SALMONELA

SHIGELLA

PSEUDOMONAS

LEGIONELLA

Properties

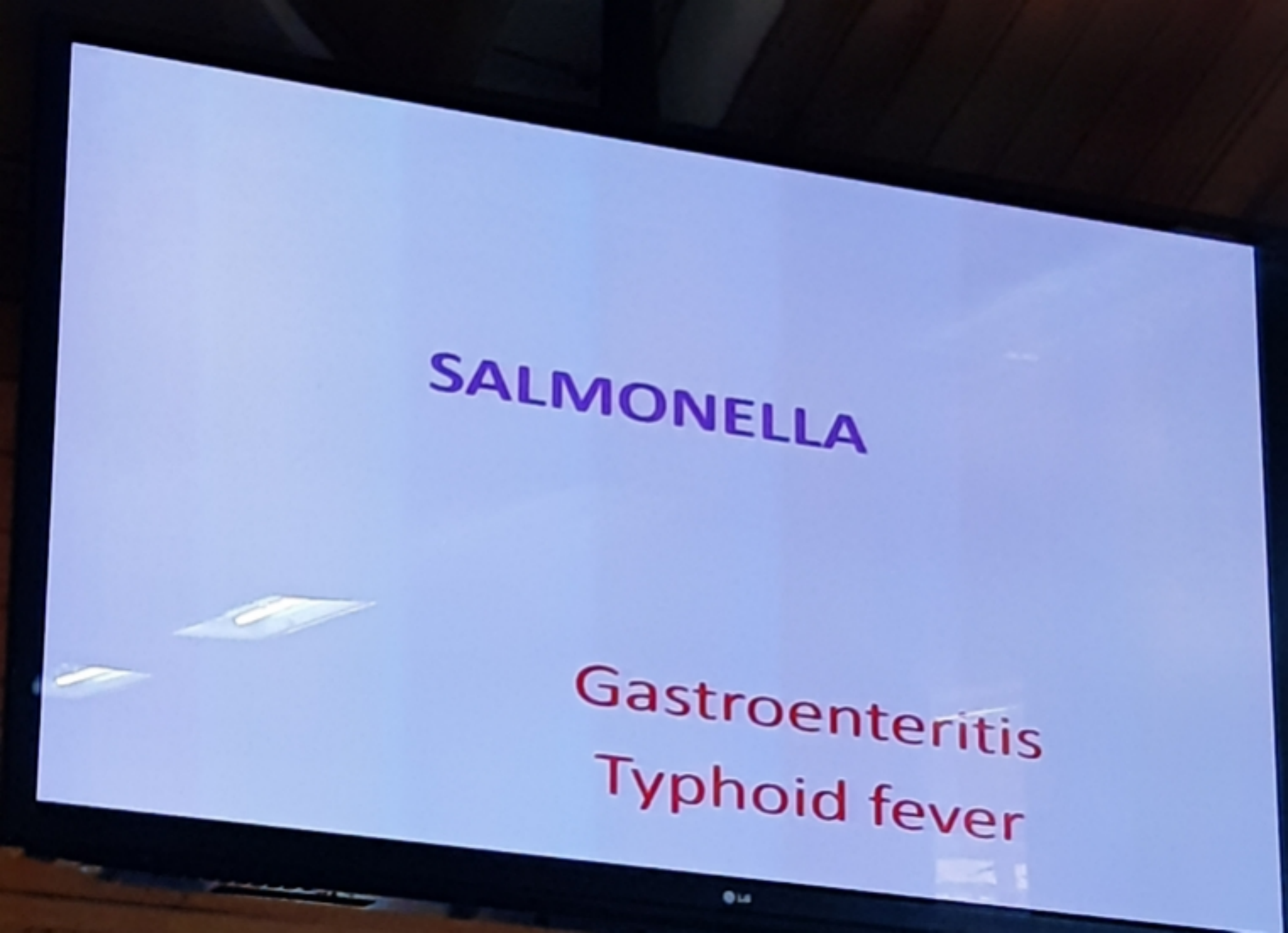
- typical members of the Enterobacteriaceae:

