

The ugly face of Food borne illnesses

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- Safe food handling is vital in preventing food borne infections
- Refrigeration is a key in preventing food borne infections

Food borne illnesses

1. Background
2. Causes of food borne disease
 1. Viruses
 2. Bacteria
 3. Parasite

What is food borne illness?

- Any diseases resulting from the consumption of **contaminated food**, pathogenic bacteria viruses or parasites that contaminate food, as well as chemical or natural toxins

Outbreaks

- Outbreaks of diarrheal illnesses are most often related to food sources
- May result in outbreaks with several affected individuals.
- Can also be associated with animal contacts & recreational water exposure (eg, swimming or wading pools).

Burden of disease

- In resource-rich countries is common
- ~ 1 episode per person per year
 - Acute gastrointestinal illness in adults in **Germany**: a population-based telephone survey. Wilking H et al, Epidemiol Infect. 2013
 - Burden of acute gastrointestinal illness in **Denmark** 2009: a population-based telephone survey. Müller L et al, Epidemiol Infect. 2012
 - Acute gastrointestinal illness in **New Zealand**: a community study. Adlam SB et al, Epidemiol Infect. 2011

- Over estimated or underestimated

Burden of disease

- As most cases of food borne disease are not reported, the true dimension of the problem is unknown.

People with a higher risk



1. Infants



Young children

Feb-19



Pregnant women



Older adult



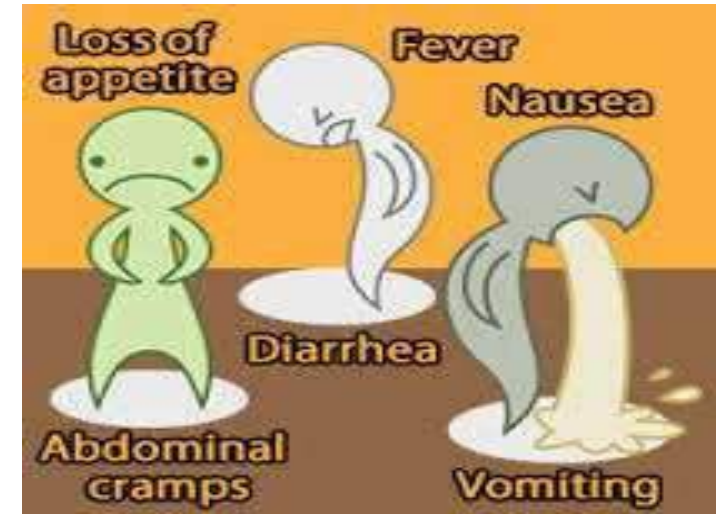
03.Young children



04.Older adult

Manifestations

- Typically manifest as a mixture of:
 - **Diarrhea**
 - **Nausea & vomiting**
 - **Abdominal discomfort.**

