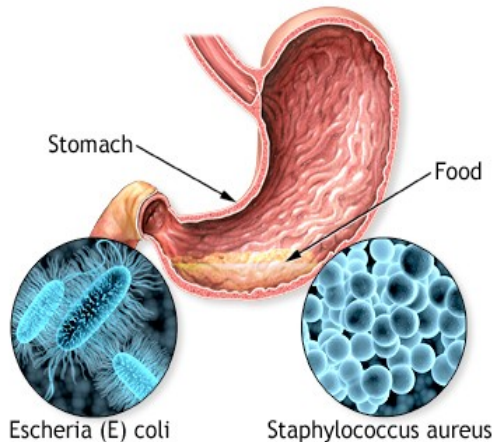




PUBLIC HEALTH ASPECTS OF FLUID MILK



MILK BORNE DISEASES: INFECTION, INTOXICATION AND TOXI INFECTION



A variety of pathogens may gain access in to milk from different sources and cause different types of milk borne illness. Milk and its products may carry microbes or their 'toxins' to the consumers. Based on the type of illness produced these are categorized as food infection, food intoxication and food toxi-infection.

Types of Food Borne Illness

A. Food infection: Ingestion of viable pathogens along with food leads to their establishment in consumers and hence is termed as food infection. Examples includes: **Typhoid, shigellosis, septic sore throat.**

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 . Examples includes: **Staphylococcal food poisoning, botulism, diarrhea caused by E. coli, Cholera.**

C. Food toxi-infection: Some micro-organisms can produce toxins 'in situ' after getting ingested with food and infect intestine. Such type of illness is referred as food toxi-infection. Eg.,: **Bacillus cereus food poisoning and Clostridium perfringens gas gangrene**

A. Milk Borne Infections

Salmonella poisoning: Salmonellosis is a disease resulting from the ingestion of salmonella along with contaminated food. This is mainly a food-borne illness and milk and milk products appear to be commonly involved. There are about 2000 closely related biotypes of *Salmonella* that can cause food poisoning in humans. It is during the mishandling of milk that the causative microorganism may enter these foods and their subsequent growth during holding may lead to salmonellosis.

Causative microorganism

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

Sources

- Water is one of the most important sources of *Salmonella*, as it frequently gets contaminated through faecal matter. If polluted water is used for washing of utensils and equipment it can also lead to contamination of milk.
- Silage is another source of *Salmonella*.
- Handlers are the carriers in active cases.
- External agents like flies also acts as a source of contamination.
- Animals suffering from salmonellosis excrete viable micro-organisms in their milk.

Symptoms:

a) **Typhoid fever:** Characterized by continuous fever, inflammation of intestines, formation of intestinal ulcers, enlargement of spleen, characteristic raised spot eruptions on the abdomen 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, prostration, muscular weakness, drowsiness, moderate fever, restlessness etc.

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

Diagnosis: Microorganism may be present in feces; urine and blood are identified by microscopic, cultural, fermentative and serological tests. **Widal test** is used for typhoid.

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
- Treatment of affected individuals

Bacillary dysentery (Shigellosis): This is one of the common food-borne infection and outbreaks are associated with consumption of unpasteurized milk.

Causative micro-organism

- *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 or mucous, fever, vomiting, abdominal cramps

Diagnosis

Isolation of microorganism by taking rectal swabs and plating on desoxycholate citrate agar, incubation period is 1 - 4 days.

Prevention and control

- Strict sanitary condition should be enforced in dairy workers particularly in pasteurization plants and retail outlets dispensing milk in bulk
- Attendants looking after the patients should be prohibited from contact with milk or utensils
- Take precautions to exclude flies

B. Milk Borne Intoxications

Staphylococcal poisoning: Infection of milk by some strains of *Staphylococcus aureus* leads to the elaboration of 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

Among different toxins, enterotoxin is responsible for major food poisoning out breaks. *S. aureus* is capable of growing and producing enterotoxins in raw milk at a concentration of 10^6 microorganisms per ml. However, not all the strains of microorganisms are capable of producing enterotoxins. The toxin production is faster in milk with low count.

Sources

Human handlers are the main source as the microorganisms are present in nose, skin, wounds, pimples and boils. Animals affected with mastitis are other sources.

Symptoms

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

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

Diagnosis

Biological methods, serological methods, coagulase test and thermo-nuclease test.

