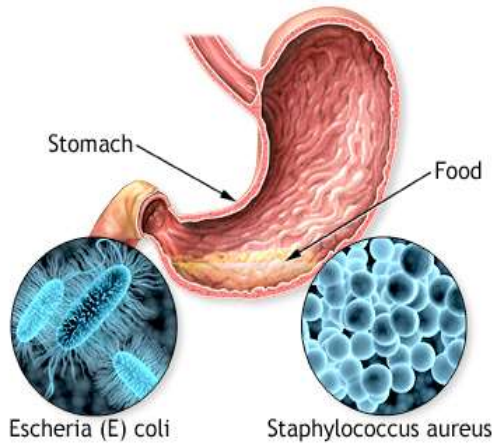




Milk Borne Diseases: Infection, Intoxication and Toxi-infection



Types of Food Borne Illness

- A. Food infection:** Ingestion of viable pathogens along with food leads to their establishment in consumers. Eg: **Typhoid, shigellosis**
- B. Food intoxication:** Ingestion of pre-formed toxins, already synthesized by microbes in food brings about poisoning syndrome in the consumers and hence, is called food intoxication. Toxins affecting gastro intestinal tract are called as enterotoxins .
Eg: **Staphylococcal food poisoning, botulism, cholera.**
- C. Food toxi-infection:** Some micro-organisms can produce toxins 'in situ' after getting ingested with food and infect intestine. Eg: ***Bacillus cereus* food poisoning and *Clostridium perfringens* gas gangrene**

A. Milk Borne Infections

Salmonella poisoning: Salmonellosis is resulting from ingestion of *Salmonella* along with contaminated milk and milk products.

Causative microorganism

- *Salmonella typhi*– Typhoid
- *Salmonella paratyphi* A, B, C – Paratyphoid
- *Salmonella enteritidis* – Food poisoning

Sources

- Water is most important source of *Salmonella*, as it frequently gets contaminated through faecal matter. If polluted water is used for washing of utensils and equipment, it will lead to milk contamination.
- Handlers are carriers in active cases.
- Flies acts as source of contamination.



contaminated
food or water



exposure to
infected animals



not washing
hands



cross-contamination



eating undercooked
or raw meat



Symptoms:

- a) Typhoid fever: Continuous fever, inflammation of intestines, formation of intestinal ulcers, enlargement of spleen and toxemia.
- b) Paratyphoid fever: Resembling typhoid fever but it is milder than typhoid. Approximately $10^5 - 10^7$ microorganisms per ml are required to cause infection.
- c) Salmonellosis: Nausea, vomiting, abdominal pain, diarrhoea, chills, headache, muscular weakness, moderate fever etc.

Incubation period: 7-14 days for typhoid and 1-7 days for paratyphoid.

Prevention and control:

- Adequate treatment of water
- Infected individuals, who had infection should not handle milk
- Follow hygienic conditions during production, processing and storage
- Educating the people about food and personal hygiene
- Periodic examination of individuals who handle foods for public consumption
- Pasteurization and other adequate heat treatment of milk and milk products
- Control of flies

Bacillary dysentery (Shigellosis): Associated with consumption of unpasteurized milk.

Causative microorganism

- *Shigella dysenteriae*
- *Shigella sonnei*
- *Shigella flexneri*

Source

- Milk contaminated with water, flies and utensils
- Milk handlers

Symptoms

Shigellosis is an acute intestinal disease characterized by diarrhoea with blood, pus, fever, vomiting, abdominal cramps

Prevention and control

- Strict sanitary condition should be enforced in dairy pasteurization plants and retail outlets dispensing milk in bulk.
- Attendants looking after the patients should be prohibited from contact with milk or utensils.

B. Milk Borne Intoxications

Staphylococcal poisoning: *Staphylococcus aureus* produce enterotoxins that cause gastroenteritis in humans.

Toxins

Staphylococci produce different metabolic end products such as:

- Haemolysin /Staphylolysin (α , β , γ and δ)
- Leukocidin
- Necrotizing factor
- Lethal factor
- Enterotoxin
- Coagulase

S. aureus is capable of growing and producing enterotoxins in raw milk at a concentration of 10^6 microorganisms per ml.



Sources

Human handlers are the main source as microorganisms are present in nose, skin, wounds, pimples and boils.

Symptoms

Nausea, vomiting, abdominal cramps, diarrhoea, sweating, headache etc.

Incubation period is 1-16 h, and symptoms last for 24-48 h.



Prevention and control

- Adequate heating destroys staphylococci but not the enterotoxin.
- Post pasteurization contamination should be avoided
- Infected handlers should not be allowed to handle milk.

Botulism: Botulism poisoning affects nervous system and is extremely fatal. In sour milk *Clostridium botulinum* cannot survive due to low pH. But it is prevalent in canned products like condensed milk and processed cheese due to existing anaerobic conditions favorable for its growth.

