



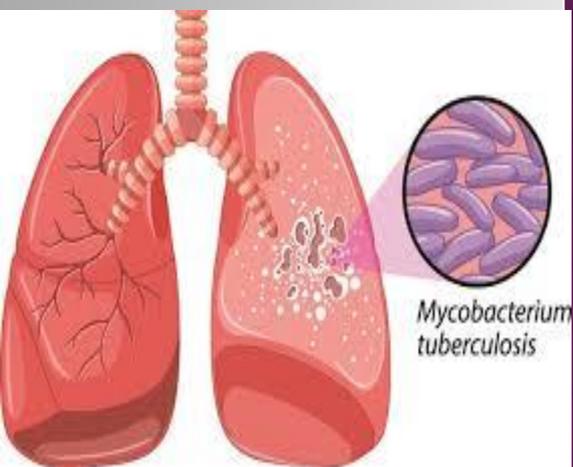
# **VPH-604**

## **Zoonoses and Public Health**

### **(Credit Hours-2+1)**



# TUBERCULOSIS



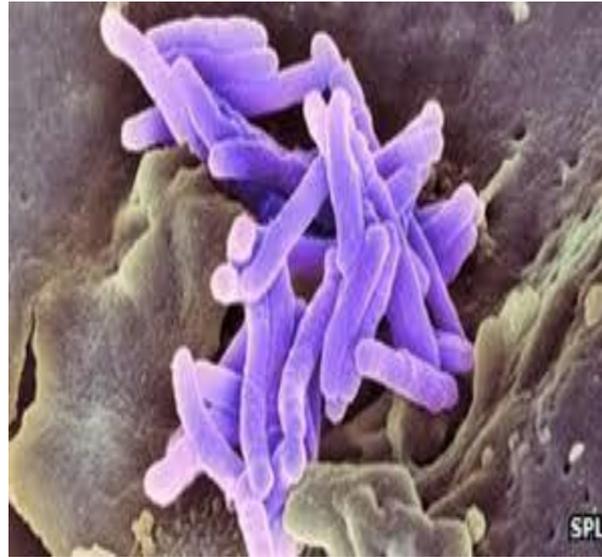
Direct anthroozoonosis, Zooanthroponosis

It is a chronic disease of man & animals caused by pathogenic *Mycobacterium spp.* causing development of tubercle in vital organs. The pulmonary tuberculosis is the most common form, characterized by protective cough, fever, fatigue, weight loss, chest pain and night sweat in human beings



# SYNONYMS

- Rajayakshman - **the king of diseases** (in Hindu texts),
- Yakshma
- Acnitis,
- Consumption,
- Great white plague,
- Great white scourge,
- Lupus vulgaris,
- **Pearl disease,**
- **Pott's disease,**
- Pthisis,
- Scrofula,
- Scrofuloderma,
- Tuberculous ◆
- Caseous pneumonia



◆ *caseous L. caseus*, cheese. The material formed resembles cheese or curd

# ETIOLOGY

⊙ The \*‘**tubercle bacilli**’ that cause tuberculosis in man belong to the so-called #*Mycobacterium tuberculosis complex*

- Genus - *Mycobacterium* (Group 1) and has four species namely
  - *M. tuberculosis*
  - *M. bovis*
  - *M. africanum*
  - *M. microti*



\* *tubercle* *L. tuberculum*, a swelling or knob

# *mycobacterium* Gr. *myces*, fungus, and *bakterion*, a small rod

# ETIOLOGY

## ▪ **Morphology:**

- Gram +Ve
- Long,
- Slender,
- Straight curved rods  
(tendency to be filamentous/branching)
- Non capsulated,
- Aerobic
- Flagella,
- Produce spores or exotoxins
- Facultative intracellular parasite
- Acid fast staining

