Lecture 2: Food Safety Hazards and Risks and types of food safety hazards

Food safety hazards and risks

"Hazards" refer to conditions or contaminants in foods that can cause illness or injury. It does **not** refer to undesirable conditions or contaminants such as: Insects, Hair, Dirt, Spoilage, Economic fraud and Violations of regulatory food standards not directly related to safety. In the context of food safety, a "hazard" can be classified as a substance or agent present in food that has the ability or the potential to cause an adverse health effect to the consumer. The substance can be a biological, chemical or physical agent. For example, salmonella, a biological agent, may be present in certain food. Ingestion of salmonella may result in food poisoning. Therefore, salmonella in food is considered a biological hazard and may also pose a potential risk to the consumer. Mercury, a natural contaminant that may be present in some foods, is regarded as a chemical hazard and could also pose a potential risk to the consumer.

In determining whether there is a "risk" posed to humans from exposure to a specific hazard through food, there must be a consideration of the likelihood of consumption and the nature or severity of the adverse health effect posed by a certain hazard if consumed. While "risk" already implies the existence of a hazard, it has the additional component of the "chance" or "probability" of that happening to the individual or the population as a whole, as well as taking into account the severity and impact of the health effect that may occur as a result of being exposed to the hazard. For example, although salmonella may be present in certain raw food, the risk of getting salmonella food poisoning is minimal when the food is thoroughly cooked before consumption to eliminate the hazard and thus minimizing the chance of exposure. However, if the food is eaten raw, the health risk from salmonella will be higher as a result of the higher likelihood that the hazard will be present and consumed.

Types of food safety hazards

1. **Biological Hazards**

Foods can contain biological hazards. These hazards can come from raw materials or from food-processing steps used to make the final product. Table 1 provides a list of biological hazards.

Table 1: Biological Hazards

Biological hazard	Symptoms
I. Bacteria	
A. Sporeformers	
Clostridium botulinum	intoxication (botulism) that affects the central nervous system and causes shortness of breath, blurred vision, loss of motor capabilities and death.
Bacillus cereus	severe nausea, vomiting, and diarrhea..
B. Nonsporeformers	
Campylobacter spp.	diarrhea (often bloody), fever, and stomach cramps. Nausea and vomiting may accompany the diarrhea.
Listeria monocytogenes	Fever, chills, headache, arthalgia, exhaustion, malaise, swollen lymph nodes mild flulike symptoms. Severe forms of listeriosis are possible in people with weakened immune systems, causing septicemia, meningitis, encephalitis and stillbirths.
Salmonella spp. (e.g., *S. typhimurium, S. enteriditis*)	nausea, vomiting, abdominal cramps, diarrhea, fever and headache. Death is possible in people with weakened immune systems.
Shigella spp. (e.g., *S. dysenteriae*)	Diarrhea (sometimes bloody), Fever, Abdominal pain, Tenesmus (a painful sensation of needing to pass stools even when bowels are empty)
Staphylococcus aureus	Nausea, vomiting, retching, diarrhea, abdominal pain, exhaustion
Vibrio cholerae	Abdominal cramps, diarrhea, vomiting, fever, malaise, nausea, headache, dehydration
II. Viruses	
Hepatitis A and E	Causes fever and abdominal discomfort, followed by jaundice.
Norwalk virus group	Causes nausea, vomiting, diarrhea and abdominal pain (gastroenteritis). Headache and low-grade fever may also occur.
Rotavirus	Fever, vomiting, watery non-inflammatory diarrhea
III. Parasitic Protozoa and Worms	
Ascaris lumbricoides	Severe abdominal pain. Fatigue. Vomiting. Weight loss or malnutrition. A worm in vomit or stool.