Toxins

Toxins A, B, E and F are known to affect human. It is estimated that **0.1 µg of toxin may cause death of person and 1 mg of purified toxin is sufficient to kill a population of million people.**

Sources

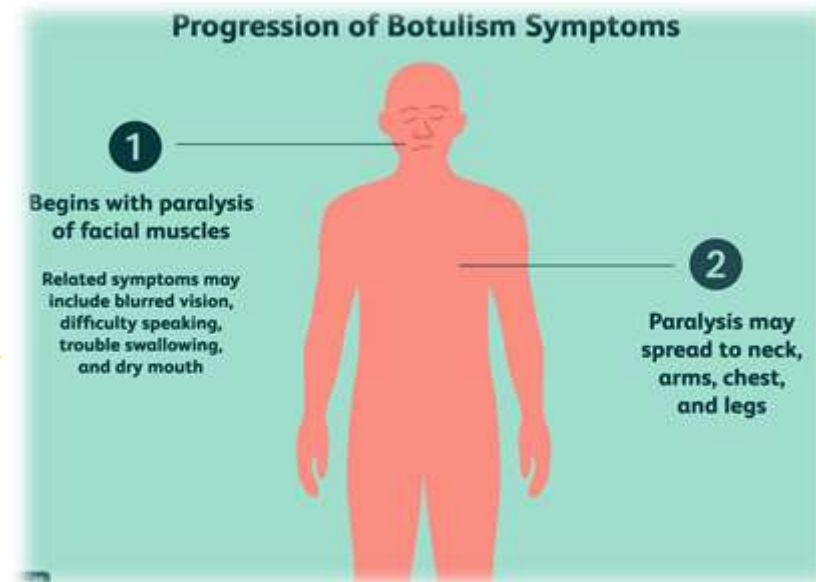
Soil and water

Symptoms

Nausea, vomiting, fatigue, headache, and dryness of skin, mouth, and throat. As it acts on Central Nervous System, it leads to paralysis of muscles, double vision and respiratory failure, resulting to death. Incubation period is 12 – 96 h.

Prevention and control

- Adequate heating of product destroys toxin (100°C per 10 – 20 min.)
- Hygienic conditions is adopted during production of milk
- Chilling after production should be essential
- Reject bulged cans and spoiled foods



Cholera: Cholera is acute diarrheal disease caused by *Vibrio cholerae*. Organism adheres to the epithelial lining of mucosa in the small intestines, where it produces enterotoxin that causes loss of fluid and electrolytes from the body followed by dehydration.

Source

- Milk infected by soiled hands of a patient
- Use of infected water for dairy purpose
- Adulteration of milk with contaminated water

Symptoms

Incubation period is usually 3 days.