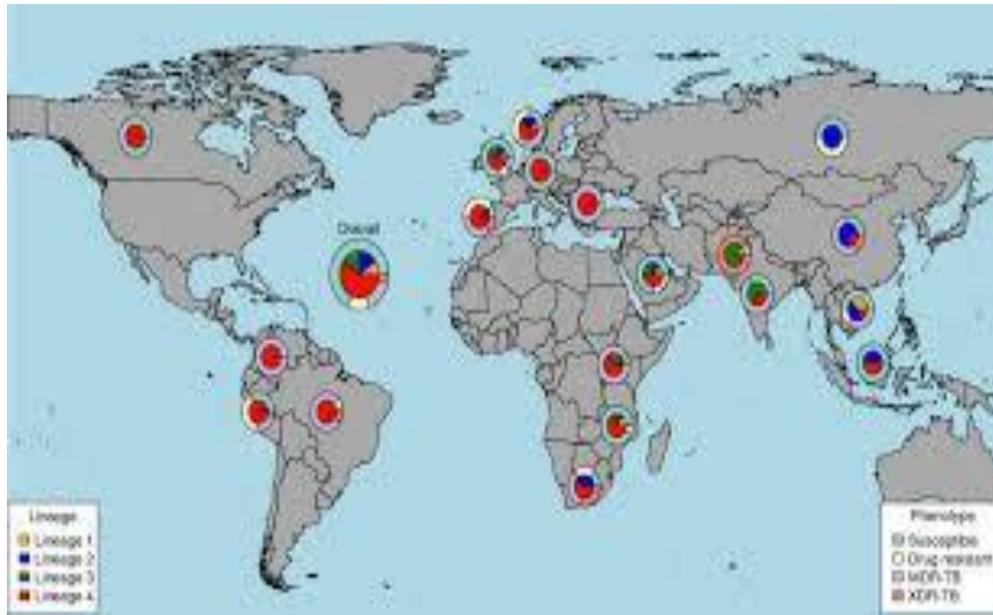


# HISTORY

- ❑ **Early as 4000 B.C:** An ancient disease:
- ❑ **15 century BC:** Described by Hippocrates & Aristotle  
As *Phthisis* (Greek literatures) which was translated in to English as ‘Consumption’
- ❑ **In 1882:** Robert Koch cultivated the agent
- ❑ **In 1890:** Demonstrated tuberculin testing first in guinea pigs
- ❑ **In 1906:** French scientists, **Calmette & Guerin** (veterinarian) developed vaccine “**BCG vaccine**”
- ❑ **In 1927:** the first human was vaccinated
- ❑ **In 1948:** the vaccine was accepted by TB workers
- ❑ **In 1907:** Tuberculin test was first discovered by Von Pirquet

# GEOGRAPHIC DISTRIBUTION

- *M. tuberculosis* & *M. bovis*: Worldwide
- *M. africanum*: In Africa, Germany, England
- *M. africanum* strains phenotypically related to *M. tuberculosis*



# TB: IN INDIA

- ◉ Ranks **first** in tuberculosis
- ◉ Falls under **MDR-TB** zone
- ◉ One of the biggest public health problems

## Annually:

- **1.8 million** people develop TB
- **4.17 lakhs** people die
- Loss of an about **83 work-days**
- More burden: **childhood** & deaths from tuberculosis by **meningitis** & **disseminated disease**
- Since 1993, India has successfully implemented **Revised National Tuberculosis Control Programme (RNTCP)** using **DOTS** strategy



# HOST RANGE

## ○ Reservoir:

- *M. tuberculosis*: Mainly man
- *M. bovis*: Infected bovines (mainly)

**Other host:** Man, sheep, goat, buffalo, dog, cat, horse, pig, deer, monkey, chimpanzee, bison, elephant, marsupials, mink, moles, badgers, opossum, cockatoo, ferret, fox, hare & parrot

- *M. avium*: cases of generalized TB

# EPIDEMIOLOGY

- ❑ About **60 million cases annually globally**
- ❑ Death: **5000 people die** daily
- ❑ **One third** of the total population of the world is infected (WHO)
- ❑ **Morbidity & mortality rates high:** Urbanites, minorities, the poor, the homeless, substance abusers & persons infected with HIV
- ❑ **Global incidence:** more in low income countries
  
- ❑ **South-east Asia region countries:**
  - 38% of the global burden of tuberculosis
  - 3 million new cases
  - Nearly 0.6 million deaths
- ❑ Resistant strains of TB (MDR-TB) pose a serious role

# EPIDEMIOLOGY

- The incidence is influenced by many factors:
  - Inadequate health care
  - Poor standard of living & socioeconomic conditions
  - Malnutrition
  - Higher population density
  - Occupational contraction
  - Poor personal hygiene
  - Lack of education & awareness
  - Various diseases like: HIV/AIDS, Diabetes mellitus
  - Close confinement of the human population