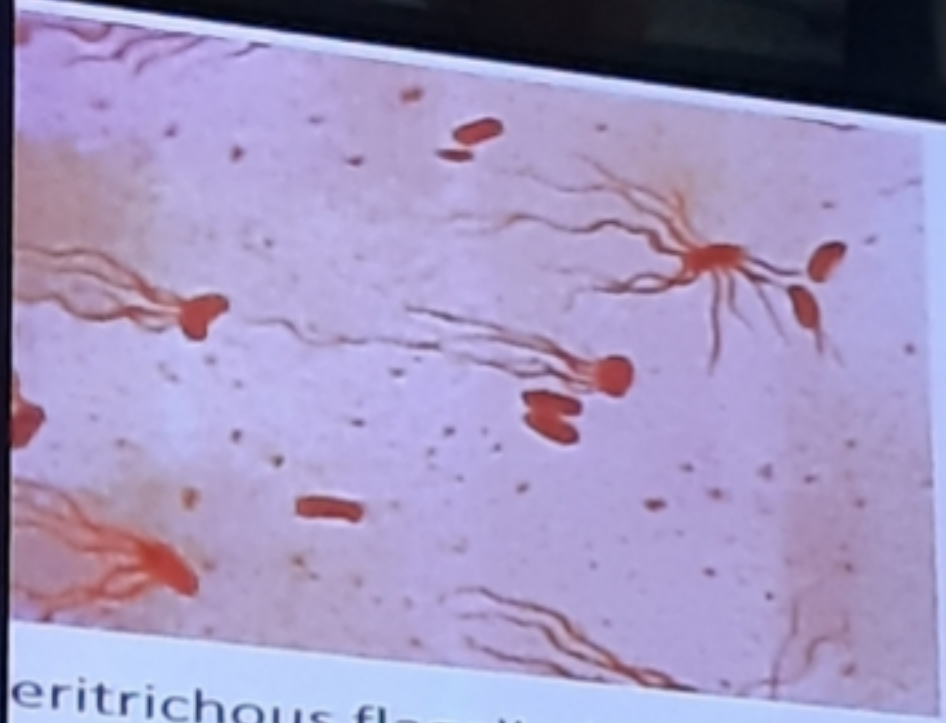
features ?

Common features in Enterobacteriacea:

1. Anatomic location
2. Gram negative rods
3. 4 metabolic processes:

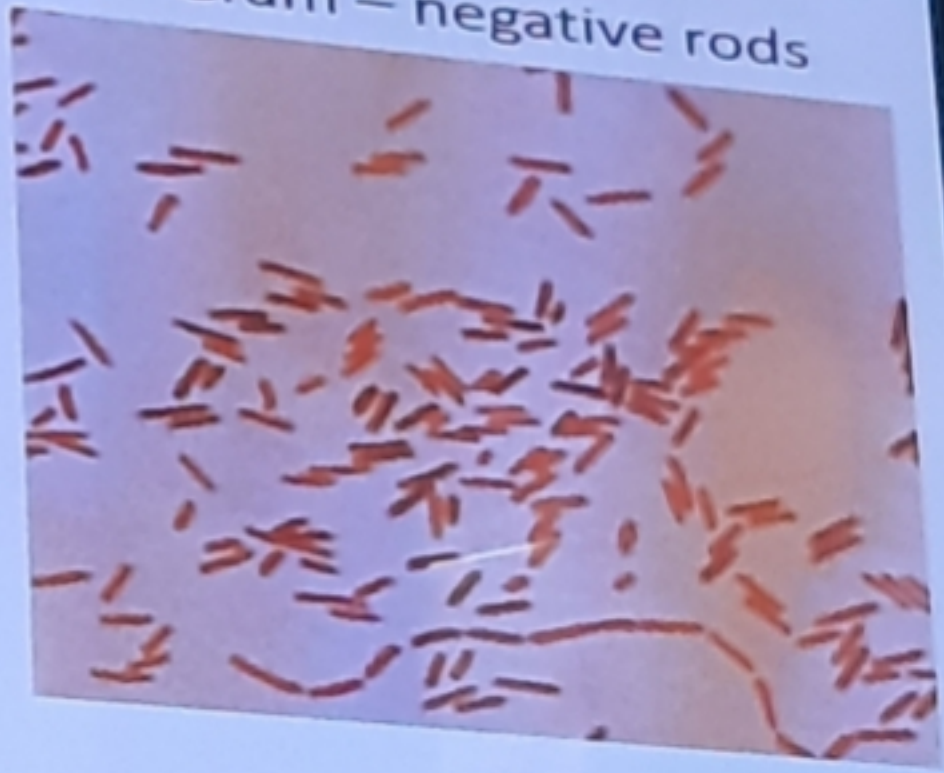
- All are facultative anaerobes
- All ferment glucose
- Oxidase negative
- Reduce nitrates to nitrites