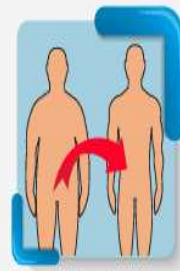
Vomiting



Low Blood Pressure



Diarrhea



Rapid Weight Loss



Increased Thirst

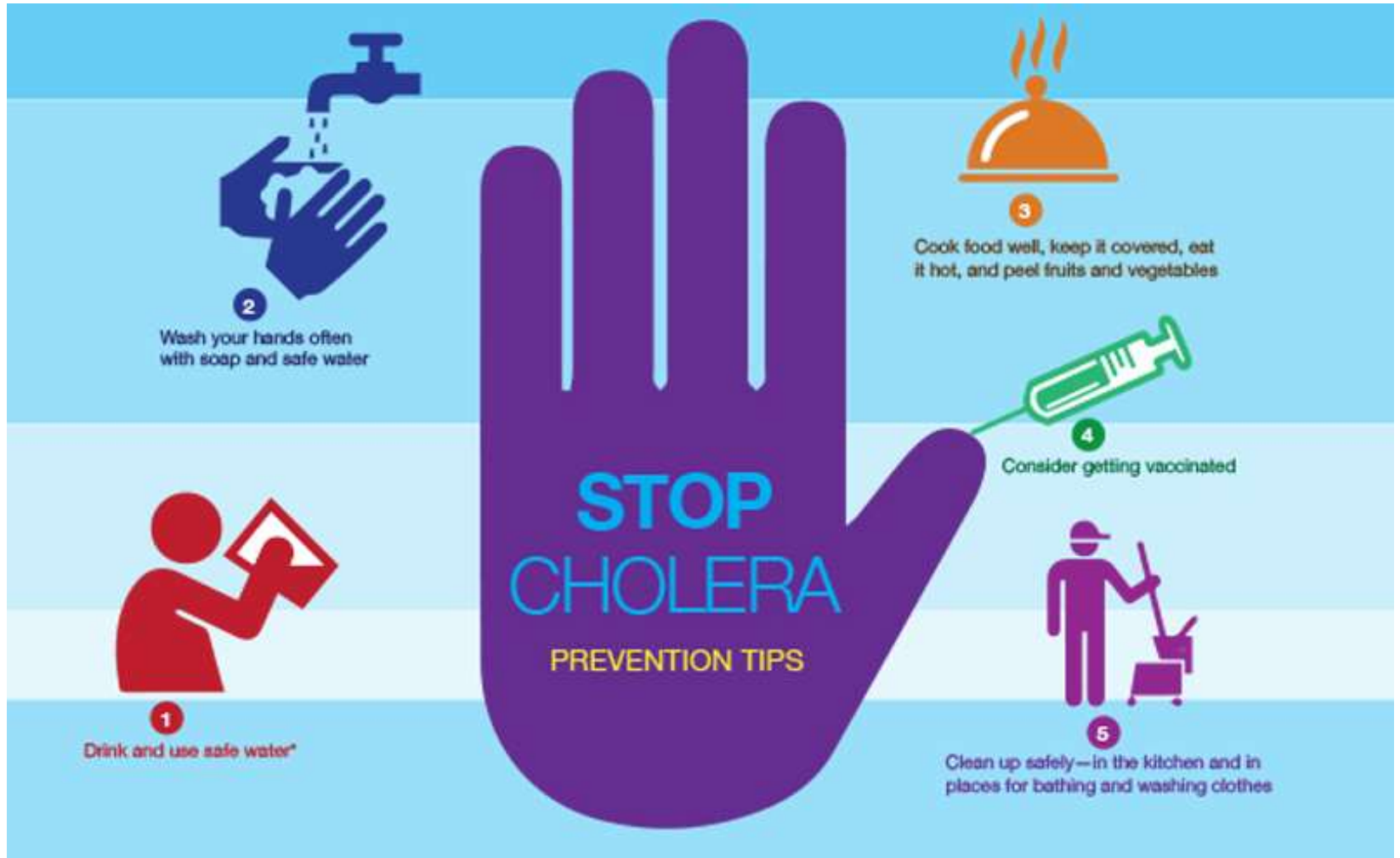


Loss of Skin Elasticity



Rice water stool

Prevention and control



Fungal intoxications: Aflatoxicosis is a common type of fungal intoxication caused by *Aspergillus flavus* by virtue of their ability to produce aflatoxin. Aflatoxin can be present in milk as preformed toxin or it can be secreted in milk by milch animal that has been fed with aflatoxin containing feed. Upon ingestion, *Aspergillus* toxins are metabolized by milch animals and secreted into milk in form of M₁ and M₂ (toxic to consumers).

Types of aflatoxins

Aspergillus flavus produces B₁, B₂, B_{2a}. B₁ is the most abundant and most toxic of the aflatoxin. Recommended upper permissible limit of aflatoxin in foods is 0.5 µg/kg.

Source

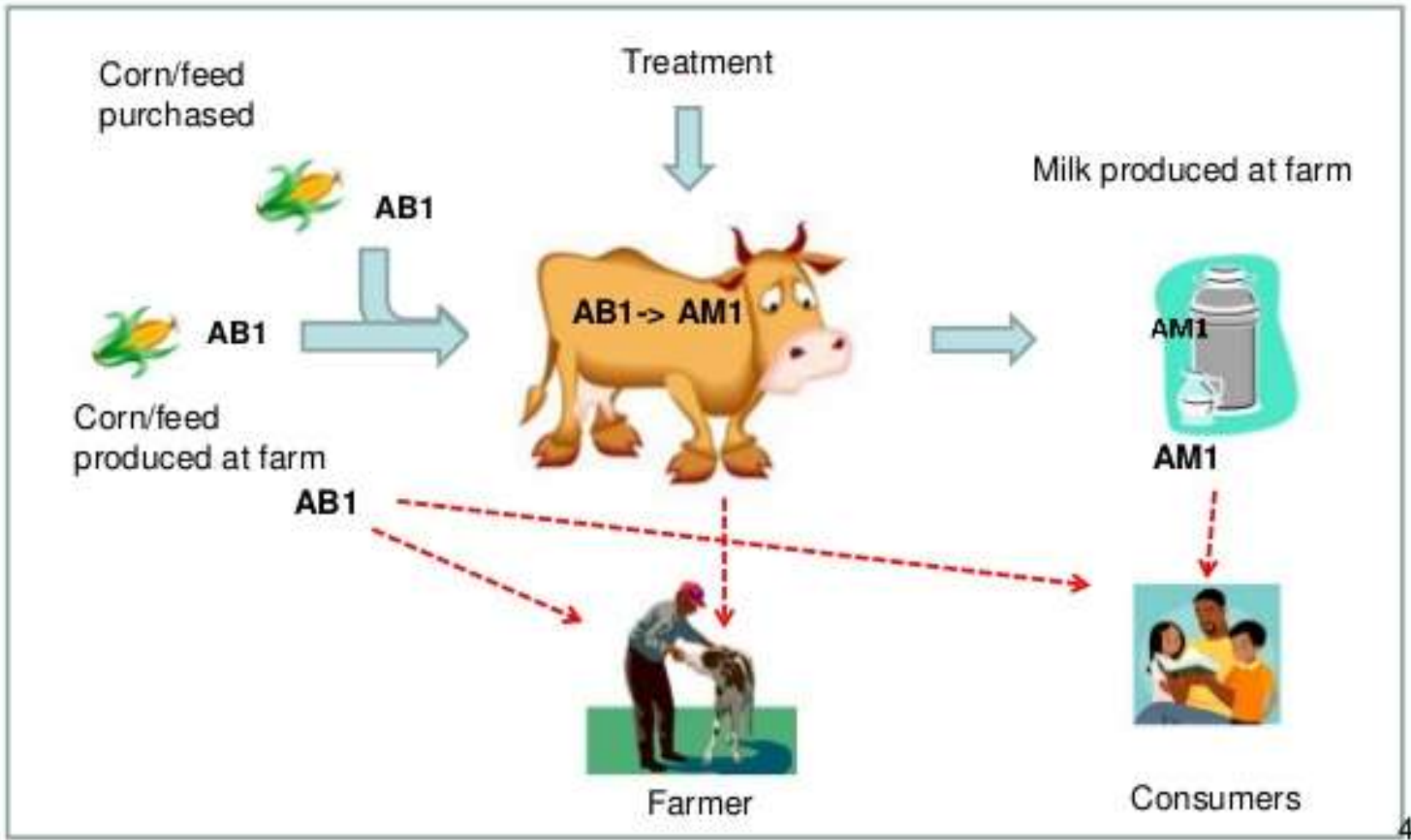
Aerial contamination and soil contaminated foods introduce mold spores in milk and milk products.