# SOURCES AND TRANSMISSION

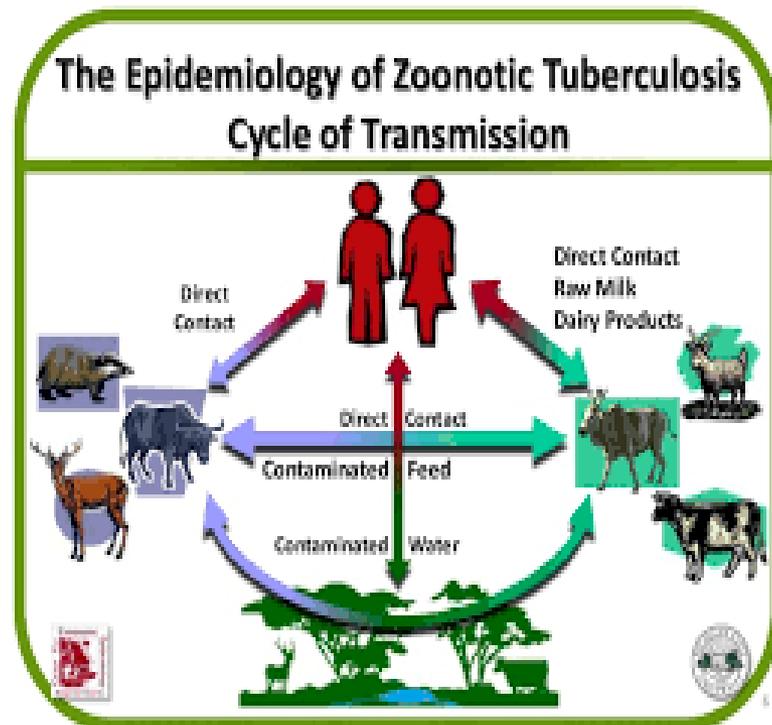
- ◉ **Human source:** Sputum
- ◉ **Bovine source:** Milk & faeces
- ◉ **Environmental source:** Water, soil and dust contaminated with human & animal sources
- ◉ **Most common mode of transmission:** Ingestion & inhalation

- ◉ **Inhalation:** droplet nuclei

- Exposure to dusty bedding
- Coughing of infected animals
- Aerosolization of the organism
- Laboratory environment

- ◉ **Ingestion:**

- Consumption of infected milk &
- milk product

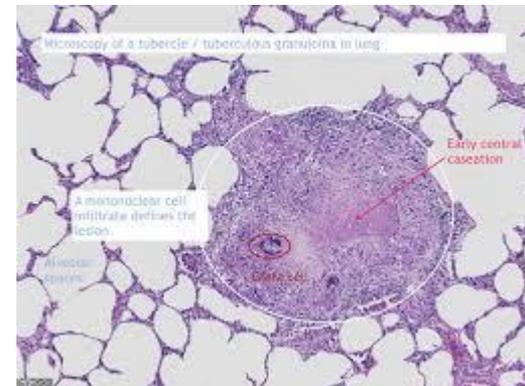
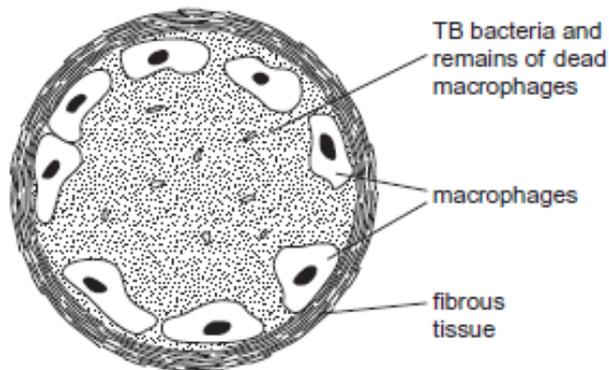


# DISEASE IN MAN

❖ Clinical tuberculosis occurs in 3 stages:

## 1. Primary tuberculosis:

- The lung infection
- Formation of the tubercle
  - **Central core** : Bacilli & enlarged macrophages
  - **Outer wall**: Fibroblasts, lymphocytes & neutrophils
- The centers may break down into **necrotic, caseous lesions** & **gradually heal by calcification**