Prevention and control

- Adequate heating destroys staphylococci but not the enterotoxin. So, heating within few hours of production would inhibit the multiplication of staphylococci and hence, no toxin production.**
- Adequate cooling immediately after producing milk also inhibits multiplication of staphylococci.**
- Post pasteurization contamination should be avoided**
- Infected handlers should not be allowed to handle milk**
- Animals having mastitis should be isolated**

Botulism: Botulism poisoning is the severest of all the food poisonings, as it affects the nervous system and is often extremely fatal. However, milk is rarely involved in the causation of botulism as fluid milk is not a suitable medium for the growth of causative agent being an anaerobe. In sour milk *Clostridium botulinum* cannot survive due to low pH. But it is quite prevalent in canned products like condensed milk and processed cheese due to the existing anaerobic conditions favorable for its growth.

Toxins

Although, the microorganism is heat resistant, it produces a variety of heat labile toxins that can be destroyed at 100°C within few minutes. Different types of toxins A to G are produced by the microorganism and out of these at least four A, B, E and F are known to affect human. These toxins are lethal in small doses. 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, dizziness, 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 in to death. Incubation period is 12 – 96 h.

Diagnosis

Microscopic examination, animal inoculation and cultural identification.

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
- Acidity inhibits the causative microorganism
- Reject bulged cans and spoiled foods

E. coli poisoning

E. coli is known to be associated with enteritis in infants and adults as well as with traveler's diarrhea and food poisoning. Milk and milk products like ice cream, kulfi, dried milks, cheese etc can be contaminated with toxigenic *E. coli* that can produce the enterotoxins under favorable conditions. A minimum of 10^5 to 10^7 cells per gram are required to produce enterotoxins sufficient to cause food poisoning.

Toxins

E. coli can produce two types of enterotoxins named as heat labile and heat stable toxins.

The labile toxin can be inactivated at 65°C for 30 min.

Sources

- **Water supplies contaminated with fecal matter**
- **Unhygienic practices by handlers may introduce the microorganism in to milk chain**
- **Infected animal may also excrete the microorganisms.**

Symptoms

Children are more susceptible. Symptoms due to heat labile toxins are almost similar to symptoms of cholera.

Massive watery diarrhoea occurs due to accumulation of fluid in the intestines.

In case of heat stable toxin, the symptoms include diarrhoea with or without vomit that is not bloody and without inflammatory exudates in stool.

Fever may be present in children but not in adults.

Incubation period is 8-24 h.

Prevention and control

- **Fecal contamination of water supply should be avoided**
- **Handlers should follow strict hygiene practices**
- **Cross contamination from infected animals should be avoided**

Cholera: Cholera is one of the acute diarrheal diseases caused by *Vibrio cholerae*. It frequently occurs in the form of massive epidemics. Unhygienic practices are mainly responsible for outbreak. Although, cholera is mainly water borne disease, the involvement of milk may also transmit the disease. The causative microorganism 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

In mild cases of cholera, diarrhoea appears to be the only symptom. In severe cases, diarrhoea, vomiting, rice water stools, abdominal pain, thirst, dehydration are major symptoms. The disease runs a short course terminating in death, sometimes within 12 h after the appearance of first symptoms. Incubation period is few hours to 5 days, usually 3 days.

Diagnosis

Intra-peritoneal inoculation of Guinea pigs with pure culture results in the death of the animal within 24 h.

Prevention and control

- **Proper pasteurization of milk and its products.**
- **Sanitary disposal of human excreta**
- **Protection of water by boiling**
- **Sanitary preparation and handling of products**
- **Control or destruction of house flies**
- **Public health education**
- **Isolation of patients and carriers**
- **Disinfection of stools and vomit and articles soiled by the patients**
- **Food left by the patients should be burnt**
- **Room of patient should be thoroughly cleaned and disinfected**
- **Use of cholera vaccine in exposed population group**

Fungal intoxications: Aflatoxicosis is a common type of fungal intoxication caused by the common molds, *Aspergillus flavus* and *Aspergillus parasiticus* 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 the milch animal that has been fed with aflatoxin containing feed. Therefore, even with satisfactory sanitation and hygiene during production and processing of milk, the mycotoxins can be transferred to consumer. Upon ingestion, the *Aspergillus* toxins are metabolized by milch animals and are secreted into milk in form of M1 and M2 that are also toxic to the consumers.

Types of aflatoxins

Aspergillus flavus produces B₁, B₂, B_{2a}. B₁ is the most abundant and most toxic of the aflatoxin. G₁, G₂ and G_{2a} toxins (produced by *A. flavus* only) are extremely heat stable, potent and exhibit very strong toxicity apart from being highly carcinogenic. The recommended upper permissible limit of aflatoxin in foods is 0.5 µg/kg.