Symptoms

Liver hyperplasia, tissue hemorrhage, anorexia and finally death in animals. The vital organs like spleen, pancreas and kidney may also be involved in aflatoxicosis.

Prevention and Control

- Prevent contamination of milk and milk products**
 - Prevent fungal growth by storing the product under proper conditions and by use of fungistatic agents**
 - Detoxification of aflatoxins by physical, chemical or biological agents.**
- However, this is relatively impractical in dairy products.**



C. Milk borne Toxi-Infections

***Bacillus cereus* poisoning:** It occurs due to ingestion of contaminated food with *Bacillus cereus* or its spores and produces 3 types of toxins:

- a) Haemolysin
- b) Lecithinase
- c) Enterotoxin

Sources

- From mastitis udder
- Spores from animal's teat and skin equipments

Symptoms

- Diarrhoea: Abdominal pain and cramps, profuse watery diarrhea.
- Vomiting: Acute attack of nausea and vomiting diarrhea is not common

Prevention and control

- Proper cooling of milk
- Maintenance of environmental hygiene and air quality
- Hygiene during production, processing etc.

***Clostridium perfringens* poisoning:** *Clostridium perfringens* causes gas gangrene. Anaerobic conditions inside canned foods are favorable for growth of *C. perfringens*. Five different enterotoxins - A, B, C, D and E are produced, where A and C causes food poisoning in man.

Sources

- From soil and faeces -dust, fodder, milk
- Faecal or sewage contamination of water

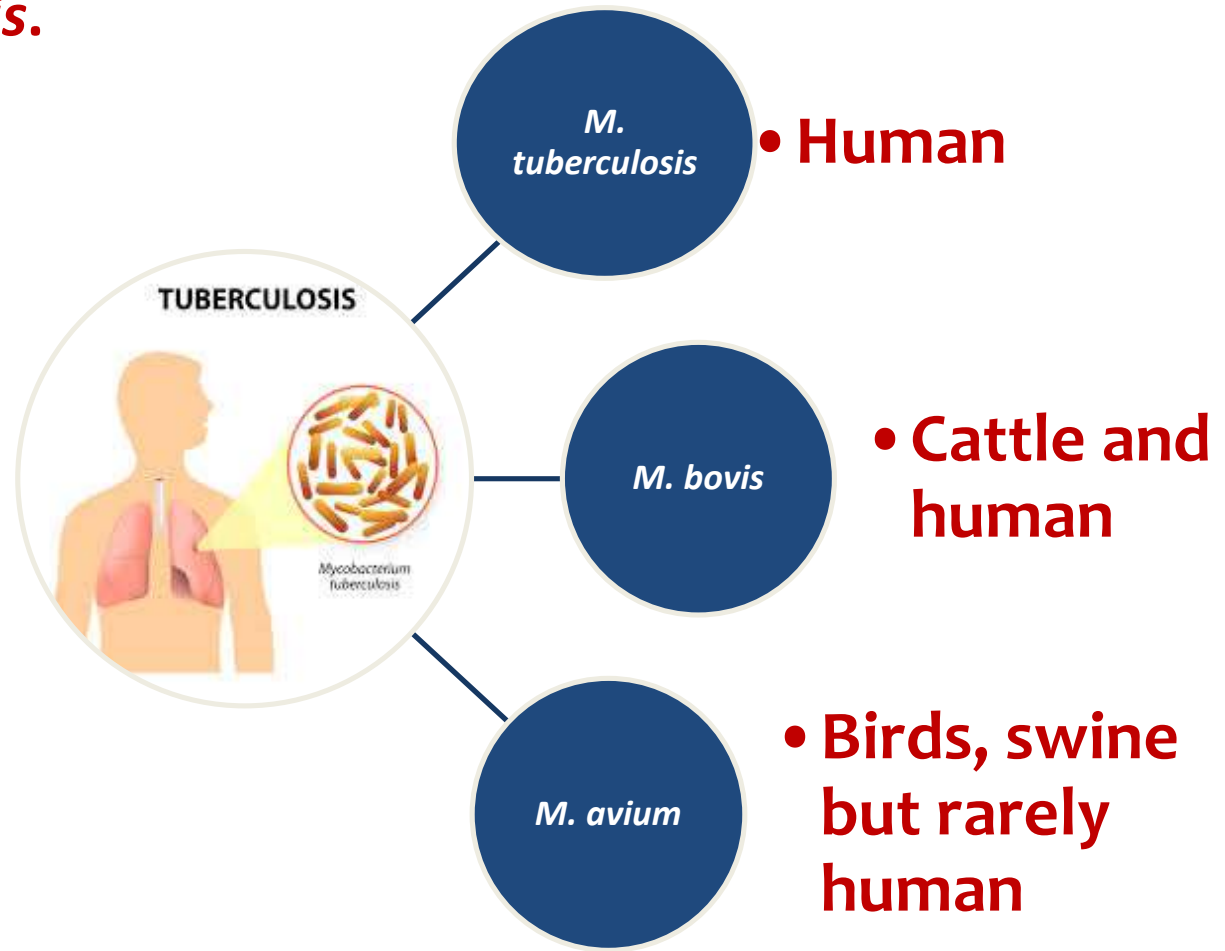
Symptoms

Diarrhoea, vomiting, abdominal pain; incubation period is 8-22 h. Sometimes it is fatal.

