of pathogens by subtype, completeness and quality of routine surveillance, underlying illnesses and other characteristics of ill population, sequelae following foodborne illness.

**Integrated Surveillance.** The ideal situation for surveillance is integration of human, animal, and food surveillance activities. This involves collecting consistent and validated information from processes throughout the food continuum from farm to fork. There are many stakeholders in food safety and many potential sources of routine surveillance data. The challenge is to develop a structure that ensures the systematic collection, collation, analysis and interpretation of surveillance data. To facilitate these activities, a coordinating body or steering committee with representatives of all stakeholders may be formed. The integration of surveillance data in a coherent fashion and its subsequent interpretation may be the task of a specialized multidisciplinary research unit, which reports to a relevant coordinating body or steering committee. The evaluation by this committee can then lead to a coordinated response.

**Outbreak Investigations.** Outbreaks investigations represent a natural source of useful data for QRA. In the majority of foodborne disease outbreaks, the contaminated food is no longer available for testing, as it has been consumed or discarded. Even when the food is available, the food may not have been properly preserved, and laboratories may not be able to quantify the amount of pathogens in the food. Patient recall of food history often limits collection of information about the types and amounts of foods ingested. However, on occasions, certain outbreaks provide valuable information for risk assessments. It may be possible to increase the frequency of useful information collected with additional epidemiological resources.

**Special Epidemiological studies.** These studies are often costly and require intense planning. They generally focus on sporadic illness and include cross-sectional, case control, cohort or experimental designs. An example of a special study is the a priori selection of an outbreak to obtain data for a QRA. It is important to recognise that dose-response information only needs to be obtained from certain outbreaks. The characteristics of an outbreak where this might be obtained are where the food vehicle is identified quickly, illness etiology is known, the laboratory is adequately resourced (preferably before the outbreak occurs), specific food is available for testing, food and pathogens are stable, and the pathogen characteristics are known.
5.5. Considerations for Developing Countries

While the data needs are if anything more acute in developing countries, in general, the resources to conduct QRA are lacking. Rather, the emphasis must be on developing basic epidemiological data that bear on the general problem of foodborne diseases.

Among the most fundamental needs are demographic data on the population and basic sanitation surveys that cover access to water (quality and quantity) and waste disposal. These baseline data will be essential to risk analysis work. Indeed, infections commonly thought of as foodborne in developed countries (e.g., salmonellosis and campylobacteriosis) may be more often spread by water or person-to-person.

Many data already exist on syndromically defined diarrheal disease, although these data may be of poor quality, use non-specific case definitions and come from poorly defined populations. Even in the absence of laboratory services, these kind of data can be developed more systematically in selected areas and can be expanded to include information about the severity and impact of disease: work loss, medical visits, costs of treatment, hospital admission, death, etc.

In the absence of local information, data from neighboring countries, or surveys that may have already been done, including published studies can be used. Basic laboratory services are required to develop a more sophisticated profile. These resources should be focused in selected sentinel sites, using appropriate sampling strategies to assess the prevalence of various pathogens in patients with diarrheal disease. Ideally, such surveys would include methods to identify common bacterial, parasitic, and viral enteric pathogens. Depending on the resources available for laboratory development, some testing (particularly viral) may need to be done with collaborating institutions elsewhere. Data about the relative prevalence of specific pathogens may provide some clues to dominant modes of transmission. There is a consensus that more useful data will be obtained from smaller, focused studies that can be sustained, rather than from larger, one-time surveys. Prevalence data should initially be generated for foods at retail/consumer levels (including street vendors) and later in raw materials.

It is noted that the prevalence of HIV/AIDS in some countries may have a very significant impact on both the incidence of diarrheal disease and the etiologic fractions. This increases the need to understand the role of foodborne disease among persons with HIV/AIDS.

Data about food consumption patterns and food preparation habits are essential for making even rough risk assessments. Some of these data may already be available through nutritional surveys conducted nationally or under the aegis of FAO, WHO, or other agencies.