Source

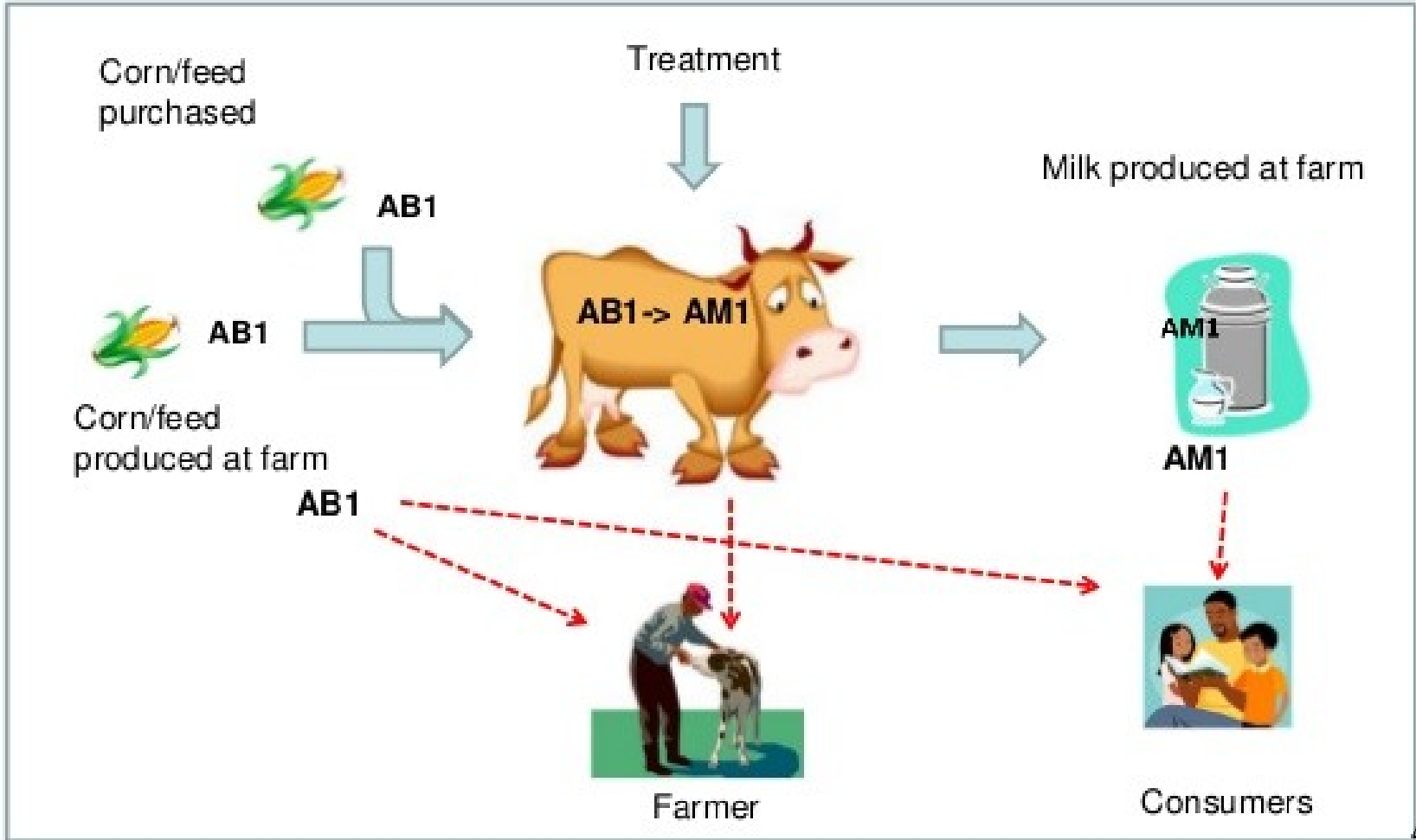
Aerial contamination and soil contaminated foods introduce mold spores in milk and milk products.

Symptoms

Liver hyperplasia, tissue hemorrhage, anorexia, hepatitis 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
- Soil-directly or indirectly

Symptoms

Two types

- Diarrhoea: Abdominal pain and cramps, profuse watery diarrhea.
- Moderate nausea with rare vomiting.

Lecithinase releases phosphoryl choline, a toxic substance from lecithin

- 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. The 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.