Prevention and control

- Proper cooling of milk
- Maintenance of environmental hygiene and air quality
- Hygiene during production, processing etc.

Tuberculosis: Causative microorganism: *Mycobacterium tuberculosis*. Two types of tuberculosis: pulmonary and non pulmonary type. Pulmonary is caused by human type of microorganisms that affects mainly respiratory tract. Bovine type bacillus cause non pulmonary tuberculosis. Tuberculosis of cattle is produced by *M. bovis*.



Symptoms

Tuberculosis is characterized by onset of parenchymal pulmonary infiltration recognizable by X-ray examination, pleurisy, followed by advanced stage that is accompanied by cough, fever, and fatigue and weight loss.

Prevention and control

- Animals should be subjected to tuberculin test.**
- Animal suffering with tuberculosis should be isolated.**
- Overcrowding of animals must be avoided.**
- Tuberculosis patients should be prohibited from handling cattle as well as milk.**
- Proper disinfection should be followed.**

Listeriosis: Causative microorganism: *Listeria monocytogenes* which can gain access into milk and milk products. Gram-positive, non-sporulating rod capable of growing at 1-45 C. Listeriosis occurs due to ingestion of contaminated milk and milk products. Since *L. monocytogenes* causes mastitis, meningioencephalitis in milch animals, it can be secreted in milk.

Sources:

1. Infected animals are major source of this organism in milk through infected udders.
2. Handlers carrying the organism also introduce organism in milk and milk products.
3. Faecal contamination of milk.
4. Unhygienic practices during production and processing of milk.
5. Contaminated refrigerators and clothes may introduce the organism in milk.

Symptoms:

- 1. Acute meningitis with or without septicaemia.**
- 2. Onset of meningitis is usually sudden fever, headache, vomiting followed by coma, collapse and shock resulting in death if not treated properly.**

Prevention and Control

- 1. Strict hygienic practices during production and processing of milk.**
- 2. Proper heat treatment of milk.**
- 3. Culling of infected animals.**

***Campylobacter* poisoning (Campylobacteriosis):** Vehicle is raw milk for this milk borne disease. Warm blooded animal have been found to be infected with *Campylobacter jejuni*.

Sources

1. Organism has been isolated from intestinal tracts and faecal matter of man, goat, sheep etc.
2. Polluted water contaminated with *C. jejuni* also enter milk and milk products.
3. Infected personnel and animals.

Symptoms

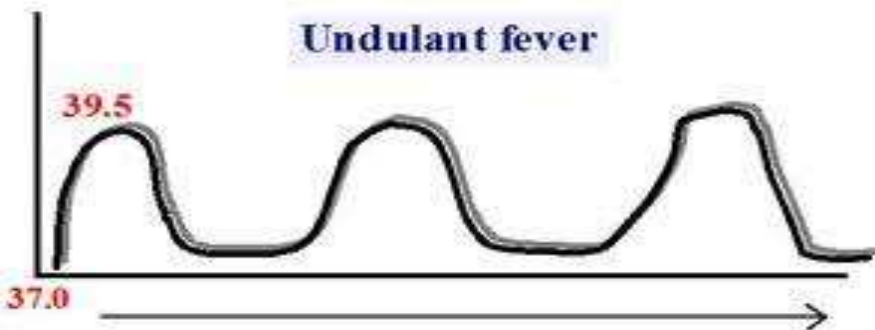
Severe abdominal pain, watery diarrhoea, acute gastroenteritis in man