Although the vast majority of cases are likely to be sporadic rather than outbreak-related, outbreak investigations may be of disproportionate value for follow-up. In addition to their immediate public health impacts, outbreaks provide opportunities for
epidemiologists, laboratorians, and others to work together and to develop skills and confidence that are essential to capacity development. Food safety programs must include outbreak management. Core data elements should be collected using a standardized methodology and collated by regional and/or national authorities. This capability implies the availability of epidemiology trainers and appropriate training materials, such as a WHO guide.

Environmental surveys will add additional dimensions to any analysis. The importance of water in foodborne and diarrheal disease transmission in developing countries cannot be overemphasized, and water quality surveys in commercial as well as residential settings will be important. Other surveys should cover the prevalence of Good Agricultural Practices (GAP), Good Hygiene Practices (GHP), and HACCP in the relevant sectors, and—while more difficult, should explore food handling practices by the general population.

5.6. Conclusions and recommendations

1. To achieve a risk-based food safety program to reduce or prevent foodborne diseases, WHO member countries should invest resources in public health surveillance and the integration of epidemiologic and risk analysis activities at the national and international levels.

2. Risk managers, in consultation with epidemiologists, risk assessors, and other stakeholders, should develop a prioritized list of pathogens and/or foods for which extra data are needed.

3. WHO member countries should encourage epidemiologists and risk assessors to identify characteristics of outbreaks that may provide relevant data for quantitative risk assessment and secure adequate laboratory support. Countries should also develop mechanisms for collecting and collating enhanced food microbiologic information that can be obtained in outbreak settings by developing mechanisms to obtain food samples and to quantitatively analyse these samples.

4. Countries should move toward integrating surveillance systems for human and animal disease and monitoring systems for food contamination. Integration would also assist quantitative risk assessment.

5. WHO should establish clearinghouses or other exchange mechanisms for raw data and results of data analysis as well as appropriate control of use of shared data.

6. WHO should support the efforts of developing countries to assess their capacity to collect and use basic epidemiological data. WHO should foster partnerships between developed and developing countries for active support (technology transfer, financial support) of the latter.
Table 1: Analysis of microbiological risk assessment data requirements.

<table>
<thead>
<tr>
<th>Risk Assessment component</th>
<th>Description</th>
<th>Rationale</th>
<th>Challenges</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Hazard Identification</td>
<td>Describe most important food/commodity combinations for risk management and assessment.</td>
<td>Surveillance identifies syndromes or pathogens.</td>
<td>Available surveillance data mainly from developed countries. Difficult to establish attributable fraction that is foodborne.</td>
<td>Extend surveillance to include developing countries. Develop specific studies to attribute risks to different transmission routes.</td>
</tr>
</tbody>
</table>
Table 1: Analysis of microbiological risk assessment data requirements.

<table>
<thead>
<tr>
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<th>Challenge</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard characterization</td>
<td>The probability of infection or illness as a function of the ingested dose and relevant factors related to pathogen, host and matrix.</td>
<td>To predict the public health impact of various rates of food contamination. Ethical considerations limit the availability of volunteer experiments.</td>
<td>Unavailability of food for quantitative microbiological analysis. Unavailability of resources for food analysis. Inability to back calculate the consumed dose. Lack of clearly defined virulence factors. Lack of subtyping schemes linked to virulence or clinical outcome. Published reports include only aggregate data, not individual records.</td>
<td>Extended storage of control food samples in institutional settings or commercial kitchens. Develop laboratory animal models. Making available food microbiology resources for selected field studies. Explore unpublished epidemiological studies and conduct other data-mining activities. Develop strain sets from well investigated epidemiological studies and extensively type or assay virulence.</td>
</tr>
</tbody>
</table>
### Table 1: Analysis of microbiological risk assessment data requirements.