Different Terms Used in Milk Borne Infections

Outbreak:

According to Communicable Disease Centre, an outbreak of food-borne disease is defined as an incident in which two or more persons experience a similar illness usually gastro-intestinal after ingestion of a common food.

Etiology:

Etiology of a food-borne disease is the confirmation or identification of the causative agent of the disease through laboratory diagnosis.

Epidemiology:

Epidemiology of a food-borne disease is a systematic approach to locate the cause and mode of transmission of the disease, so that corrective measures can be applied.

Investigation of Milk Borne Diseases

There exists a systematic monitoring and surveillance system to investigate the causes of food-borne illness in developed countries but, there is lack of adequate investigating system in developing countries and as a result, no follow-up action is taken to avoid reoccurrence. Generally gastrointestinal disorders are perhaps the greatest single cause of morbidity in developing countries. For investigation of an outbreak the following steps are to be followed:

- 1. A detailed description of gastro-intestinal cases should be made.**
- 2. A record of food eaten and a common source of infection should be identified, if large number of individuals is involved.**
- 3. History of previous illness of personnel handling milk should be traced.**
- 4. Evidence of enteric disorders, scratches, wounds, sores, pyogenic infections or other evidence of sepsis should be looked for and swabs should be taken.**
- 5. Sanitary facilities and practices used in plant should be recorded.**
- 6. A detailed veterinary record of animals should be obtained with particular attention to recent cases of mastitis.**
- 7. Pooled milk samples from one or several animals should be taken aseptically, immediately cooled and held cool until delivered for examination.**

Other Milk Borne Diseases

Tuberculosis: Causative microorganism: *Mycobacterium tuberculosis*. German physician Robert Koch (1843-1910) revealed it from contaminated raw milk, and its role in infant mortality. Another strain, *M. bovis*, was responsible for tuberculosis in cows, and that it was species specific and would not infect humans. Milk borne tuberculosis is directly or indirectly related to consumption of raw milk from infected dairy herds. The tuberculosis traceable to raw milk was the result of external contamination or lesions in the udders of cows racked with bovine tuberculosis. The milk buckets, too, were easily contaminated by workers. There are 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*. Avian type of the microorganism may cause both types of tuberculosis.

- *M. tuberculosis* - Human
- *M. bovis* - Cattle and human
- *M. avium* - Birds, swine but rarely human

- 1. Human type tuberculosis bacilli may gain access to milk from milkers and other handlers. It causes human type tuberculosis in cattle. This cannot be immediately noticed and may give tuberculin negative test but after 2-3 months, this test will be positive. Such suspected animals are usually held under observation and rested periodically. If the reaction disappears, these are restored to their normal status in herd. Such cattle may excrete bacilli in their milk from apparently normal udders.**
- 2. Milch animals other than cattle are also affected with tuberculosis mainly by bovine type. Buffaloes and goats are less frequently affected by tuberculosis. Bovine type infection in man appears to be practically nonexistent, in spite of a considerable proportion of cows being infected. It may be attributed to the habit of boiling milk before consumption. Sour milk may kill human and bovine tuberculosis bacilli within 18 - 24 h**
- 3. Avian type tuberculosis bacilli also cause natural infections in cattle. Human infection with avian type bacilli is quite rare.**

Symptoms

Tuberculosis is characterized by the 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. Incubation period is 4-6 weeks from infection to demonstrable primary lesion.

Prevention and control

- Animals should be subjected to tuberculin test.**
- Animal suffering with tuberculosis should be isolated.**
- Proper heat treatment of milk. The traditional habit of boiling every lot of milk before consumption in India is good, in combating the incidence of tuberculosis.**
- Overcrowding of animals must be avoided and living conditions must be improved.**
- 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. It is a Gram-positive, non-sporulating rod capable of growing at wide range of temperature (1-45 C). The pathogenicity of the culture is associated with the production of extracellular haemolysin (α , β) by the organism. 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 disease organism also introduce the 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. The 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

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

***Campylobacter* poisoning (Campylobacteriosis):** The vehicle is raw milk for this milk borne disease. A wide variety of warm blooded animal have been found to be infected with *Campylobacter jejuni*.

Sources

1. The organism has been isolated from intestinal tracts and faecal matter of man, goat, sheep etc. Faecal matter is the chief source of this organism.
2. Polluted water contaminated with *C. jejuni* is also important source for the entry of this organism in milk and milk products.
3. Infected personnel and animals.