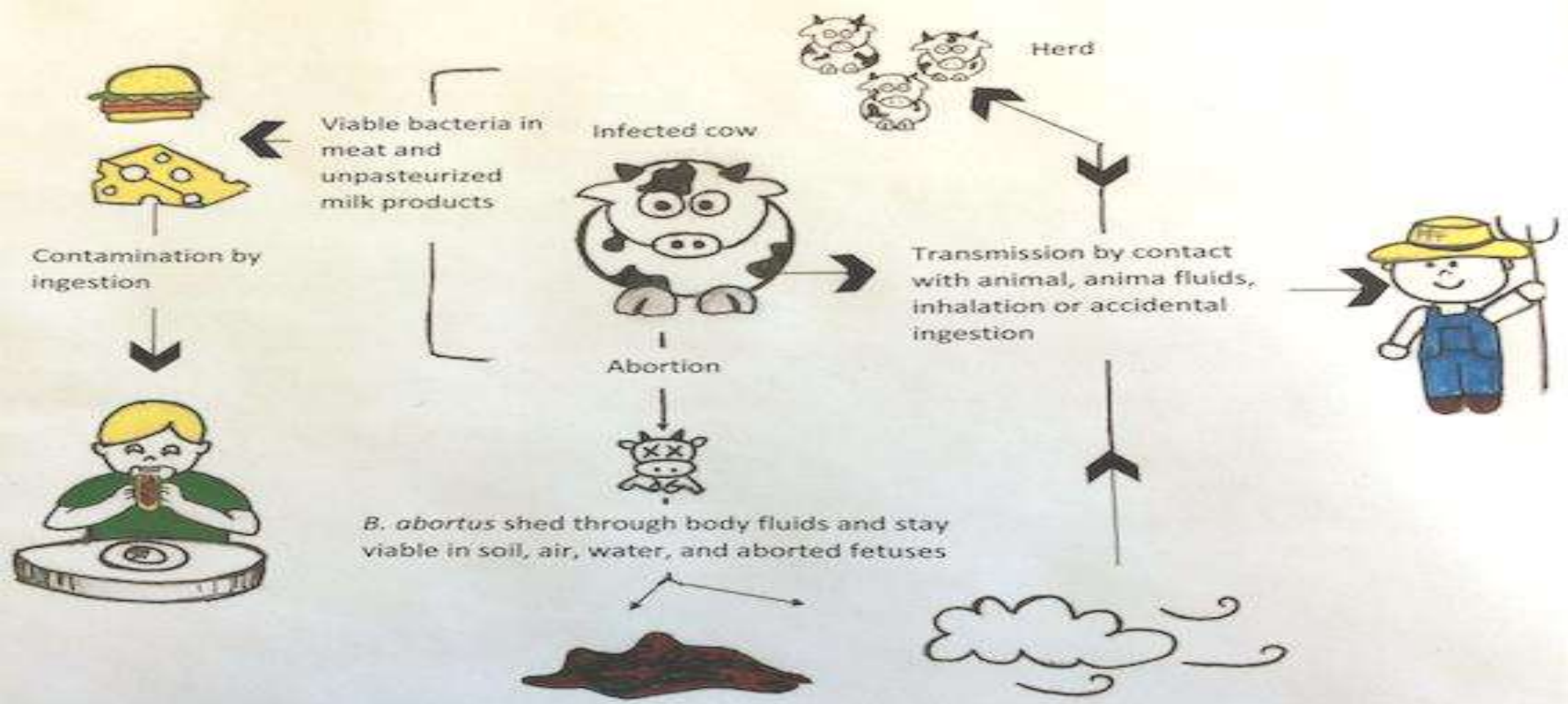
Prevention and control

1. Milk should be properly pasteurized and heat treated as the organism does not survive pasteurization.
2. Public water supply should be effectively chlorinated.
3. Good hygiene should be practiced by personnel.

Brucellosis:

1. Also called Bang's disease, Malta fever or undulant fever.
2. Highly contagious zoonosis caused by ingestion of unsterilized milk or meat from infected animals or close contact with their secretions.
3. *Brucella* spp. are small, Gram-negative, non-motile, non-spore-forming, rod shaped (coccobacilli) bacteria.
4. In cattle, brucellosis is also known as contagious abortion and infectious abortion.
5. Three principal sp. of *Brucella* : *B. melitensis* (in goats), *B. suis* (in hogs), *B. abortus* (in cattle). All 3 infect humans and are excreted in the milk of dairy animals.





- **Brucellosis in humans is usually associated with consumption of unpasteurized milk and soft cheeses made from milk of infected animals and with exposure of workers, veterinarians and slaughterhouse workers.**
- **Fever, sweating, weakness, anaemia, headaches, depression, muscular and body pain and disease remain from few weeks to months or years.**

Prevention and control

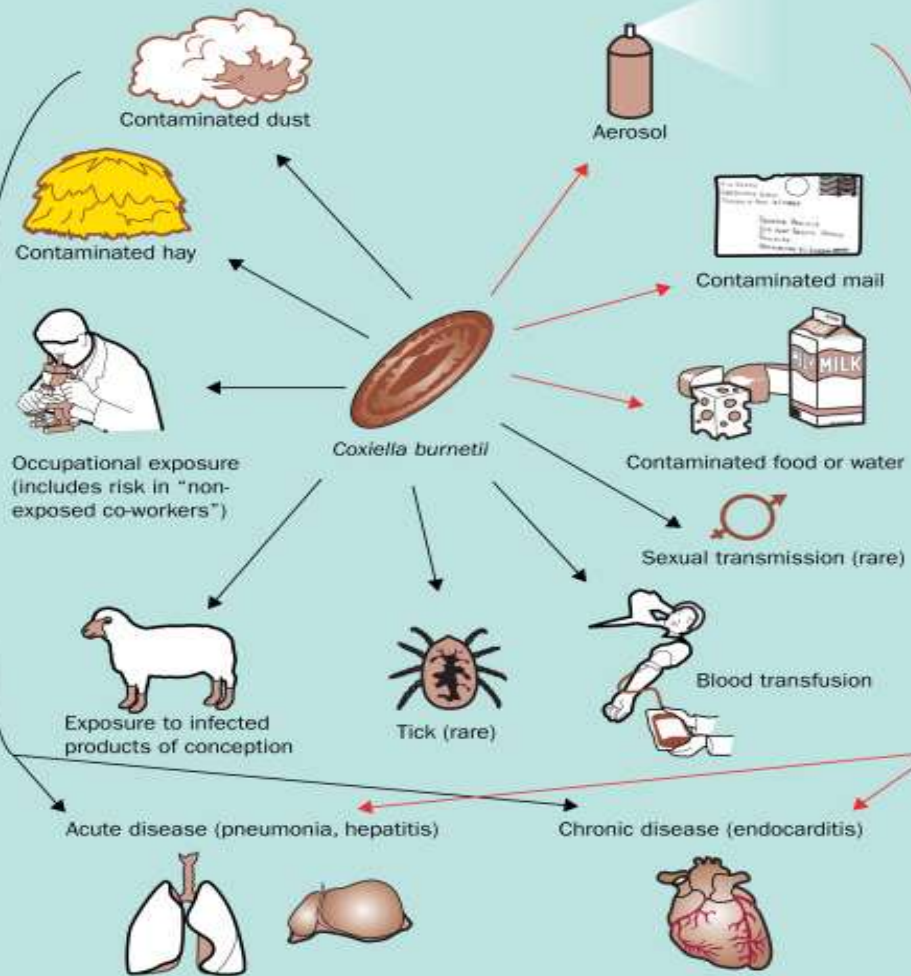
- **Segregation of infected herd to avoid cross infection and if possible, infected animals should be slaughtered.**
- **Herds should be properly vaccinated.**
- **Adequate heat treatment should be given to milk for the destruction of causative microbial agents.**

