Tuberculosis (TB): Here and Now

Session One of a Four-Part Webinar Series
Presented in Partnership with the
BC Lung Association

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Overview

- What is tuberculosis (TB)?
- Review of global, national, provincial, and regional incidence of TB disease (2011)
- TB transmission
- TB pathogenesis
- TB and smoking
- Q&A

Learning Objectives

At the end of this webinar, participants will be able to:

- Describe the 2011 incidence of TB disease in Canada and British Columbia
- Identify populations at increased risk for TB in BC
- Explain how TB is transmitted
- Explain the difference between TB infection and TB disease
- Describe the influence of medical and other risk factors on progression from TB infection to TB disease

Abbreviations and Key Terms

- **TB bacteria:** bacteria that can cause TB disease
- **LTBI:** latent TB infection
- **MDR-TB:** TB that is resistant to isoniazid (INH) and rifampin
- **XDR-TB:** TB that is resistant to INH, rifampin, fluoroquinolones and at least one of three injectable drugs (amakacin, kanamycin, capreomycin)
- **Cavity/Cavitation:** a chest X-ray finding in some cases of pulmonary TB disease

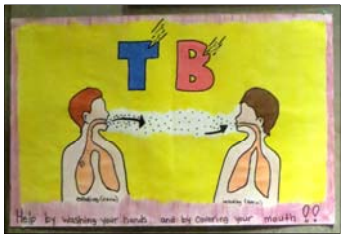
Tuberculosis - Etiology

***Mycobacterium tuberculosis* complex**: several closely related mycobacteria that cause TB disease

- *M. tuberculosis* including MTB subspecies, *canetti*
- *M. bovis*
- *M. africanum*
- *M. caprae*
- *M. microti*
- *M. pinnipedii*

What is Tuberculosis (TB)?

- An infectious disease
- Often (but not always) attacks the lungs



What was the most unusual presentation of TB disease that you have seen or heard about?

What is Tuberculosis (TB)?

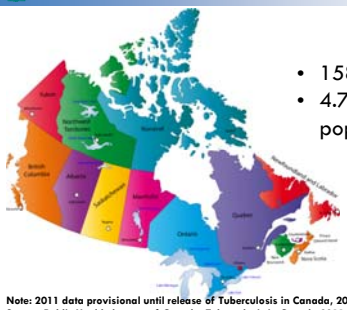
- An infectious disease
- Often (but not always) attacks the lungs
- Usually (but not always) curable with appropriate treatment
- Untreated, kills more than 50%
- Typically, only cases with respiratory disease transmit

World Health Organization

- 1/3 of the global population infected with TB
- 8.7 million new cases, 1.4 million deaths (2011)
  - 310 000 cases of MDR-TB (est)
    - 3.7 % of new cases and 20% of previously treated cases MDR-TB
    - 60% of MDR-TB cases: India, China, and Russian Federation
    - 9% of MDR-TB have XDR-TB

Source: http://www.who.int/tb/publications/factsheet_global.pdf

TB in Canada: 2011



- 1587 new cases
- 4.7 cases per 100 000 population

Note: 2011 data provisional until release of Tuberculosis in Canada, 2011
Source: Public Health Agency of Canada. Tuberculosis in Canada 2011 – Pre-Release. Ottawa (Canada): Minister of Public Works and Government Services Canada; 2012

TB in Canada: 2011

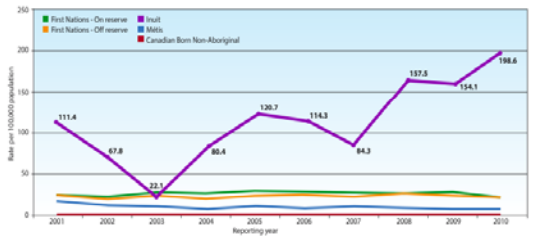
Origin	Cases	Rate / 100 000
Foreign-born	1081 (67%)	13.5
North American Indian (Status)*	176	20.4
North American Indian (Non-status)*	2	--
Inuit*	106	177.6
Metis*	21	6.0
Canadian-born non-Aboriginal	186 (12%)	0.7
Birthplace unknown	8	--

*19% of cases were of Aboriginal origin

Note: 2011 data provisional until release of Tuberculosis in Canada, 2011
Source: Public Health Agency of Canada. Tuberculosis in Canada 2011 – Pre-Release. Ottawa (Canada): Minister of Public Works and Government Services Canada; 2012

TB in Canada

Incidence rate of TB disease by Aboriginal group compared with Canadian-born non-Aboriginals, 2001-2010



Note: 2011 data provisional until release of Tuberculosis in Canada, 2011
Source: Inuit-specific Tuberculosis (TB) Strategy. Inuit Tapiriit Kanatami; 2013. Available from http://www.itk.ca