Symptoms

Severe abdominal pain, watery diarrhoea, acute gastroenteritis in man

Prevention and control

4. Milk should be properly pasteurized and heat treated as the organism does not survive pasteurization.
5. Public water supply should be effectively chlorinated.
6. Good hygiene should be practiced by personnel.
7. Persons suffering from disease shouldn't handle milk and its products.

Brucellosis:

1. Most common milk-borne diseases, also called Bang's disease, Gibraltar fever, Malta fever, Maltese fever, Mediterranean fever, rock fever, or undulant fever, is a highly contagious zoonosis caused by the ingestion of unsterilized milk or meat from infected animals or close contact with their secretions.
2. *Brucella* spp. are small, Gram-negative, non-motile, non-spore-forming, rod shaped (coccobacilli) bacteria.
3. This is facultative intracellular parasites causing chronic disease that usually persists for life.
4. Malta fever first came to the attention in 1850s in Malta during the Crimean War.
5. In cattle, this disease is also known as contagious abortion and infectious abortion.
6. Undulant fever originates from the characteristic undulance (or 'wave-like' nature) of fever, that rises and falls over weeks in untreated patients.

7. 3 principal sp. of *Brucella* responsible are: *B. melitensis* (in goats), *B. suis* (in hogs), *B. abortus* (in cattle). All the 3 infect humans and are excreted in the milk of dairy animals.
8. Brucellosis in humans is usually associated with the consumption of unpasteurized milk and soft cheeses made from milk of infected animals, primarily with *B. melitensis* and with occupational exposure of workers, veterinarians and slaughterhouse workers.
9. Brucellosis induces fevers, sweating, weakness, anaemia, headaches, depression, muscular and body pain and the duration of disease can vary from a few weeks to months or years.
10. In the first stage of disease, septicaemia occurs and leads to undulant fevers, sweating and migratory arthralgia.
11. During episodes of Malta fever, melitococchemia (presence of brucellae in blood) can usually be demonstrated by means of blood culture in tryptose medium. If untreated, the disease can become chronic.
12. The focalizations of brucellosis occur usually in bones and joints and spondylitis of lumbar spine accompanied by sacroiliitis.

- 1. Diagnosis: Blood cultures in tryptose broth, bone marrow cultures.**
The growth of brucellae is extremely slow and the culture poses a risk to lab personnel due to high infectivity of brucellae.
- 2. Demonstration of antibodies against the agent either with, ELISA or 2-mercaptoethanol assay for IgM antibodies associated with chronic disease.**
- 3. Histologic evidence of granulomatous hepatitis**
- 4. The preferential erosion of antero-superior corner of lumbar vertebrae and marked osteophytosis are suspicious of brucellic spondylitis.**

Prevention and control

- Segregation of infected herd to avoid cross infection and if possible the 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.**

Diphtheria: Diphtheria is caused by only toxigenic strains of *Corynebacterium diphtheriae*. Rarely, a diphtheria-like illness is caused by a toxigenic strain of *C. ulcerans* or *C. pseudotuberculosis*. *C. diphtheriae* has three biotypes: gravis, intermedius, and mitis. The gravis biotype is associated with the most severe disease, but any strain may be toxigenic. All clinical isolates should be tested for toxigenicity. Nontoxigenic strains can cause sore throat and other invasive infections, and are associated with endocarditis.

- 1. Illness:** Classic diphtheria is an upper-respiratory tract infections characterized by sore throat, low-grade fever, and an adherent pseudomembrane of the tonsil(s), pharynx, and/or nose. The disease can involve almost any mucous membrane. For clinical purposes, diphtheria can be classified according to the site of the infection.
- 2. Anterior nasal diphtheria:** Usually presents with mucopurulent discharge from nose that may be bloody and a white pseudomembrane on nasal septum.
- 3. Laryngeal diphtheria:** If the infection involves larynx, it may occur either as an extension of pharyngeal form, or as laryngeal involvement alone. Patients can present with fever and a barking cough. The pseudomembrane can cause potentially fatal airway obstruction.