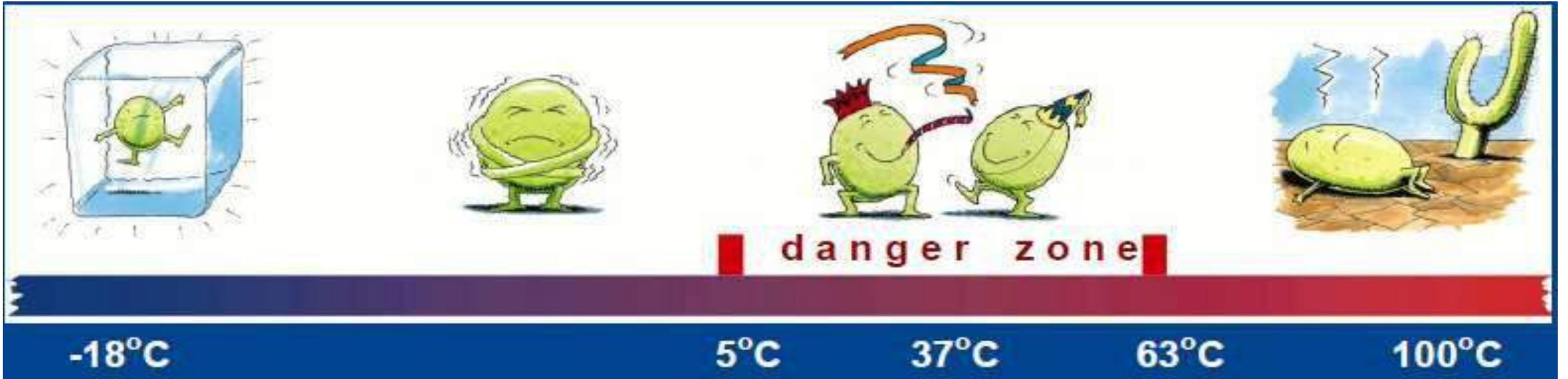


Main causes of food borne disease

- **Cross Contamination:** Occurs when microorganisms are transferred from one surface or food to another.
- **Time temperature abuse:** Happens when food is exposed to Temp. Danger Zone (41^o - 140^oF) (5^o- 60^oC) for > 4 hrs.
- **Poor personnel hygiene:** Food handlers are carriers of disease

DANGER ZONE

On a hot day (90°F or higher), food should not left out for more than 1 hour.



Bacteria multiply rapidly between 5-60°C

THE TWO-HOUR RULE

Refrigerate perishable foods within two hours at a refrigerator temperature of 40°F or lower.

Foods include:

- Meat, poultry, fish, eggs, tofu
- Dairy products
- Pasta, rice, cooked vegetables
- Fresh, peeled/cut fruits and vegetables



RECOMMENDED REFRIGERATOR & FREEZER TEMPERATURES



Set refrigerator at **40° F or below.**

Set freezer at **0° F**

How is it transmitted

- Transmitted through contaminated food or water
- Viral Outbreaks : commonly associated with leafy vegetables
- Bacterial outbreaks: commonly associated with poultry & beef.

Foodborne disease outbreaks in USA

- Usually single etiology.
- **Norovirus:** most commonly identified causative pathogen (43 %)
- ***Salmonella*** second most common etiology (18 %)

R LaRocque et al, Up To Date 2019

Enteric pathogens

Pathogen	Small bowel	Colon
Bacteria	<i>Salmonella</i> * <i>Escherichia coli</i> [†] <i>Clostridium perfringens</i> <i>Staphylococcus aureus</i> <i>Aeromonas hydrophila</i> <i>Bacillus cereus</i> <i>Vibrio cholerae</i>	<i>Campylobacter</i> * <i>Shigella</i> <i>Clostridioides difficile</i> <i>Yersinia</i> <i>Vibrio parahaemolyticus</i> Enteroinvasive <i>E. coli</i> <i>Plesiomonas shigelloides</i> <i>Klebsiella oxytoca</i> (rare)
Virus	Rotavirus Norovirus Astrovirus	Cytomegalovirus* Adenovirus Herpes simplex virus
Protozoa	<i>Cryptosporidium</i> * <i>Microsporidium</i> * <i>Cystoisospora</i> <i>Cyclospora</i> <i>Giardia lamblia</i>	<i>Entamoeba histolytica</i>

* Can involve both the small and large bowel, but are most likely to occur as listed.

