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GLOBAL EDUCATION

Bacteriology of Tuberculosis

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WHO | THE STOP TB DEPARTMENT

Outline

1. *Mycobacterium tuberculosis* complex
2. Classification of mycobacteria within the genus
3. Bacteriological characteristics of tuberculosis
4. TB Diagnostic tools

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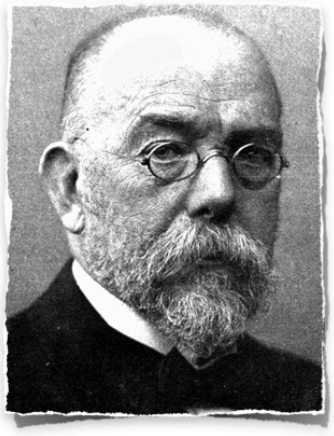
Mycobacterium tuberculosis Complex (MTBC)

Robert Koch identified the organism of the MTBC

- *Mycobacterium tuberculosis*
- *Mycobacterium bovis*
- *Mycobacterium bovis BCG*
- *Mycobacterium microti*
- *Mycobacterium africanum*

- Acid-fast organisms
- Slow growing organisms
- Only one group in the Genus Mycobacteria
- Major public health implications



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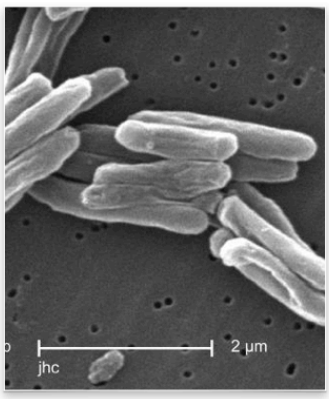
Genus Mycobacteria

Almost 100 different species

- 50 have potential for disease

Runyon classification system

- morphology
- growth rate
- pigmentation



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Nontuberculous mycobacteria

Rapidly growing: < 7 days	Intermediately growing: 7-10 days	Slowly growing: > 7 days on agar
M.fortuitum complex	*M.marinum – pigmented 30°C*	*M.avium complex*
(M.fortuitum, M.peregrinum, M.fortuitum third biovariant complex, M.mucogenicum)	*M.gordonae - pigmented 35°C*	*(M.avium, M.intracellulare, M.avium complex "xvar") M.kansasii, M.xenopi, M.simiae, M.szulgai, M.malmoense, M.terrae/ M.nonchromogenicum complex, M.haemophilum, M.genavense*
M.chelonae / abscessus group		
(M.chelonae, M.abscessus, M.immunogenum)		***Others:***
M.smegmatis – pigmented / nonpigmented		*M.interjectum, M.confluentens, M.lentiflavum etc*
Others pigmented:		
(M.phlei, M.aurum, M.flavescens, M.neoaurum, M.vaccae, M.thermoresistible)		

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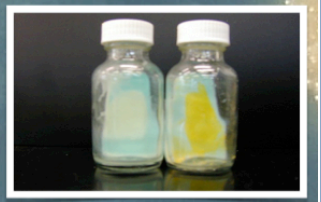
TB Bacteriology
Growth rates and pigmentation

Runyon groups

- ✓ slowly growing *photochromogens*
- ✓ slowly growing *scotochromogens*
- ✓ slowly growing non-chromogens
- ✓ rapid growers



TB Bacteriology
Clinical classification

Human pathogens
- ✓ M. tuberculosis, M. leprae, M. ulcerans

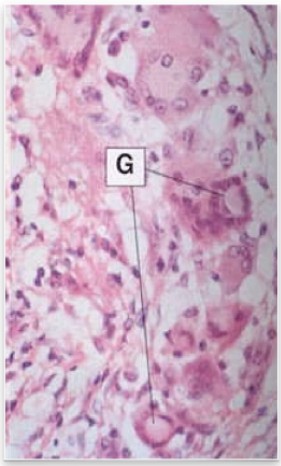
Animal pathogens
- ✓ M. bovis, M. avium, M. marinum

Environmental mycobacteria
- free living in water or soil
- Classification is not strict
- M. tuberculosis infection is acquired primarily by person to person transmission
- Infections with non-tuberculous mycobacteria (NTM) are acquired from the environment and are not transmitted person to person

