



FOOD SAFETY AND FOODBORNE ILLNESS

Food safety is an increasingly important public health issue. Governments all over the world are intensifying their efforts to improve food safety. These efforts are in response to an increasing number of food safety problems and rising consumer concerns.

Definition of Foodborne Illness: Foodborne illnesses are defined as diseases, usually either infectious or toxic in nature, caused by agents that enter the body through the ingestion of food. Every person is at risk of foodborne illness.

Magnitude of Foodborne Illness: Foodborne diseases are a widespread and growing public health problem, both in developed and developing countries.

- The global incidence of foodborne disease is difficult to estimate, but it has been reported that in 2000 alone 2.1 million people died from diarrhoeal diseases. A great proportion of these cases can be attributed to contamination of food and drinking water. Additionally, diarrhoea is a major cause of malnutrition in infants and young children.
- In industrialized countries, the percentage of people suffering from foodborne diseases each year has been reported to be up to 30%. In the United States of America (USA), for example, around 76 million cases of foodborne diseases, resulting in 325,000 hospitalizations and 5,000 deaths, are estimated to occur each year.¹
- While less well documented, developing countries bear the brunt of the problem due to the presence of a wide range of foodborne diseases, including those caused by parasites. The high prevalence of diarrhoeal diseases in many developing countries suggests major underlying food safety problems.
- While most foodborne diseases are sporadic and often not reported, foodborne disease outbreaks may take on massive proportions. For example, in 1994, an outbreak of salmonellosis due to contaminated ice cream occurred in the USA, affecting an estimated 224,000 persons. In 1988, an outbreak of hepatitis A, resulting from the consumption of contaminated clams, affected some 300,000 individuals in China.

Major Foodborne Diseases from Microorganisms

- **Salmonellosis** is a major problem in most countries. Salmonellosis is caused by the *Salmonella* bacteria and symptoms are fever, headache, nausea, vomiting, abdominal pain and diarrhoea. Examples of foods involved in outbreaks of salmonellosis are eggs, poultry and other meats, raw milk and chocolate.

¹ Mead, et al., *Food-Related Illness and Death in the United States*, Emerging Infectious Diseases, Vol.5, No.5, September/October 1999.

- **Campylobacteriosis** is a widespread infection. It is caused by certain species of *Campylobacter* bacteria and in some countries, the reported number of cases surpasses the incidence of salmonellosis. Foodborne cases are mainly caused by foods such as raw milk, raw or undercooked poultry and drinking water. Acute health effects of campylobacteriosis include severe abdominal pain, fever, nausea and diarrhoea. In two to ten per cent of cases the infection may lead to chronic health problems, including reactive arthritis and neurological disorders.

- **Infections due to enterohaemorrhagic** (causing intestinal bleeding) *E. coli*, e.g. *E. coli* O157, and **listeriosis** are important foodborne diseases which have emerged over the last decades. Although their incidence is relatively low, their severe and sometimes fatal health consequences, particularly among infants, children and the elderly, make them among the most serious foodborne infections.

Pathogenic *Escherichia coli* strains, such as *E. coli* O157, which produce a potent (vero-) toxin cause haemorrhagic infections in the colon, resulting in bloody diarrhoea or life-threatening complications such as kidney failure. *E. coli* O157 outbreaks have been mainly related to beef, but sprouts, lettuce and juice have also caused outbreaks.

Listeria monocytogenes is the cause of listeriosis which has a fatality rate of up to 30%. The most frequent effects are meningitis and miscarriage or meningitis of the foetus or newborn. Many types of foods have been implicated in listeriosis cases. Often a long refrigeration period seems to have contributed to outbreaks.

- **Cholera** is a major public health problem in developing countries, also causing enormous economic losses. The disease is caused by the bacterium *Vibrio cholerae*. In addition to water, contaminated foods can be the vehicle of infection. Different foods, including rice, vegetables, millet gruel and various types of seafood have been implicated in outbreaks of cholera. Symptoms, including abdominal pain, vomiting and profuse watery diarrhoea, may lead to severe dehydration and possibly death, unless fluid and salt are replaced.