† EPEC, EAaggEC, EHEC, ETEC may all contribute; routine laboratories

Up To Date 2019

- Tell me **what** did you eat I tell you what virus/bacteria you have 😊

Differential diagnosis of foodborne disease by item consumed

Item	Commonly associated microbes*
Raw seafood	Norwalk-like virus, <i>Vibrio</i> spp, hepatitis A
Raw eggs	<i>Salmonella</i> spp
Undercooked meat or poultry	<i>Salmonella</i> spp, <i>Campylobacter</i> spp, STEC, <i>Clostridium perfringens</i>
Unpasteurized milk or juice	<i>Salmonella</i> spp, <i>Campylobacter</i> spp, STEC, <i>Yersinia enterocolitica</i>
Unpasteurized soft cheeses	<i>Salmonella</i> spp, <i>Campylobacter</i> spp, STEC, <i>Y. enterocolitica</i> , <i>Listeria monocytogenes</i>
Homemade canned goods	<i>Clostridium botulinum</i>
Raw hot dogs, deli meat	<i>L. monocytogenes</i>

STEC: shiga toxin-producing *Escherichia coli*.

* This is a simplified list. There are many other microbes associated with food.

- Tell me **when** did you eat it; I tell you what virus/bacteria you have 😊

Timing

- **Within hours** of exposure: Ingested preformed toxins
 - E.g, *Staphylococcus aureus* & *Bacillus cereus*
- **After ~ 24 hrs**: Ingested pathogens:
 - To produce toxin, eg, enterotoxigenic *E. coli*
 - Directly damage/ invasion of intestinal epithelial (eg, *Salmonella*, *Campylobacter*, *Shigella*)
- **~7 days** : Protozoal pathogens: eg, *Cryptosporidium parvum*.

Viruses

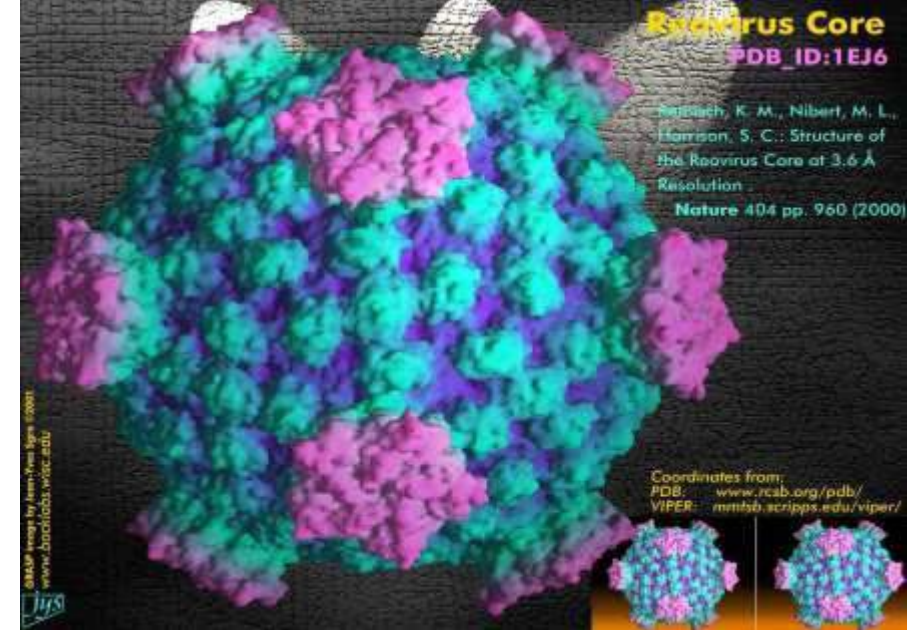
- Most cases are caused by viruses, in particular norovirus
- Testing for viral pathogens is not routinely performed
- Outbreaks due to viruses were most commonly associated with leafy vegetables

Viruses: Norovirus

- Also known as Norwalk-like virus
- Extremely common cause of watery diarrhea
- Low infectious dose (~ 10 particles)
 - Readily transmitted from vomitus & stool of an infected

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- Food Sources : Contaminated water, shellfish from contaminated water, contaminated fruits & vegetables



Viruses: Norovirus

- Responsible for epidemic form of family & community wide outbreaks
- Acute explosive **vomiting & diarrhea**.
- Symptoms begin 24 -48 hs after exposure
- Last for 48 - 72 hours.
- Recovery is rapid & full
- Does **not** result in long-lasting immunity. ☹️

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Other Viruses

- Children:
 - Rotavirus
 - Enteric adenoviruses (serotypes 40 & 41)
 - Astrovirus
 - Sapovirus
- Adults: diarrhea associated with these viruses has been described mainly in immunocompromised or institutionalized patients.