<table>
<thead>
<tr>
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<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sequelae and Mortality</strong></td>
<td>Probability of sequelae and mortality resulting from acute illness and relevant host factors (e.g. age).</td>
<td>The public health burden of rare sequelae or mortality is considerable and may outweigh the effects of acute illness.</td>
<td>Limited availability of data on unselected populations. Small probabilities require large cohorts for accurate results.</td>
<td>Follow-up studies on patients identified in population-based surveillance or in large outbreaks. Develop registry-based studies.</td>
</tr>
<tr>
<td><strong>Host factors</strong></td>
<td>Defining characteristics of the infected/ill/control population.</td>
<td>Host factors may influence the probability of infection at low dose, as well as the probability of illness and severe outcomes resulting from infection.</td>
<td>Ill defined host factors that predict increased risk. Sub-populations may bear disproportionate risks. Cannot measure protective immunity for enteric infectious illness or quantify the impact on dose response relationships.</td>
<td>Basic research on physiopathology and virulence factors. Register based studies to follow up large cohorts of patients. Coordinate with ongoing chronic disease and lifetime health studies. Extend acute clinical epidemiological studies to evaluate the effect of host factors on development of chronic effects.</td>
</tr>
</tbody>
</table>
Table 1: Analysis of microbiological risk assessment data requirements.

<table>
<thead>
<tr>
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<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>III</td>
<td>Pathogen load</td>
<td>Prevalence and concentration of the pathogen along the food chain.</td>
<td>To assess the concentration of the pathogen at the step closest to consumption and any prior prevention point in the production chain.</td>
<td>Limited insight in the complexity of the food production system. Non random sampling schemes. Qualitative data. Data from different modules are unlinked.</td>
</tr>
</tbody>
</table>
Table 1: Analysis of microbiological risk assessment data requirements.

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<tr>
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<tr>
<td>Consumption</td>
<td>Amount and frequency of food consumed, for general and high risk populations.</td>
<td>To assess the population at risk and to quantify its exposure.</td>
<td>Current food intake surveys do not record information important for microbial food safety and many have broad food categories, e.g. &quot;was milk pasteurized or not?&quot;. Consumption is regionally specific and cannot be generalized from one region to the other.</td>
<td>Use special studies to address deficiencies in existing datasets. Add specific modules to existing surveys. Coordination with chemical risk assessment studies. Data on unmatched controls from epidemiological studies.</td>
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<tr>
<td>Consumer handling, storage preparation</td>
<td>Time/temperature for storage and cooking. Degree of cross-contamination.</td>
<td>Consumer handling influences pathogen numbers in the food as consumed.</td>
<td>Representative and accurate datasets on consumer behavior do not exist. Difficult to model the effects of cross contamination.</td>
<td>Observational studies on food handling practices. Improve survey instruments using current developments in social sciences. Develop standardized scenarios for consumer behavior.</td>
</tr>
</tbody>
</table>
Table 1: Analysis of microbiological risk assessment data requirements.

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</thead>
<tbody>
<tr>
<td>IV Risk characterization</td>
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<tr>
<td>Attributable fraction</td>
<td>Estimate of incidence of illness attributable to specific food commodities.</td>
<td>Validate outcome of QRA studies.</td>
<td>All available data are used in model development.</td>
<td>Better understanding of causal pathways.</td>
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<td></td>
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<td>Resolution of epidemiological studies not high enough.</td>
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<tr>
<td>Economic impact of foodborne illness</td>
<td>Use of medical case, assessment of quality of life, cost benefit to industry.</td>
<td>Societal costs are important in the decision making process.</td>
<td>Datasets exist but have not been aggregated.</td>
<td>Aggregate existing data.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Questionnaires do not include adequate economic metrics.</td>
<td>Include economic aspects into epidemiological studies.</td>
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</table>
### Annex 1 – Meeting Agenda