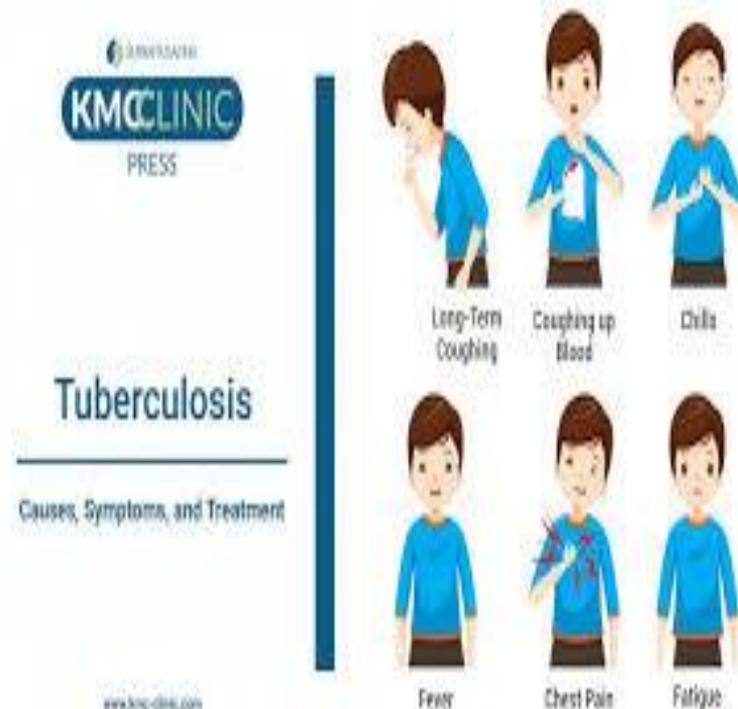
# DISEASE IN MAN

## 2. Secondary tuberculosis:

- **Primary case:** dormant bacilli from 1<sup>o</sup> C become reactivated
- **In chronic:** the bacilli drain into the bronchial tubes & upper respiratory tract

### □ The patient shows

- Violent coughing
- Greenish or bloody sputum
- Fever
- Anorexia
- Weight loss
- Extreme fatigue
- Night sweats
- Chest pain



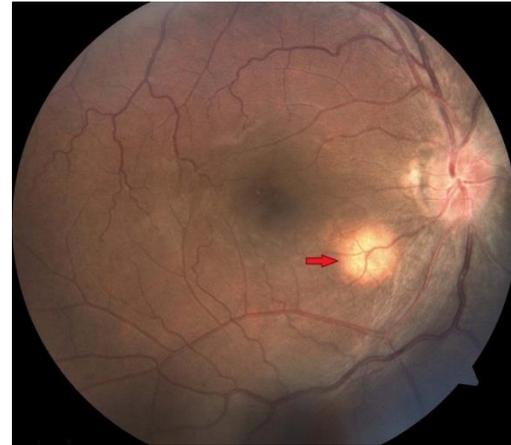
# DISEASE IN MAN

## 3. Extrapulmonary tuberculosis:

Secondary tuberculosis the bacilli disseminate rapidly

### ❑ Organ effected:

- Regional lymph nodes,
- Kidneys,
- Long bones,
- Genital tract,
- Brain
- Meninges
- Eyes: **Miliary TB**



- **Renal TB:** necrosis & scarring of renal medulla, pelvis, ureters, bladder
- **Genital TB:** Affects reproductive functions in both sexes
- **Bones & joints** (vertebral column): Paralysis & sensory loss
- **Meninges:** Mental deterioration, permanent retardation, blindness & deafness

# DISEASE IN MAN

- ◉ **Bovine TB:** *M. bovis*
- ◉ **Source:** unpasteurized milk
  
- ◉ **In young ones:** as ‘**Scrofula**’ - a condition  
(established in cervical &, less frequently, axillary lymph nodes)
- ◉ **In adults:** Post primary pulmonary disease is more common
  
- ◉ **Infection through skin wound:**
  - lesions in skin
  - Tendon & localized lymph node lesions (in the persons handling infected carcasses)

# DISEASE IN ANIMALS

## ◎ **In cattle:**

- Superficial lymph nodes will be swollen
- **Udder:** Progressive hardening & swelling
- **Milk:** thin and watery with yellow flakes
- **The generalized TB cases:**
  - ✓ Emaciation (hide bound condition),
  - ✓ Cough, dry & harsh body coat
  - ✓ Dull & sunken eyes
  - ✓ Diarrhoea with capricious appetite
  - ✓ Fluctuating body temperature,
  - ✓ **Snoring:** involvement of retropharyngeal lymph node



- ◎ **In cutaneous TB:** lumpy swelling, sometimes cording (In the lower part of the front legs & rarely on hind legs)