Q-Fever:

- ❑ Caused by *Coxiella burnetii*.
- ❑ Raw milk is commonly implicated as a vehicle for transmission of disease.
- ❑ *C. burnetii* is more heat resistant than *Mycobacterium tuberculosis*.
- ❑ Individuals, who have frequent direct contact with animals (veterinarians and dairy farmers) are at higher risk.
- ❑ Most patients get Q fever by coming in contact with animals infected with Q fever bacteria, their tissues, or fluids.
- ❑ Transmission may occur through breathing contaminated air or dust from an area with a large concentration of animals.

Natural mode of transmission

Biorealist mode of transmission



- ❑ People become infected indirectly from animals through contaminated materials like wool, straw, and fertilizer.
- ❑ Sheep, cattle, goats, cats, dogs, some wild animals and rodents, birds, and ticks carry the bacteria.

First symptoms of Q fever resemble flu and may include fever, chills, sweats, headache, and weakness. Progress to affect liver, nervous system, or heart valve.

Sources

Mostly human infection is by inhalation of infected dust of the fecal matter. Infected cattle continue to excrete the microorganisms in milk for a long time.

Prevention and control

- 1. Adequate heating of milk and cream**
- 2. Calving sheds should be away from the milking sheds and dairy**
- 3. Animals should be properly vaccinated.**

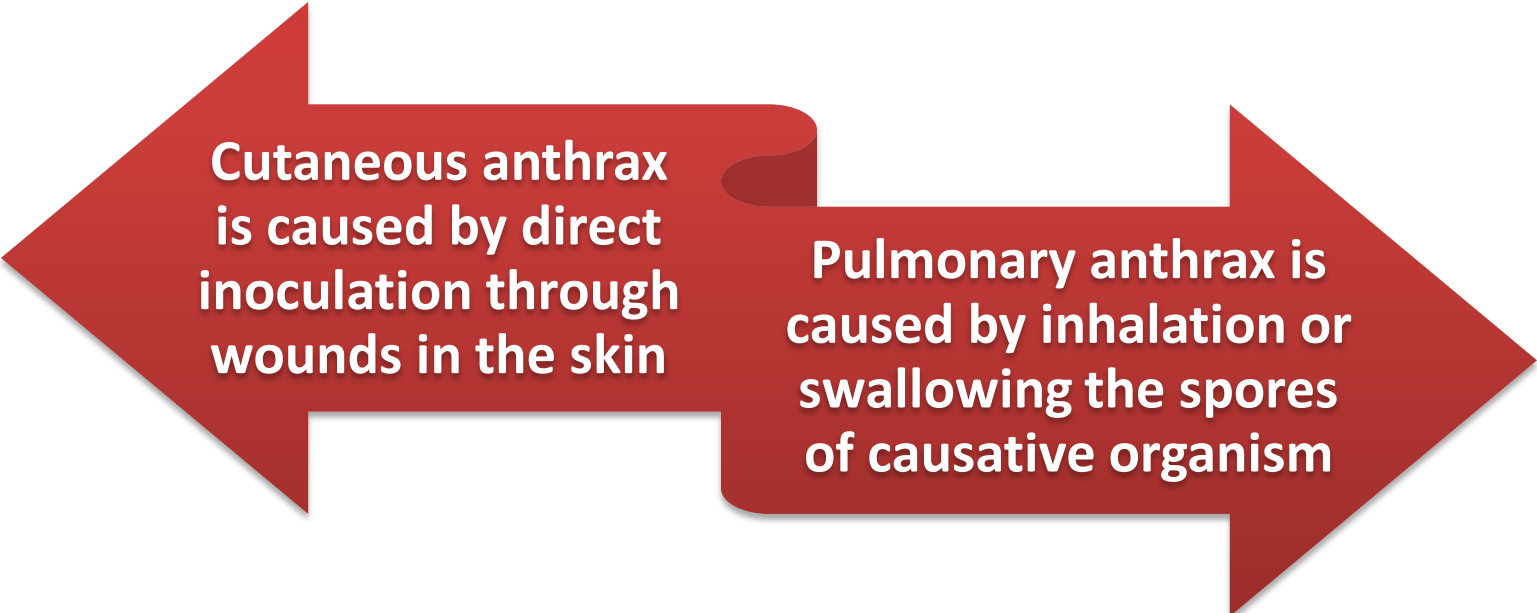
Anthrax: *Bacillus anthracis* is the causative agent of anthrax which pass from blood of infected animals into their milk.

Sources of pathogen

Infected animal: The discharges and other secretions of the infected animals may introduce causative organisms into milk.

Environment: Surroundings of dairy farm and plant may also *B. anthracis* into milk.