4. **Pharyngeal and tonsillar diphtheria:** The most common type of infection, initially presents with malaise, sore throat, anorexia, and low-grade fever. Within a few days, a bluish-white pseudomembrane forms on one or both tonsils that can extend to the tonsillar pillars, uvula, soft palate, pharynx and nasopharynx. Over time, the pseudomembrane evolves, assuming a dirty gray color with areas of green or black necrosis surrounded by a minimal amount of erythema. Attempts to remove the pseudomembrane cause bleeding. With severe disease patients can develop edema of the anterior neck. If a significant amount of toxin is absorbed into the blood stream, patients may develop rapid pulse, coma and death. The differential diagnosis of diphtheria includes streptococcal pharyngitis, viral pharyngitis, infectious mononucleosis, oral syphilis and candidiasis.
5. **Cutaneous diphtheria:** Caused by either toxigenic or nontoxigenic strains of *C. diphtheriae* is usually mild, typically consisting of non-distinctive sores and rarely causes toxic complications. The disease may present as a scaling rash or as clearly demarcated ulcers. A chronic skin lesion may harbor *C. diphtheria* along with other microorganisms. Skin infections are common in tropical climates, so high levels of natural immunity among local populations in these regions.

Modes of transmission

Diphtheria is transmitted from person to person through respiratory droplets or less commonly, through contact with discharge from skin lesions. Historically, raw milk and fomites were known to have served as vehicles.

Incubation period

The incubation period is usually 2–5 days (range 1–10 days).

Communicability

- 1. Persons are communicable for up to 4 days after treatment with effective antibiotics has been initiated.**
- 2. Untreated persons generally shed bacteria from the respiratory tract or from skin lesions for 2–4 weeks after infection.**
- 3. A chronic carrier state is rare, but known to exist, and such a carrier may shed microorganisms for 6 months or more.**

Prevention and control

- 4. Adequate heat treatment of milk.**
- 5. Infected person should not be allowed to handle milk and milk products.**
- 6. Unhygienic practices like sneezing and coughing by the dairy persons should be avoided.**
- 7. Proper vaccination of individuals against disease is an efficient prophylactic measure**

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*. It can survive pasteurization, if the specified temperature is not maintained and also freezing temperatures. As it is heat resistant, the time-temperature combination used in pasteurization is selected on the basis of heat inactivation of this microorganism. It is viable for 2 years at -20°C , resist 0.5% formalin and 1% phenol. It also remain viable for 25 days in rennet cheese, 42 days in cottage cheese, whereas in yoghurt it is killed within 24 hours due to acidity.

Individuals, who have frequent direct contact with animals (veterinarians, meat workers, and sheep and dairy farmers) are at higher risk. Most patients get Q fever by coming in contact with animals infected with the 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.

People also become infected indirectly from animals through contaminated materials like wool, straw, and fertilizer. There is a risk of Q fever from consumption of contaminated raw milk. Sheep, cattle, goats, cats, dogs, some wild animals like bobcats and rodents, birds, and ticks carry the bacteria. Most infected animals do not show signs of illness, but Q fever may sometimes cause abortion.

Only about one-half of all people infected show signs of illness. First symptoms of Q fever resemble flu and may include fever, chills, sweats, headache, and weakness. It may rarely progress to affect liver, nervous system, or heart valve.

Q fever is diagnosed by identifying the bacteria in tissues or through a blood test that detects antibody to the micro-organism. Patients with mild transient illness usually do not require treatment.

Placenta, other birth products, and aborted foetus should be disposed of immediately.

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.

Symptoms

High fever, headache, weakness, malaise, severe sweating and virus like pneumonia.

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**
- 4. Survey for determining the prevalence of infection in an area should be carried out.**

Anthrax: *Bacillus anthracis* is the causative agent of anthrax which pass from blood of infected animals into their milk. In acute anthrax, the milk secretion is suppressed or altered that milk is not likely to be consumed.

Sources of pathogen

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

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

Diseases in human beings

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

The 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.

Diagnosis

The identification is carried out by Gram, capsule and spore staining. The organism can be detected from the exudates of infected individual leading to confirmation of disease.

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: These are a group of viruses that can cause severe epidemics of diarrhea in infants and children on ingestion of contaminated milk. The most common human pathogens are polio and coxsackie viruses. Milk and its products are commonly contaminated with enteroviruses mainly through fecal contamination. Unheated milk contaminated after pasteurization play a significant role in the transmission of disease, especially in developing countries. However, polio virus can be inactivated in milk by pasteurization. Compared to polio virus, coxsackie viruses are more resistant to heat treatment.

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 the spread of the 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**
- Hygienic measures should be strictly followed to avoid fecal contamination**
- 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: It is considered as one of the 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

- Since the disease spreads through person to person contact, hence handlers can be an important source
- Defective water supply in a milk plant introduce the virus to milk
- Polluted environment in milk plant may also contaminate milk

Symptoms

Nausea, vomiting, lethargy, abdominal pain, diarrhea, fever, chills, anorexia, 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
- Adequate heat treatment of milk is likely to inactivate the virus