Other Food Safety Problems: Some major examples are:

- **Naturally occurring toxins**, such as mycotoxins, marine biotoxins, cyanogenic glycosides and toxins occurring in poisonous mushrooms, periodically cause severe intoxications. Mycotoxins, such as aflatoxin and ochratoxin A, are found at measurable levels in many staple foods; the health-implications of long-term exposure of such toxins are poorly understood.
- **Unconventional agents** such as the agent causing bovine spongiform encephalopathy (BSE, or "mad cow disease"), is associated with variant Creutzfeldt-Jakob (vCJD) Disease in humans. Consumption of bovine products containing brain tissue is the most likely route for transmission of the agent to humans.

² Buzby and Roberts, *Economic costs and trade impacts of microbial foodborne illness*, World Health Statistics Quarterly, Vol. 50, No 1-2, 1997.

³ Report of a Joint FAO/PAHO/WHO Technical Consultation, Buenos Aires, April 6-8, 1992.

- **Persistent Organic Pollutants (POPs)** are compounds that accumulate in the environment and the human body. Known examples are **Dioxins** and **PCBs (polychlorinated biphenyls)**. Dioxins are unwanted byproducts of some industrial processes and waste incineration. Exposure to POPs may result in a wide variety of adverse effects in humans.
- **Metals:** such as lead and mercury, cause neurological damage in infants and children. Exposure to cadmium can also cause kidney damage, usually seen in the elderly. These (and POPs) may contaminate food through pollution of air, water and soil.

Costs of Foodborne Diseases

- Food contamination creates an enormous social and economic burden on communities and their health systems. In the USA, diseases caused by the major pathogens alone are estimated to cost up to US \$35 billion annually (1997) in medical costs and lost productivity.² The re-emergence of cholera in Peru in 1991 resulted in the loss of US \$500 million in fish and fishery product exports that year.³

Challenges and Developments in Food Safety

The safety of food derived from **biotechnology** needs to be carefully assessed. To provide the scientific basis for decisions regarding human health, new methods and policies to assess such food need to be developed and agreed upon internationally. The assessment should consider health benefits as well as possible negative health implications. Crops modified to resist pests, foods with allergens removed or food with an increase of essential nutrients are possible examples of the former, while anti-microbial markers in some genetically modified foods have been suggested to be an example of the latter. The weighing of potential risks and benefits is an important aspect of assessment of foods derived from biotechnology that has not received much attention in the past. Likewise, clear communication of the basis for safety assessment in this area is generally lacking at national and international levels.

If not properly monitored and assessed, changes in animal husbandry practices, including feeding, may have serious implications for food safety. For example, increased use of ruminant bone and meat meal as feed supplement for cattle appear to have played a role in the emergence of BSE.

Adding low levels of antibiotics to animal feed in order to increase growth rate has raised concern about the transfer of antibiotic resistance to human pathogens from this practice.

Modern intensive agricultural practices contribute to increasing the availability of affordable foodstuffs and the use of food additives can improve the quality, quantity and safety of the food supply. However, appropriate controls are necessary to ensure their proper and safe use along the entire food chain. Pre-market review and approval followed by continuous monitoring are necessary to ensure the safe use of pesticides, veterinary drugs and food additives.

Other challenges, which need to be addressed to help ensure food safety, include the globalization of trade in food, urbanization, changes in lifestyles, international travel, environmental pollution, deliberate contamination and natural and manmade disasters. The food production chain has become more complex, providing greater opportunities for contamination and growth of pathogens. Many outbreaks of foodborne diseases that were once contained within a small community may now take on global dimensions.

Future Directions for Food Safety at the World Health Organization (WHO)

In partnership with other stakeholders, WHO is developing policies that will further promote the safety of food. These policies cover the entire food chain from production to consumption and will make use of different types of expertise.

Work of the WHO Food Safety Programme and other WHO programmes and departments includes strengthening food safety systems, promoting good manufacturing practices and educating retailers and consumers about appropriate food handling. Education of consumers and training of food handlers in safe food handling is one of the most critical interventions in the prevention of foodborne illnesses.