# DISEASE IN ANIMALS

## ⊙ In dogs and cats:

- Marked emaciation
- Constant discharge from nose
- Cough
- Pleurisy (pleural cavity may get filled with fluid)
- Causing difficulty in breathing
- Swelling on chest & abdomen



## ⊙ In poultry:

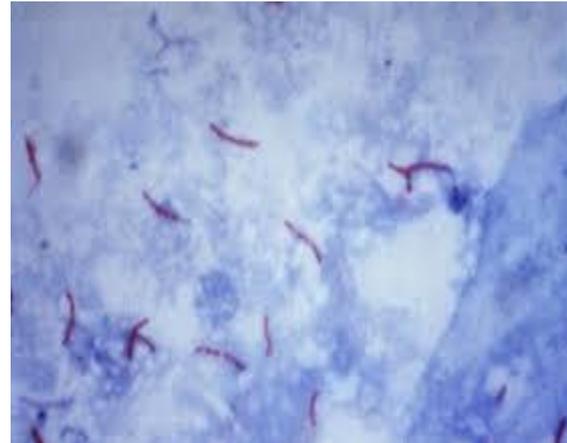
- Severe emaciation
- Pale mucous membrane
- Intermittent diarrhoea



Figure 3: Bluish discoloration after injection of tuberculin shown by the tip of the arrow.

# DIAGNOSIS

- ❑ **Microscopic detection of acid-fast bacilli:**
  - ✓ From sputum
  - ✓ On histological examination of the tubercle
  
- ❑ **Delayed type hypersensitivity (DTH) assays**
  - ✓ Single intradermal tuberculin test,
  - ✓ Stormont test,
  - ✓ Short thermal test,
  - ✓ Subcutaneous tuberculin test and
  - ✓ Ophthalmic test



# DIAGNOSIS

## ❑ Animal inoculation:

- ❖ Suspected material: milk samples (not heavily infected)
- ❖ Can be inoculated into the thighs of guinea pigs
- ❖ Typical lesions of tuberculosis of liver, spleen & lymph nodes of infected animals

## ❑ New techniques:

- ❖ **PCR assays:** multiplex PCR
- ❖ **Gamma-interferon (IFN-g) assay:** More sensitive than skin test remains costly & inconvenient
- ❖ **Blood test (BT) to monitor:** Humoral & cellular responses  
by ELISA & lymphocyte transformation tests

# DIAGNOSIS

- ❑ A combination therapy: Intradermal skin test (ST) & ELISA enhanced sensitivity (95%) in comparison to individual test

- ❑ Isolation and identification of the pathogen:

- ✓ Confirmatory test but requires viable bacilli,
- ✓ Growth of *M. bovis* may take **6-8 weeks**



- ❑ Roentgenography: Chest x-rays or roentgenographs

- ❑ Mantoux test: (in human)

0.1 ml of PPD is inj. I/D

Forearm: induration after 48 and 72 hours



# TREATMENT

**In animals:** No treatment

**In man:** To avoid drug resistance

➤ **The combined therapy** (at least two drugs)

- Isoniazid (INH),
- Rifampicin
- Ethambutol
- Streptomycin
- Pyrazinamide
- Thioacetazone
- Para-aminosalicylic acid (PAS)



▪ **Immunotherapy:**

- ✓ Purified recombinant cytokines like interleukin-2, (IL-2), IL-12 & IFN-g

# PREVENTION AND CONTROL

- ◉ **In animals:**
- ◉ **Effective control: Test and slaughter policy**
- ◉ **In India: Test & segregations policy**
  - ✓ Implementation of elimination program: diagnosis, reporting & movement
  - ✓ Notification of outbreaks of disease
  - ✓ Effective trace back systems
  - ✓ Research on potential role of other domestic and wild animals as disease reservoirs
  - ✓ Maintenance of good hygienic conditions in shed,
  - ✓ Good animal management practices
  - ✓ Vaccination: bovis bacille Calmette-Guérin (BCG) vaccine

# PREVENTION AND CONTROL

## ⊙ In humans:

- ❑ Notification of human cases due *M. bovis*
- ❑ Tracing of source
- ❑ Condemnation of milk from infected herd,
- ❑ Treatment of meat from infected animal,
- ❑ Regular health checks for occupational groups at risk
- ❑ Proper abattoir controls,
- ❑ Awareness among butchers & farmers
- ❑ Promotion of milk pasteurization,
- ❑ Health education, training of health personnels,
- ❑ Effective implementation of national TB control programmes in India
- ❑ BCG vaccination and preventive chemotherapy