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday 26 November 2001</th>
<th>Speaker</th>
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</thead>
<tbody>
<tr>
<td>9.00-9.45</td>
<td><strong>Opening Session</strong></td>
<td>G. Rodier (Director WHO/CSR)</td>
</tr>
<tr>
<td></td>
<td>• Opening and Welcome</td>
<td>J. Schlundt (Coordinator WHO/FOS)</td>
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<tr>
<td></td>
<td>• Introductions</td>
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<tr>
<td>9.45-10.00</td>
<td>• Election of Chairperson and Vice-Chairperson</td>
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<tr>
<td></td>
<td>• Appointment of Rapporteur</td>
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<td>• Adoption of the agenda</td>
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<td></td>
<td>• House-keeping</td>
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<tr>
<td>10.00-10.45</td>
<td><strong>Tea/Coffee break</strong></td>
<td></td>
</tr>
<tr>
<td>10.45-11.15</td>
<td><strong>Session I: Overview Foodborne Disease Surveillance and Risk Analysis</strong></td>
<td>R. Tauxe (USA)</td>
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<tr>
<td></td>
<td>• Overview of foodborne disease surveillance</td>
<td></td>
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<tr>
<td>11.15-11.45</td>
<td>• Overview of risk analysis and its interactions with surveillance</td>
<td>E. Esteban (USA)</td>
</tr>
<tr>
<td>11.45-12.15</td>
<td>• FAO/WHO microbial risk assessment studies</td>
<td>S. Cahill (FAO/WHO)</td>
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<tr>
<td></td>
<td><strong>Session II: Foodborne Disease Surveillance Networks</strong></td>
<td></td>
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<tr>
<td>12.15-12.30</td>
<td>• WHO Survey of international foodborne disease and foodborne pathogens surveillance networks</td>
<td>M. Evans (Denmark)</td>
</tr>
<tr>
<td>12.30-12.50</td>
<td>• WHO Global Salmonella Surveillance Programme</td>
<td>H. Wegener (Denmark)</td>
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<tr>
<td>12.50-14.00</td>
<td><strong>Lunch</strong></td>
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<tr>
<td>Time</td>
<td>Monday 26 November 2001</td>
<td>Speaker</td>
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<tr>
<td>14.00 – 14.20</td>
<td>Session II: Foodborne Disease Surveillance Networks (cont’d)</td>
<td>I. Fisher (UK)</td>
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<tr>
<td></td>
<td>• Network of National Enteric Diseases Surveillance Programmes in the EU (EnterNet)</td>
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<tr>
<td>14.20 – 14.40</td>
<td>• The Mediterranean Zoonosis Control programme (MZCP)</td>
<td>P. Economides (Cyprus)</td>
</tr>
<tr>
<td>14.40 – 15.10</td>
<td>• WHO Surveillance Programme for Control of Infections and Intoxications in Europe</td>
<td>B. Röstel (BgVv-FAO/WHO Collaborating Center)</td>
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<td></td>
<td>• C. Tirado (WHO-EURO)</td>
<td>C. Tirado (WHO-EURO)</td>
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<tr>
<td>15.10 – 15.30</td>
<td>• FoodNet</td>
<td>F. Angulo (USA)</td>
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<tr>
<td>15.30 – 15.50</td>
<td>Coffee break</td>
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<tr>
<td>15.50 – 16.10</td>
<td>Session II: Foodborne Disease Surveillance Networks (cont’d)</td>
<td>C. Almeida/M. D’Agostino (PAHO)</td>
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<tr>
<td></td>
<td>• PAHO/WHO Surveillance System on Foodborne Diseases in the Americas</td>
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<tr>
<td>16.10 – 16.30</td>
<td>• CAREC: Surveillance in networks in developing countries</td>
<td>E. Boisson (Trinidad and Tobago)</td>
</tr>
<tr>
<td>16.30 – 16.50</td>
<td>• LCDC/PAHO network: EQC for enteric organisms and antibiotic susceptibility</td>
<td>F. Rodgers (Canada)</td>
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<td>16.50 – 17.10</td>
<td>• PulseNet</td>
<td>E. Ribot (USA)</td>
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<tr>
<td>17.10 – 17.30</td>
<td>• Global outbreak response</td>
<td>D. Werker (WHO)</td>
</tr>
<tr>
<td>17.30-17:45</td>
<td>• Zoonotic human infections and prevalence in foods in EC Europe</td>
<td>A. Kaesbohrer (BgVV-ECref.lab)</td>
</tr>
<tr>
<td>17:45 – 19:15</td>
<td>Reception</td>
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</table>
## Global surveillance of foodborne disease: Developing a strategy and its interaction with risk analysis. Report of a WHO consultation