- WHO is promoting in-country laboratory-based surveillance of priority foodborne diseases in humans and animals, as well as the monitoring of pathogens in food. In cooperation with its Member States, WHO is working to support the development of internationally agreed-upon guidelines for data collection in countries. WHO is also compiling outbreak and surveillance databases, and is broadening its epidemic surveillance capacity to include foodborne disease outbreaks.
- WHO is expanding its global network of participating institutions to monitor chemical contamination of the food supply, particularly in developing countries.
- WHO is promoting the use of all food technologies which may contribute to public health, such as pasteurization, food irradiation and fermentation.
- WHO has undertaken an important new initiative to strengthen the scientific basis of food safety activities through the establishment of a WHO/FAO (Food and Agriculture Organization of the United Nations) expert advisory body to assess microbiological risks in food.
- WHO is increasing its involvement in the work of the FAO/WHO Codex Alimentarius Commission, whose standards, guidelines and recommendations are regarded as the international reference for food safety requirements by the World Trade Organization. WHO and FAO is initiating a thorough review of Codex primo 2002.
- Biotechnology has become a major public issue in developed as well as developing countries. WHO, jointly with FAO, will convene a series of expert consultations to assess the safety and nutritional aspects of foods derived from genetically modified plants, microorganisms, and animals. WHO has initiated work to establish a knowledge base focusing on a broader evaluation of risks, benefits and other considerations related to the production and consumption of foods derived from biotechnology.

TO IMPROVE HEALTH AND BOOST ECONOMIC DEVELOPMENT, COUNTRIES STRIVE FOR BETTER FOOD SAFETY

Lessons Learned Shared at Global Forum

Marrakech — The first ever Global Forum of Food Safety Regulators opened today, seeking ways to improve the safety of food worldwide at every step of the food production chain — from farmers, through processors and retailers, to consumers.

Over the next three days, some 300 participants from 120 countries and organizations will present and discuss their successes and mistakes in fighting foodborne disease. Lessons learned at the Global Forum will help countries improve their food safety strategies and systems, and ultimately reduce the large foodborne disease burden.

Participants will consider, among other issues, the handling of food safety emergencies, tackling currently identified and emerging microbiological and chemical hazards and meeting the needs of developing countries.

New challenges in food safety have arisen as a result of changes in microbiological and chemical hazards, shifts in consumption patterns, urbanization, new food production methods, modern technology and increases in international trade and travel.

Foodborne disease is of great concern. According to World Health Organization (WHO) estimates, more than 2 million people — principally children — die every year from diarrhoea caused by consuming contaminated food and water. Even in industrialized countries, as much as one-third of the population experiences foodborne disease every year. Food safety, a critical area of public health, is a high priority for both WHO and the UN Food and Agriculture Organization (FAO).

Dr Gro Harlem Brundtland, WHO Director-General, said, "Many countries are reporting significant increases in foodborne disease. We must reflect on these trends. We must try to improve our food safety systems, and avoid repeating past mistakes. WHO, together with FAO and our Member States, are working hard to develop new evidence-based, preventative strategies to lower disease risk throughout the whole food production chain."

The main hazards are well identified and there are proven, cost-effective measures that protect populations against them. Some countries have intensified efforts against certain pathogens, and have obtained good results in five to ten years. The first step is for a government to set food safety high on the political agenda.

Food safety problems can have serious consequences on a country's economy. According to the United Kingdom's Department for Environment, Food and Rural Affairs, gross public expenditures as a result of the Bovine Spongiform Encephalopathy (Mad Cow disease) crisis were an estimated £3.4 billion from 1996-2000. Food safety problems hurt developing countries by hindering their economic development. Food exports, an important source of foreign exchange and revenue, are refused if they do not meet the standards of importing countries resulting in the loss of jobs in the food and agriculture industries of developing countries. Productivity suffers in all sectors because so many workers fall ill. International tourism cannot achieve its full potential.

"Food safety is a shared responsibility of developed and developing countries," FAO Director-General Dr Jacques Diouf told the Forum. "With the increasing globalization of trade in food products, health requirements applied by importing countries must seek to protect consumers and not to raise technical barriers to trade."

Dr Diouf urged "developed countries to provide the developing countries with their technical and financial support."