SALMONELLA
Gastroenteritis
Typhoid fever



eritrichous flagella (motility)

Gram – negative rods



Classification systems:

- (1) the Kaufmanns-White system, which identified each serotype as an individual Salmonella species
- (2) the Edwards-Ewing system, which divided the salmonellae into 3 species (*S. choleraesuis, S. enteritidis, and S. typhi*) and hundred of serotypes
- (3) a DNA hybridization scheme that lumped the Salmonella into two species known as *S. enteritidis* and *S. bongori*.

Daniel Elmer Salmon...scientist

- *S. enterica* is divided into six subspecies: *S. e. enterica*, *S. e. salamae*, *S. e. arizonae*, *S. e. diarizonae*, *S. e. houtenae*, and *S. e. indica*
- **S. enterica** contains more than 2500 serotypes differentiated on the O and H- Antigens
- Salmonella serotype (serovar) Typhimurium,
- Salmonella serotype Enteritidis,
- Salmonella serotype Typhi,
- Salmonella serotype Paratyphi,
- Salmonella serotype Cholerae suis etc.

Ex.: ***Salmonella enterica*** **subspecies** ***enterica*** **serovar Typhi or** ***Salmonella*** **Typhi**

S. enterica can be found in the digestive tracts of humans and other warm blooded animals, and in the environment.

ood and water can be contaminated with the acteria if they come in contact with the feces of nfected people or animals

S. bongori is restricted to cold-blooded animals, particularly reptiles

almonella on the skin of reptiles or amphibians an be passed to people who handle the animals

Antigenic Structure

O (somatic) and H (flagellar) and Vi (virulence)

O antigen:

- located in the outer membrane
- heat stable long chain lipopolysaccharides (LPS).
- exhibit variation in sugar composition and degree of polysaccharide branching
- structural heterogeneity contributes to the large number of serotypes of *S. enterica*.

.....antigens

H antigen:

- Contain epitopes that form the basis of flagella based serotyping.
- exhibit diphasic variation resulting in *phase 1* and *phase 2* antigens.
- Some salmonellae express only one flagellar phase.
- heat labile.

Vi antigen: ….antigens

- Surface polysaccharides (capsules)
- Not present in all serotypes
- *Salmonella enterica* serotype Typhi is the most important example which expresses this antigen.

- Further differentiation (reference laboratories) of serotypes in epidemiological investigations can be based on :
  - pulsed-field gel electrophoresis
  - multilocus sequence typing
  - whole genome sequencing

etc

- Clinically Salmonella has been categorized as invasive (typhoidal) or noninvasive (non-typhoidal salmonellae) based on host preference and disease manifestations in humans

- Transmission related to ingestion of food, water contaminated by human, animal waste.
- Frequent animal sources: Poultry, Eggs, Beef, Milk
- Contaminated Vegetables

PATHOGENESIS

- Typhoidal Salmonella (Typhoid fever, Paratyphoid fever
- Non-typhoidal Salmonella disease
  - Non-invasive non-typhoidal Salmonella
  - Invasive non-typhoidal Salmonella disease

...pathogenesis

Typhoidal *Salmonella* (Typhoid fever, Paratyphoid fever)