Cryptosporidium parvum	This roundworm causes intestinal and lung infection.
Entamoeba histolytica	This tapeworm attaches itself to the intestinal wall and can grow to 3 to 7 feet. Symptoms include abdominal pain, cramping, flatulence and diarrhea.
Giardia lamblia	This protozoa causes dysentery (severe, bloody diarrhea).
Pseudoterranova dicepiens	This protozoa causes diarrhea, abdominal cramps, fatigue, nausea, flatulence (intestinal gas) and weight loss. Illness may last for one to two weeks, but chronic infections can last months to years.
Taenia solium, T. saginata	Nervousness, insomnia, hunger pains, anorexia, weight loss, abdominal pain, sometimes gastroenteritis
Giardia lamblia	Watery, sometimes foul-smelling diarrhea that may alternate with soft, greasy stools. Fatigue or malaise. Abdominal cramps and bloating. Gas or flatulence. Nausea. Weight loss
Trichinella spiralis	Gastroenteritis, fever, oedema around eyes, perspiration, muscular pain, chills, prostration, laboured breathing

Chemical Hazards

Chemical contamination can happen at any stage in food production and processing. Chemicals can be helpful and are purposefully used with some foods, such as pesticides on fruits and vegetables. Chemicals are not hazardous if properly used or controlled. Potential risks to consumers increase when chemicals are not controlled or the recommended treatment rates are exceeded. The presence of a chemical may not always represent a hazard. The amount of the chemical may determine whether it is a hazard or not. Some may require exposure over prolonged periods to have a toxic effect. Regulatory limits are set for some of those contaminants.

Chemical hazards can be separated into three categories:

- Naturally occurring chemicals.
- Intentionally added chemicals.
- Unintenionally or incidentially added chemicals.

- ***Naturally Occurring Chemicals (including allergens)***

These chemicals are derived from a variety of plants, animals or microorganisms.In most cases, these naturally occurring chemicals are found prior to or during harvest. Although many naturally occurring toxins are biological in origin, they are traditionally categorized as chemical
hazards

Example:
The following are examples of foods containing naturally occurring chemical hazards:

Source	**Why a hazard?**
Certain fish species (e.g., tuna, mahi-mahi)	Spoilage of certain species of fish can result in production of toxic levels of histamine and related compounds.
Nuts, Seafood	Certain varieties or species produce an allergic reaction in sensitive people.
Corn	Certain molds that grow on corn can create toxins (e.g., aflatoxin).
Molluscan shellfish	Some of the microscopic organisms and plants upon which they feed can produce a toxin, such as domoic acid, that affect people but not shellfish.

Intentionally Added Chemicals
These chemicals are intentionally added to food at some point during the food's growth and distribution. Intentionally added chemicals are safe when used at established safe levels but can be dangerous when those levels are exceeded. *Example:* The following are examples of food additives that may be chemical hazards if used improperly:

Source	**Why a hazard?**
FD&C Yellow No. 5(food coloring)	Can produce an allergic-type reaction in sensitive people.
Sodium nitrite (preservative)	Can be toxic in high concentrations.
Vitamin A (nutrient supplement)	Can be toxic in high concentrations.

Sulfiting agents(preservative)	Can cause allergic-type reaction in sensitive people.

Unintentionally or Incidentally Added Chemicals

Chemicals can become part of a food without being intentionally added. These incidental chemicals might already be in a food ingredient when it is received. For example, certain seafood may contain small but legal residues of approved antibiotics. Packaging materials that are in direct contact with ingredients or the product can be a source of incidental chemicals, such as sanitizers or inks. Most incidental chemicals have no effect on food safety, and others are only a concern if they are present in too high an amount. Incidental chemicals also include accidental additions of prohibited substances such as poisons or insecticides that may not be allowed at any level. *Example:* The following are examples of incidental contaminants that may be
chemical hazards:

Source	**Why a hazard?**
Agricultural chemicals (e.g., pesticides, herbicides)	Can be acutely toxic if present in the food at high levels and may cause health risks with long-term exposure.
Cleaning chemicals (e.g., acids, caustics)	Can cause chemical burns if present in the food at high levels.
Maintenance chemicals (e.g., lubricants, paint)	Chemicals that are not approved for food use and may be toxic.

Physical Hazards

Physical hazards include any potentially harmful extraneous matter not normally found in food. When a consumer mistakenly eats the foreign material or object, it is likely to cause choking, injury or other adverse health effects. Physical hazards are the most commonly reported consumer complaints because the injury occurs immediately or soon after eating, and the source of the hazard is often easy to identify. *Example:*The following are examples of materials that may be physical hazards:

Material	**Why a hazard?**
Glass	Cuts, bleeding; may require surgery to find or remove.
Metal	Cuts, broken teeth; may require surgery to remove.
Stone	Can break teeth and cause choking