The Global Forum will help build international cooperation among countries on food safety. With the food supply becoming more global, no country can solve food safety problems alone.

FAO and WHO jointly convened the Forum at the recommendation of their member countries. The final communiqué of the G-8 Summit, held in Okinawa, Japan in 2000, called on the two UN agencies to "organize periodic international meetings of food safety regulators".

For further information, please contact: Mr John Riddle, FAO Information Officer, Mobile: +39 348 257 2921; E-mail: john.riddle@fao.org or Ms Melinda Henry, WHO Public Information Officer, Mobile: +41 79 244 6073; E-Mail: henrym@who.int

The Global Forum of Food Safety Regulators' web site is: <http://www.foodsafetyforum.org/global/>

All WHO Press Releases, Fact Sheets and Features, as well as other information on this subject can be obtained on Internet on the WHO home page: <http://www.who.int>

ARSENIC – MASS POISONING ON AN UNPRECEDENTED SCALE

Geneva, March 2002—The largest mass poisoning of a population in history is now underway in Bangladesh.

It is a terrible public catastrophe, asserts Allan H. Smith, Professor of Epidemiology at the University of California, Berkeley, and a WHO consultant who has investigated arsenicosis in Bangladesh on several trips.

The number of people affected by this arsenic disaster is among the greatest of any disease facing the world today. "By virtue of its sheer size it is pushing the limits of our knowledge and capacity to respond to it," asserts Professor Hans van Ginkel, Rector of the United Nations University in Tokyo.

The crisis has, however, spurred intense research in water de-contamination techniques. How to ensure tens of millions of people arsenic-free drinking water when their water supply comes from wells, many of them rich in arsenic.

How many Bangladeshi are exposed to a high level of arsenic? Estimates vary from a low of 28-35 million to a high of 77 million, more than half the population of the country.

The Bangladeshi are being poisoned by drinking well water, usually without knowing it. Only three decades ago health and development experts, and small local contractors, dug between 7-11 million deep tube wells throughout Bangladesh. The experts encouraged the whole nation to drink well water because it was safe. It was free of the bacteria that caused water-borne diseases such as diarrhoea and other intestinal maladies that have long plagued tropical Bangladesh.

Ironically, the people of Bangladesh exchanged water-borne diseases for arsenicosis. In the 1970s public health specialists and government policy-makers did not think of arsenic. It was only in 1993 that the "clean" well water was discovered to contain dangerous quantities of the poison.

Arsenicosis can cause skin cancer as well as cancers of the bladder, kidney and lung, and diseases of the blood vessels of the legs and feet, and possibly diabetes, high blood pressure and reproductive disorders.

WHO's most recent guideline for a maximum amount of arsenic in drinking water recommends 10 parts per billion (ppb). That was in 1993 when it was lowered to that level from 50 ppb. A new guideline is anticipated in 2003. But most water that is drunk in arsenic affected areas in Bangladesh has substantially higher levels, frequently far above 50 ppb.

Arsenic-contaminated water is not restricted to developing countries. In the western states of the United States of America about 13 million people drink arsenic-tainted water, albeit less contaminated than the well water in Bangladesh. Australia, too, has arsenic-contaminated water. So do Argentina, Brazil, Chile, Hungary, Mexico, Taiwan (Province of China), Thailand, Viet Nam, and the eastern areas of India in Bengal.

"Unfortunately," says WHO sanitary engineer, Hiroki Hashizume, a Japanese expert on arsenic, "it is virtually impossible, with present measurement techniques, especially in the developing world, to measure quantities below 10 ppb. When drinking water guidelines or national standards are established, careful attention has to be paid to analytical capability, arsenic removal technology, etc., to ensure that the levels are really achieved. Since the principal health gain comes from targeting those most exposed to arsenic poisoning, using an intermediate target of 50 ppb, until a lower target can be achieved, would already improve people's health given Bangladesh's limitations.

"Another unfortunate and complicating fact about arsenic poisoning," Hiroki Hashizume adds, "is that it generally takes from seven to 10 years, sometimes longer, for the disease to be recognized. When it finally is, it may be too late to treat."