- caused by serovars Salmonella Typhi, Paratyphi A, Paratyphi B and Paratyphi C
- salmonellae pass through the lymphatic system of the intestine into the blood...
- carried to various organs (liver, spleen, kidneys) to form secondary foci...
- dead salmonellae → endotoxins released

....Typhoidal *Salmonella* (Typhoid fever, Paratyphoid fever)

- endotoxins act on vascular and nervous apparatus: increased permeability, decreased tone of vessels, upset thermal regulation, vomiting and diarrhea...
- lost liquid, electrolytes; decrease in circulating blood volume and arterial pressure..hypovolemic shock.
- septic shock may also develop.

..PATHOGENESIS

on-Invasive Non-typhoidal Salmonella
(Salmonellosis)

caused by non-typhoidal serovars of *Salmonella*
- require a high infectious dose
generally cause food poisoning
salmonellae enter the small intestine & multiply
in tissues...
cells are poisoned by endotoxins released from
dead salmonellae...
the local response to the endotoxins is enteritis
and gastrointestinal disorder

...pathogenesis

Invasive Non-typhoidal salmonella disease (iNTS)

- caused mainly by serovars *S* Typhimurium or *S* Enteritidis
- commonly isolated from blood of those presenting with fever

TS....

While in developed countries, non-typhoidal
erotypes present mostly as gastrointestinal
isease, in sub-Saharan Africa, these serotypes
ave been implicated in bloodstream infections
..most patients presenting with fever)

The increased prevalence of iNTS in sub-Saharan Africa compared to other regions is thought to be due to the large proportion of the African population with some degree of immune suppression due to the burden of HIV, malaria, and malnutrition, especially in children.

The genetic makeup of iNTS is evolving into a more typhoid-like bacterium, able to efficiently spread around the human body.

urvival in macrophages...Resistance to oxidative burst

A hallmark of *Salmonella* pathogenesis is the ability of the bacterium to survive and proliferate within phagocytes.

Phagocytes produce DNA damaging agents such as nitric oxide and oxygen radicals as a defense against pathogens...these molecules challenge genome integrity.

Salmonella enterica typhi have the RecA and RecBC proteins that mediate recombinational repair of DNA damage

CLINICAL FINDINGS

1. Enteric fever

- caused by strains of S. Typhi or S. Paratyphi A, B or C.
- early symptoms: dull continuous headache, abdominal tenderness, hepatomegaly, splenomegaly .
- Complications: severe intestinal haemorrhage, perforation.

2. Gastro-enteritis

- organisms penetrate mucosal cells into the lamina propria with resulting inflammation and diarrhea.
- clinical features: vomiting, abdominal pain, fever and diarrhoea.
- dehydration can lead to hypotension, cramps and renal failure.

3. Bacteraemia and Metastatic disease.

- constant feature of Typhoidal *Salmonella*
- Sickle cell anaemia- important predisposing factor resulting in osteomyelitis, pneumonia and meningitis.
- Ability of the salmonella to survive within macrophages particularly in the liver and bone marrow leads to persistent infection and chronic carrier state.

4. Prolonged Carrier State

- Chronic carriage- excretion of salmonella for a year or more.
- can occur with any serotype.
- bacilli are present in the gall bladder and are shed in faeces.
- The long duration of the carrier state enables the enteric fever bacilli to survive in the community in non- epidemic times

LABORATORY DIAGNOSIS

SPECIMEN

In enterocolitis

- Organism isolated from a stool sample.
- Stool samples may also be positive in chronic carriers
- In enteric fever
- Blood culture
- Bone marrow cultures are often positive.

