# Food Safety: Challenges, Major Food Borne illnesses, Advance Techniques to Ensure food safety & Future Food safety

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Food Safety as an "assurance that food is acceptable for human consumption according to its intended use." Food Safety ensures that food is safe for human consumption and involves handling, preparation, and storage of food in ways that prevent food borne illness.

## Major challenges of food safety

**Microbiological Safety –** Food by nature is biological. It is capable of supporting the growth of microbials that are potential sources of foodborne diseases. Viruses are more responsible for the majority of foodborne illnesses but hospitalizations and deaths associated with foodborne infections are due to bacterial agents. The illnesses range from mild gastroenteritis to neurologic, hepatic, and renal syndromes caused by either toxin from the disease-causing microbe. Foodborne bacterial agents are the leading cause of severe and fatal foodborne illnesses. Over 90% of food-poisoning illnesses are caused by species of Staphylococcus, Salmonella, Clostridium, Campylobacter, Listeria, Vibrio, Bacillus, and E. coli

**Chemical Safety –** Non-food grade chemical additives, such as colorants and preservatives, and contaminants, such as pesticide residues, have been found in foods. Some food samples had higher levels of heavy metals such as lead, cadmium, arsenic, mercury, and copper than average food samples, suggesting possible leaching from the utensils and inadequate food hygiene.

**Personal Hygiene –** Poor personal hygiene practices of food handler and preparers pose considerable risks to personal and public health. Simple activities such as thorough hand washing and adequate washing facilities can prevent many foodborne illnesses.

**Environmental Hygiene –** Inadequate recycling and waste disposal equipment and facilities lead to the accumulation of spoiled and contaminated food. This leads to an increased pest and insect population that can result in risk of food contamination and spoilage. Poor sanitary conditions in the area where foods are processed and prepared contribute to poor food storage and transport as well as selling of unhygienic food.

## Major foodborne illnesses

**Bacteria –** Salmonella, Campylobacter, and Enterohemorrhagic Escherichia coli (EHE coli) are among the most common foodborne pathogens. Symptoms include fever, headache, nausea, vomiting, abdominal pain and diarrhea. Sources of salmonellosis include eggs, poultry and other products of animal origin. Foodborne Campylobacter is caused by raw milk, raw or undercooked poultry and drinking water. Listeria is found in unpasteurized dairy products and various ready-to-eat foods and can grow at refrigeration temperatures. Vibrio cholerae infects people through contaminated water or food. Symptoms include abdominal pain, vomiting and profuse watery diarrhea, which may lead to severe dehydration and possibly death. Rice, vegetables, millet gruel and various types of seafood have been implicated in cholera outbreaks.

**Viruses –** Norovirus infections are characterized by nausea, explosive vomiting, watery diarrhea and abdominal pain. Food handlers infected with Hepatitis A virus are common source of contamination and spreads typically through raw or undercooked seafood or contaminated raw produce.

**Parasites –** Some parasites, such as fish-borne trematodes, are only transmitted through food. Others, for example Echinococcus spp, may infect people through food or direct contact with animals. Other parasites, such as Ascaris, Cryptosporidium, Entamoeba histolytica or Giardia, enter the food chain via water or soil and can contaminate fresh produce.

**Worms –** Cestodes, nematodes, trematodes and helminths are worms most prevalent in regions where food preparation and storage, personal hygiene, water sanitation and environmental health are not routinely practiced Even though worm related foodborne illness are not as fatal as virus and bacteria, they account for a substantial burned to foodborne disability.

**Chemicals –** Naturally occurring toxins and environmental pollutants have caused many outbreaks. In addition, chemical residues used to eradicate or control pests and worms can be an independent risk of foodborne hazard. Mycotoxins, marine biotoxins, cyanogenic glycosides and poisonous mushrooms are all natural toxins. Staple foods like corn or cereals can contain high levels of mycotoxins, such as aflatoxin and ochratoxin. A long-term exposure can affect the immune system and normal development, or cause cancer.

## Diagnostic advances to ensure food safety

Due to the globalization of the world's food trade, food has become a major pathway for human exposure to pathogenic microbials responsible for foodborne illness entering at many points along the value chain. Thus, tracking and detecting microbials especially pathogenic bacteria in foods back to their sources pose challenges to producer, processor, distributor, and consumer of food alike. Rapid and accurate detection of foodborne pathogens is essential for public health bio-surveillance to prevent foodborne infections and ensure the safety of foods. Detection methods of microbials have improved over time.

### 1. PCR-based

Polymerase chain reaction (PCR) based assay enzyme linked immuno-sorbent assay (ELISA) and instruments rely on extensive enrichment (up to 24 h) to produce enough cells for detection. Following enrichment, the assay requires DNA amplification and detection. The entire process from enrichment through detection may take several hours to days. Because of sample preparation processes and ancillary lab equipment (shakers, incubators, microplate readers) such detection system may not be practical as PONT devices. Another commonly utilized technology is based on either standard or real-time PCR (qPCR) depending on the instrument and takes up to 3.5 h for detection. The system is limited to using PCR method thus unable to perform multiple biomarkers detection.

### 2. NMR-Nanotechnology

Nuclear Magnetic Resonance (NMR) nanotechnology platform detects multiple target microbials hybridizing to pathogen's DNA or protein in same the device chamber that runs assays using nucleic acid, antibodies, and other biomarkers [30]. Orthogonal confirmatory tests can be achieved via multiple biomarkers of single microbial in same detection device. This raises specificity and accuracy thus serving as both screening and confirming tool at the same time. It has a dynamic range of 8 log before saturation, more sensitive than other systems due to standard amplification process plus signal amplification through the nanoparticles. Hence, this technology increases the sensitivity and specificity of detecting target microbial. End point PCR can be applied on DNA amplification while antibody ligands method can be used for protein structure amplification. Multiplexing with large sample volume enables multiple biomarker measurements to be analysed thus further increases specificity of the detection method.

## The future food safety

Safe food provides basic human necessity. It supports national economy, trade and tourism, contributes to nutrition security, and underpins sustainable development. Globalization has triggered growing consumer demand for a wider variety of foods, resulting in an increasingly complex and longer global food chain. As the world's population grows, the intensification and industrialization of agriculture and animal production to meet increasing demand for food creates both opportunities and challenges for food safety. The food producers, distributors, handlers and vendors must bear the primary responsibility to ensure food safety. Consumers should remain vigilant and literate on food safety issues.

## Reference

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