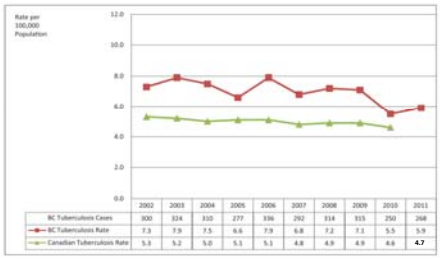
TB in British Columbia: 2011

- 268 new cases
- 5.9 cases per 100 000 population

Note: 2011 data provisional until release of Tuberculosis in Canada, 2011
Source: Public Health Agency of Canada. Tuberculosis in Canada 2011 – Pre-Release. Ottawa (Canada): Minister of Public Works and Government Services Canada; 2012

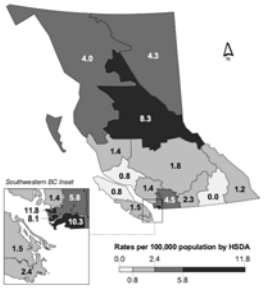
TB in British Columbia: 2011

Tuberculosis rates by year, 2002 - 2011



Source: BC 2011 Annual Summary of Reportable Diseases, available from: http://www.bccdc.ca

TB in British Columbia: 2011

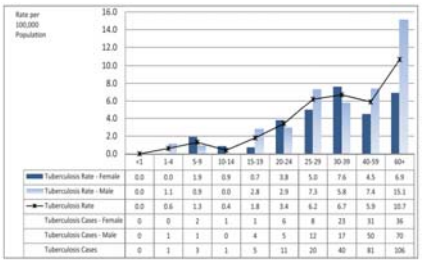


HSDA	Health Service Delivery Area	Cases	Rate
11	East Kootenay	1	1.2
12	Kootenay Boundary	0	0.0
13	Okanagan	8	2.3
14	Thompson Cariboo Shuswap	4	1.8
21	Fraser East	13	4.5
22	Fraser North	36	5.8
23	Fraser South	75	10.3
31	Richmond	16	8.1
32	Vancouver	79	11.8
33	North Shore/Coast Garibaldi	4	1.4
41	South Vancouver Island	9	2.4
42	Central Vancouver Island	4	1.5
43	North Vancouver Island	1	0.8
51	Northwest	3	4.0
52	Northern Interior	12	8.3
53	Northeast	3	4.3

Source: BC 2011 Annual Summary of Reportable Diseases, available from: http://www.bccdc.ca

TB in British Columbia: 2011

Tuberculosis rates by age group and sex, 2011



Source: BC 2011 Annual Summary of Reportable Diseases, available from: http://www.bccdc.ca

TB in British Columbia (2011)

Origin	Cases	Rate / 100 000
Foreign-born	194	14.7
Aboriginal*	26	19.6
Canadian-born non-Aboriginal	34	1.1
Other and Unknown	15	--
BC Total	269	6.5

* includes Registered and Non-registered aboriginal, both on- and off-reserve

Source: BCCDC, F. Hutton, April 4, 2013

Foreign-born Cases of TB Disease BC, 2011

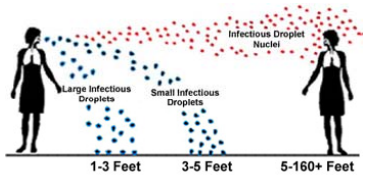
Five most common countries of origin:

- India
- Philippines
- China
- Hong Kong
- Vietnam

How is TB Transmitted?

Transmission is almost always via air contaminated with droplet nuclei that contain TB bacteria

TB Transmission – Droplet Nuclei



Droplet nuclei can remain suspended for hours and…

Larger droplets settle to the ground more quickly

TB Transmission – Droplet Nuclei

…droplet nuclei can travel on air currents!

Did You Know…

Not everyone who is exposed to TB disease will become infected with TB bacteria; risk of transmission depends on several factors.

Risk of TB Transmission

Risk of transmission is influenced by:

1. Concentration of droplet nuclei
   - Degree of infectiousness of case
   - Exposure environment
2. Specifics of the exposure event(s)
3. Susceptibility of contacts
4. Virulism of the TB bacteria

1. Concentration of Droplet Nuclei

Concentration = Case + Environment

Case-Related Influences

Concentration of droplet nuclei influenced by:

- **Type of TB disease**
  (i.e., respiratory TB vs. non-respiratory TB)
- **Extent of TB disease**
  (e.g., cavities on CXR, AFB smear + sputum)
- **Behaviours**
  (e.g., strength and frequency of cough)