LABORATORY DIAGNOSIS

- Fluid enrichment media –

Stool Specimen on day 1:

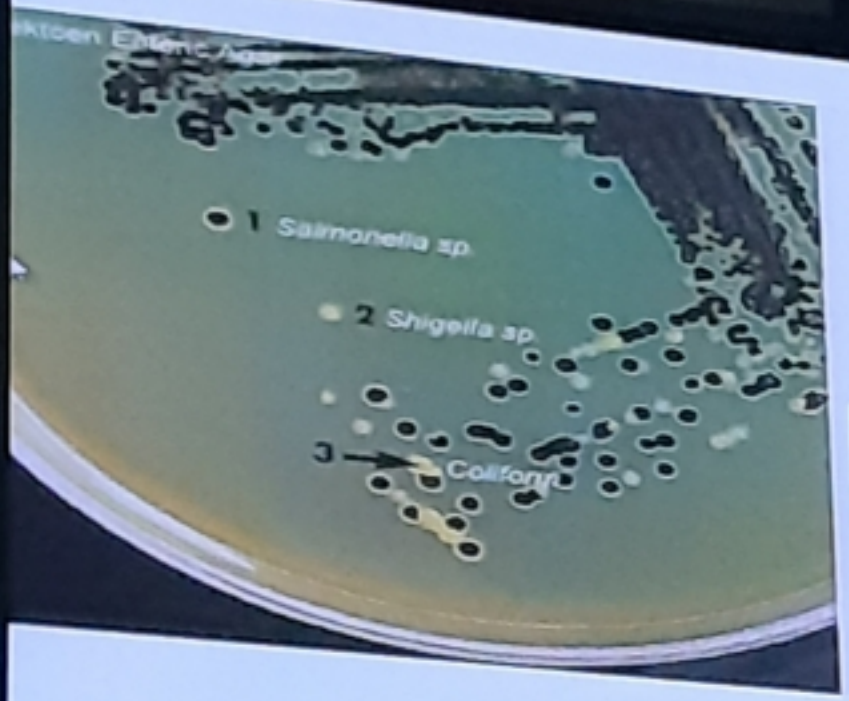
Tetrathionate or Selenite F broth.

- Selective media –

Stool Specimen on day 2 subculture: either on

- Desoxycholate citrate agar (DCA)
- Xylose lysine desoxycholate agar (XLD)
- Salmonella-Shigella agar (SS)

35-37°c, 18-24hrs, in air


1 Salmonella sp.
2 Shigella sp.
3
Coliform

- Characteristics:
  - Facultative anaerobe
  - Non-lactose fermenters
  - Gram negative bacilli
  - Oxidase negative
  - Urease negative

- On TSI, salmonellae produce an alkaline slant, acid butt frequently with both gas and H_2S.
- Slide agglutination -detects presence of the somatic (O) antigen from suspicious colonies from culture plates.
- Colonies are also sub-cultured to peptone water for determination of flagellar (H) antigen.

TSI. Triple Ion Sug
ar Test

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TSI

- Gold standard of diagnosis of typhoid fever is culture

TREATMENT

Enteric fever:

- Ciprofloxacin
- Ceftriaxone

Gastro- enteritis:

- Replacement of fluids and electrolytes, control of nausea, vomiting and pain.

Salmonella bacteremia:

- ciprofloxacin, chloramphenicol, co-trimoxazole or high dose ampicillin.

TREATMENT

Salmonella meningitis

- Cefotaxime and Ceftriaxone - both can penetrate into the CSF.

Chronic asymptomatic carriers:

- If the principle site of carriage is the biliary tact, cholesystectomy (it poses a risk of dissemination of the organism during surgery.)
- Ampicillin, Amoxicillin, Cotrimoxazole or Ciprofloxacin.

PREVENTION AND CONTROL.

- Vaccination- heat killed phenol preserved whole vaccines containing a mixture of cultures of Typhi, Paratyphi A and Paratyphi B (TAB)
- Public availability of treated water
- Proper disposal of human excreta.
- Prevention of contamination by food handlers, rodents
- Raw foodstuffs of animal origin must never have direct or indirect contact with cooked foods.
- Food storage: Proper refrigeration of cooked foods.
- Wash hands after handling pets

The WHO *Five keys to safer food* serve as the basis for educational programmes. They are especially important in preventing food poisoning. The five keys to Safer Food are:

- keep clean
- separate raw and cooked
- cook thoroughly
- keep food at safe temperatures
- use safe water and raw materials/packaging