Professor Robert Goyer, who headed a nine-member commission of the US National Academies of Science, says its findings bolster a 1999 study by the Academy that found that men and women who drink every day water with 10 ppb of arsenic have an increased risk of more than 3 in 1000 of developing bladder or lung cancer during their lifetime. That risk rises to 7 in 1000 at 20 ppb.

Arsenicosis is recognizable from skin color changes, blotches all over the face and body, hyper pigmentation on the chest and upper arms, hard patches on palms and soles of the feet, inability to walk, debilitating pain, watery eyes.

Recently, a woman staggered into a village in Chandpur District where Nasrine R. Karim, the head of a Bangladeshi non-governmental organization, Earth Identity Project, was visiting arsenic-sick villagers.

"She was in a pitiful state," recalls Nasrine. "She could barely walk or stand up. Her face and body were covered with dreadful splotches. Her hands and the bottoms of her feet were a solid mass of hard patches, her eyes watery. Her lips and tongue were blue. I had never seen a victim of arsenicosis in such a ghastly condition."

Nasrine, whose NGO deals with 5,000 villagers who have been drinking the arsenic-tainted water found in 98% of the area's wells, decided to transport Chandrabanu to Dhaka. There she was given vitamins and was well nourished for her severe malnutrition. Nasrine took the woman into her house for two months.

"During this period she followed the STAR water treatment," Nasrine says. "STAR stands for Stevens Technology for Arsenic Removal. Stevens is an institute in Hoboken, New Jersey, and one of their engineers, an environmental chemist named Xiaoguang Meng, has invented an effective and inexpensive method for filtering out the arsenic from drinking water for individual households.

"You pour well water into a 20-liter bucket and then empty into it a small packet of powder containing 3.8 grams of an iron sulphate mixture with a small quantity of calcium hypochlorite. You stir with a stick for less than a minute. Then pour the water into three or four inches of sand which serve as a filter. To make sure that no arsenic has slipped through the sand, we throw away this first water. The next batch of water flows into a hole in the bucket through a tube into a second bucket. It is perfectly clean and ready to be drunk.

"In about two months Chandrabanu felt and looked well enough to return to her village. Since then, the splotches on her face and body and the hard patches on her feet have disappeared. Today she is no longer in any pain, and she is walking and working. She has improved tremendously, and yet we thought we couldn't possibly save her life. For Chandrabanu it is a miraculous cure. For us at the Earth Identity Project it is a remarkable result, full of hope. I don't dare yet to call it a 'cure,' although it has all the signs of one."

Nasrine says that her 5,000 villagers are all using the same water treatment and "responding favorably. The results are, again, very encouraging."

Jamie Bartram, Coordinator of WHO's Water, Sanitation and Health Programme, says "we know that arsenic is rapidly excreted in urine. So, for early or mild cases of arsenicosis no specific treatment other than clean, safe water is required. Nasrine Karim's experience seems to suggest that ceasing to drink arsenic-tainted water, combined with the natural excretion of the arsenic in urine, can eliminate arsenicosis. Any technique that guarantees uncontaminated water, will do the trick. It remains to be seen, however, whether all the possible long-term after-effects of arsenicosis will really have been eliminated. Basically, clean water is the cure."

Considering what approach one should take for curing or preventing arsenic poisoning, Professor Smith of U. Cal. Berkeley, agrees that "the basic treatment is to supply the patient with drinking water that is free from arsenic. This is the first priority. Indeed, in the absence of good evidence for the effectiveness of other treatments, the second priority is to continue providing arsenic-free water, and the third priority is to monitor patients to ensure that they remain unexposed to arsenic."

And is Nasrine Karim's success on a small scale meaningful for the tens of millions of other Bangladeshi who are exposed to arsenic poisoning?

"I think so," she says. "Instead of paying \$10 for the buckets and importing the chemical packets from the United States, we could easily manufacture them here in Bangladesh in huge quantities and sell them at a far lower price. To do this we need substantial funding. I'm often told that health funding is available if it's for a good cause. Coping with the arsenic poisoning of millions of women, children and men -- 'the largest mass poisoning of a population in history' -- is a good cause, is it not?"