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Bacteria & Parasite

- Outbreaks due to bacteria most commonly associated with **poultry & beef.**

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Bacteria & Parasite

- US Commonest: *Salmonella*: non-typhoidal & *Campylobacter* spp
- Incidence of culture-confirmed cases per 100,000 persons in 2016 was estimated by the FoodNet survey:
- ***Salmonella*: 15.4%** ***Campylobacter*: 11.8%**
- *Shigella*: 4.6% *Cryptosporidium*: 3.7%
- Shiga toxin-producing *E. coli*: 2.8% *Vibrio*: 0.45%
- *Yersinia*: 0.42 % *Listeria*: 0.26%

Marder EP et al, MMWR Morb Mortal Wkly Rep. 2017

Salmonella



- **Poultry, eggs, milk** products, fresh produce, meats, nut products, spices and animal contact.
- Symptoms within 8 - 72 hours following exposure
- Diarrhea, nausea, vomiting, and **fever**
- Diarrhea is not usually grossly bloody.

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Campylobacter *jejuni*

- Undercooked contaminated poultry
- 70-80 % percent of retail poultry is contaminated with *Campylobacter*
- Diarrhea: 2-5 days following exposure ; watery or hemorrhagic

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Shigella

- Mucoid or bloody diarrhea with abdominal cramps and **fever**
- As few as 10 organisms can initiate disease.
- 1-7 days , (average 3 days)

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Enterohemorrhagic *E. coli*: (EHEC),

- Also known as Shiga toxin-producing *E. coli* (STEC)
- Most commonly associated with of undercooked ground beef.
- Transmission also with other foods, uncooked or unpasteurized products
- Onset time : 3-8 days; Symptoms : Bloody diarrhea
- Transmission also with other foods, including produce/other uncooked or unpasteurized products
- Can be complicated by hemolytic uremic syndrome (HUS) Kidney failure

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Enterotoxigenic E. coli

- ETEC: common cause of diarrhea; Sporadic outbreaks
- Travelers' diarrhea, **cruise ship** diarrhea outbreaks
- Transmitted via fecal contamination of food or water from an infected person.

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- The forgotten cause !!!

C. perfringens : Toxin

- Important cause of foodborne
- Toxin-mediated watery diarrhea in resource-rich settings
- US: 2nd most common cause of foodborne bacterial infection (behind non-typhoidal *Salmonella* spp)
- ~1 million illnesses each year

Scallan E et al, Emerg Infect Dis. 2011

- ***Less frequently reported*** as a cause of outbreaks since symptoms are relatively mild & testing is not routinely performed.

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C. perfringens: Type A strains

- Cause typical foodborne outbreaks
- Spores **can survive** normal cooking temp.
- Can germinate & proliferate in foods that are improperly stored.
- Associated with **inadequately heated/reheated meats, poultry, gravy**
- Following ingestion of a **large** quantity of organisms it releases an enterotoxin in GI tract

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C. perfringens: Type A strains

- Incubation period 6-24 hrs (usually 10-12)
- Watery diarrhea & abdominal cramping
- Vomiting & fever can occur but are uncommon.
- Symptoms resolve within 24-48 hrs.
- Restaurants & catering facilities are most frequent food sources
- Outbreaks occur year-round
- Median size of ~ 20 individuals

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Giardia lamblia

- Both epidemic & sporadic cases of diarrhea.
- Most common parasitic causes of diarrhea
- Associated with waterborne & foodborne diarrhea
- Common pathogen in **daycare** center outbreaks.