<table>
<thead>
<tr>
<th>Time</th>
<th>Tuesday 27 November 2001</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>9.00 – 9.20</td>
<td><strong>Session III: Interaction between Foodborne Disease surveillance and Risk Analysis</strong></td>
<td>• Surveillance data needs in hazard characterization • A. Havelaar (The Netherlands)</td>
</tr>
<tr>
<td>9.20 – 9.40</td>
<td></td>
<td>• Surveillance data needs in exposure assessment • M. Potter (USA)</td>
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<tr>
<td>9.40 – 10.00</td>
<td></td>
<td>• Surveillance data needs in risk characterization • A. Lammerding (Canada)</td>
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<tr>
<td>10.00 – 10.30</td>
<td></td>
<td><strong>Coffee break</strong></td>
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<tr>
<td>10.30 – 10.50</td>
<td><strong>Session III: Interaction between Foodborne Disease surveillance and Risk Analysis (cont’d)</strong></td>
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<tr>
<td>10.50 – 11.20</td>
<td></td>
<td>• The Use of Surveillance data in risk management • K. Wachsmuth (USA)</td>
</tr>
<tr>
<td>11.20 – 11.50</td>
<td></td>
<td>• The impact of surveillance data in risk communication • D. Powell (Canada)</td>
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<tr>
<td>11.50 - 12.10</td>
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<td>• An epidemiologist point of view on risk analysis • J. Painter (USA)</td>
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<tr>
<td>12.10 - 12.30</td>
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<td>• Surveillance as a major tool of an integrated approach of food safety • D. Wong (Denmark)</td>
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<tr>
<td>12.30 – 13.30</td>
<td></td>
<td><strong>Lunch</strong></td>
</tr>
<tr>
<td>13.30 – 16.00</td>
<td><strong>Session IV: Working Groups</strong></td>
<td>• Foodborne Disease surveillance and bioterrorism • S. Page (WHO)</td>
</tr>
<tr>
<td>13.30 – 16.00</td>
<td><strong>Working group 1:</strong> (Location: Executive Board Room) Foodborne Disease Surveillance: Network-of-Networks</td>
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<tr>
<td></td>
<td><strong>Working Group 2:</strong> (Location: Room E 232) Surveillance and risk analysis</td>
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<tr>
<td>16.00 - 16.30</td>
<td></td>
<td><strong>Coffee break</strong></td>
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<tr>
<td>Time</td>
<td>Wednesday 28 November 2001</td>
<td>Speaker</td>
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<tr>
<td>9.00 – 10.30</td>
<td>Working Group 1</td>
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<td></td>
<td>(Location: Executive Board Room)</td>
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<td></td>
<td>Working Group 2</td>
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<td>(Location: Room E 232)</td>
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<tr>
<td>10.30 – 11.00</td>
<td>Coffee break</td>
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<tr>
<td>11.00 – 12.30</td>
<td>Plenary</td>
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<tr>
<td>12.30 – 14.00</td>
<td>Lunch</td>
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<tr>
<td>14.00-16.00</td>
<td>Working Groups 1 and 2</td>
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<tr>
<td>16.00 -  16.30</td>
<td>Coffee break</td>
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<tr>
<td>16.30- 18.00</td>
<td>Working Groups 1 and 2</td>
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</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Thursday 29 November 2001</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>9.00 – 10.30</td>
<td>Report</td>
<td></td>
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<tr>
<td>10.30 – 11.00</td>
<td>Coffee break</td>
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<tr>
<td>11.00 – 12.30</td>
<td>Report</td>
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<tr>
<td>12.30 – 14.00</td>
<td>Lunch</td>
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</tr>
<tr>
<td>14.00 – 16.00</td>
<td>Adoption of Report</td>
<td></td>
</tr>
</tbody>
</table>
Annex 2 – List of participants

Dr Awa Kane Aidara  
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