Tuberculosis transmission and disease (I)

- MTB an obligate pathogen, requires host to survive
- Inhalation into alveolar spaces, ingestion by macrophages
- Development or elimination of disease depends on microbiocidal activity
- Degenerated macrophages sensitize local lymphocytes and mobilise more macrophages.
- Dynamic turnover of engulfment and degeneration

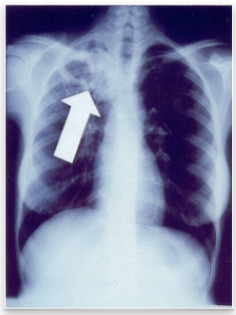
Tuberculosis transmission and disease (II)



- Zone of **lymphocytes** and **mononuclears** surround centre of necrosis, development of capsule of fibrous connective tissue
- Extensiveness of disease due to virulence, route of infection, stage of infection, host factors

TB Bacteriology
Oxygen dependence

- TB bacilli require oxygen
- Prefer top of lung or cavities where air circulation is best for multiplication
- TB bacilli can survive in a metabolically inactive form or "dormant" in the host
- Dormant bacilli can reactivate to cause active disease after years or decades and especially with deterioration of the host immune system



Probability TB will be transmitted

- Infectiousness of person with TB
- Environment in which exposure occurred
- Susceptibility of the host
- Duration of exposure
- Virulence of the organism

Disease progression

- Only some individuals infected will develop active disease
- Approx. 10% of infected persons with normal immune systems develop TB at some point in life
- HIV strongest risk factor for development of TB
- Risk of developing TB disease among persons with HIV is 7% - 10% each year
- Certain medical conditions increase risk that TB infection will progress to TB disease

Conditions that increase the risk of progression to TB disease

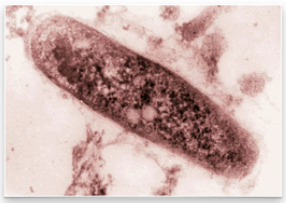
- HIV infection
- Substance abuse
- Recent infection
- Diabetes mellitus
- Silicosis
- Immunosuppression (corticosteroids and other drugs, malnutrition)

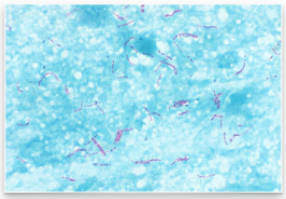
TB Bacteriology
Cellular characteristics

Cell wall composition
- layer of mycolic acid
- heat and phenol needed for the primary stain to penetrate the cell wall

Acid fast bacilli - AFB
- all mycobacteria are AFB (i.e resistant to decolorization with acid or acid alcohol)
- lack of specificity
- resistance to chemicals inc. disinfectants acids, alkali, detergents

Long generation time
- chronicity of disease

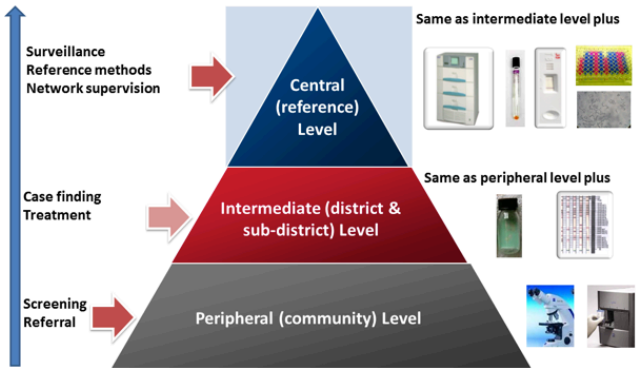




TB Bacteriology
Resistance characteristics

Natural resistance to common antibiotics
- ✓ Inherent resistance to penicillins
- ✓ Intracellular bacteria are protected by the acid environment of macrophages
- ✓ Spontaneous mutations each million – 100 million divisions
- ✓ High selection pressure once mutants occur especially for the key mycobactericidal drugs (rifampicin and isoniazid)
- ✓ Exposure to a single drug
  - poor adherence to treatment / inappropriate prescription
  - irregular drug supply / poor quality

WHO recommended diagnostics for use at different levels of laboratory sophistication



Available at: www.who.int/tb/dots/laboratory/policy/en WorldMEDSchool

Thank you!

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