Anthrax in man is of two types:



Cutaneous anthrax is caused by direct inoculation through wounds in the skin

Pulmonary anthrax is caused by inhalation or swallowing the spores of causative organism

Symptoms

Main symptom in cutaneous anthrax is the appearance of small fruncles within 12-24 h of infection. In pulmonary anthrax, pneumonia occurs which may be fatal.

Prevention and control

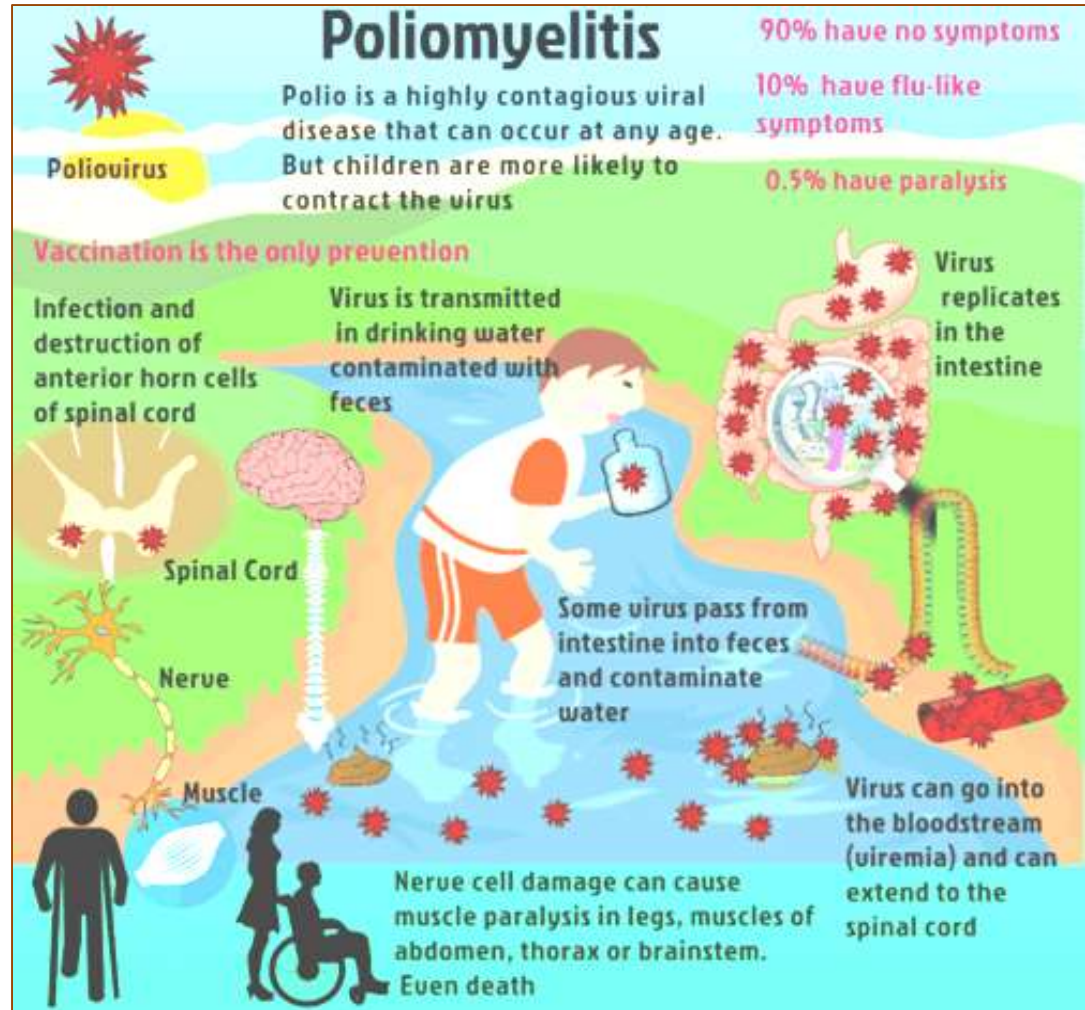
- 1. Milk from infected animal should not be used**
- 2. Killing of the affected animals.**
- 3. Proper vaccination of dairy herds.**
- 4. Proper sanitation of dairy environment.**

Enteroviruses: Group of viruses that cause severe epidemics of diarrhea in infants and children on ingestion of contaminated milk.

Poliomyelitis: Occurs commonly in summer.

Sources

- Person to person contact is the main mode of spread of viruses
- Flies may also serve as a vector for spread of disease
- Fecal contamination of water and milk



Symptoms

First, there is a minor disease associated with viremia characterized by gastrointestinal disturbance. Headache, fever, muscle stiffness and paralysis associated with cell destruction in central nervous system.

Prevention and control

- Proper pasteurization of milk**
- Infected persons should not be allowed to handle milk.**
- Immunization is also effective in preventing disease.**
- Proper vaccination of the children confers protection against disease**

Infectious hepatitis: Most serious viral disease for which milk may be important vehicle for transmission. The illness is also known as hepatitis A and is caused by Hepatitis A virus, whereas hepatitis B is not transmitted through milk.

Sources

- Defective water supply in a milk plant introduce the virus to milk
- Polluted environment in milk plant may also contaminate milk

Symptoms

Nausea, vomiting, abdominal pain, diarrhea, fever, chills, sore throat, bile in urine and jaundice.

Prevention and control

- Proper sanitary conditions should be maintained during production and processing of milk
- Infected persons should not be allowed to handle milk
- Fecal contamination of water should be avoided