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Giardia lamblia

- Incubation period: 7 to 14 days
- Diarrhea, abdominal cramps, bloating, foul-smelling stools
- Symptoms can persist for several weeks
- Diagnosis: antigen detection assays, nucleic acid detection assays, microscopic examination of stool

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Cryptosporidium parvum

- Endemic in **cattle**
- Transmission: from infected animal or person, or fecally contaminated environment
- Numerous waterborne community outbreaks
- Immunocompetent hosts: severe dehydrating but self-limited
-
- Immunocompromised hosts: prolonged & severe course

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Summary

- Food borne illnesses are not rare
- Viruses are the commonest: Norovirus
- Bacteria : Salmonella, Campylobacter *jejuni* , E.coli

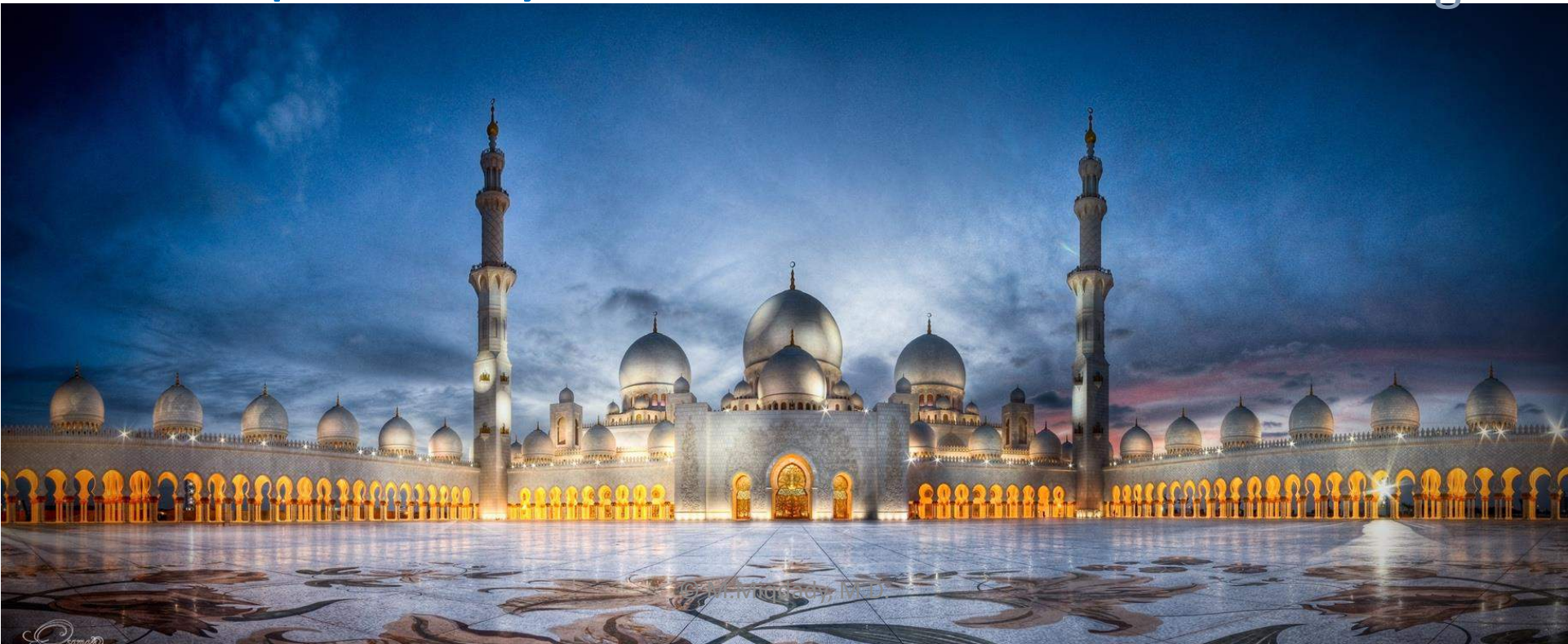
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