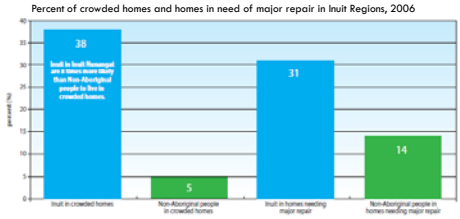
Environmental Influences

Concentration of droplet nuclei influenced by:

- Physical proximity to the source of TB bacteria*
- Room size (air volume)
- Air circulation pattern
- Rate of air exchange
- Presence or absence of ultraviolet light

Environmental Influences (con't)

- Level of humidity & degree of crowding



Source: Inuit-specific Tuberculosis (TB) Strategy. Inuit Tapiriit Kanatami; 2013. Available from http://www.itk.ca

2. Specifics of the Exposure Event(s)

- Concentration of droplet nuclei (MTB) in the air
- Characteristics of the exposure:
  - How often (frequency)
  - How long (duration)
  - Timing of the exposure(s) relative to the level of infectiousness of the case

3. Susceptibility of Contacts

- Prior infection*
- Personal respiratory protection

3. Susceptibility of Contacts

BCG vaccine DOES NOT protect against infection with TB bacteria!

4. Virulism of the TB Bacteria

Some strains of TB bacteria might be more easily transmitted than others

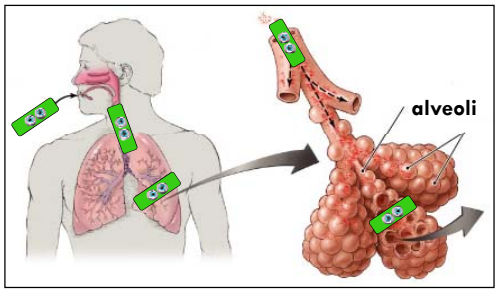
TB Transmission: Inhalation

TB Transmission: Inhalation

When a person with infectious **TB disease** coughs, sneezes, sings or shouts, TB germs are passed into the air in "**droplet nuclei**".

People become infected with TB germs by inhaling droplet nuclei.

TB Transmission: Inhalation



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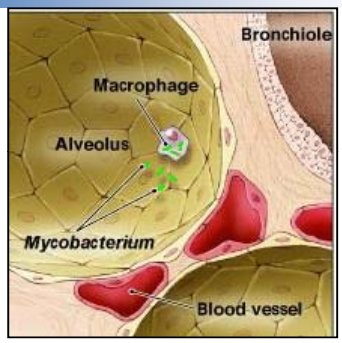
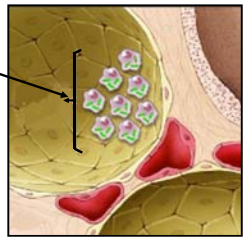


Macrophages at Work

Coloured scanning electron micrograph of a macrophage (red) engulfing TB bacteria (yellow)

Development of Immune Response: Weeks 3 to 8

TB bacteria multiply within macrophages



Cell mediated immunity and delayed-type hypersensitivity (CD4) are stimulated*

TB Pathogenesis: Primary TB Disease

Infection with TB bacteria

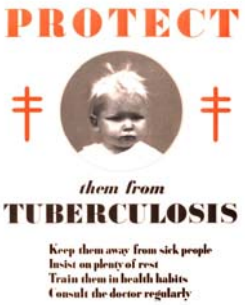
~ 5%*

"primary" TB disease

What is "Primary TB Disease"?

- ~5% of newly infected are unable to limit bacterial replication
- TB disease will develop within 18 to 24 months or sooner (immune suppressed)
- Pleural TB, TB meningitis, and miliary TB are often presentations of primary TB disease

Who is at Risk for Primary TB Disease?



Children less than 5 years of age;

Without treatment for LTBI, 40% will develop TB disease within 2 years of becoming infected with TB bacteria.

Who is at Risk for Primary TB Disease?

AIDS + **new infection with TB bacteria** = **TB disease**

in 37% within 5 months

How does risk for primary TB disease impact TB prevention and control practices?

TB Pathogenesis: Latent TB Infection

Infection with TB bacteria

~ 5%*	~ 95%
↓	↓
"primary" TB disease	latent TB infection (LTBI)

Latent TB Infection (LTBI)

The term 'LTBI' is used to describe the situation when a person is infected with TB bacteria but has not developed TB disease.

Latent TB Infection (LTBI)

Person is infected with TB bacteria but:

- **NO symptoms** of current TB disease
- **NORMAL** clinical examination and chest x-rays
- **NO TB bacteria** in clinical specimens (e.g., sputum)
- **NOT** contagious
- **NOT** a "case" of TB disease

Latent TB Infection (LTBI)

There are medications available to treat LTBI and prevent TB disease!

TB Pathogenesis: Post-Primary TB Disease

LTBI

~ 95%	~ 5%* (over lifetime)
↓	↓
continued LTBI	eventually develop "reactivation" or "post-primary" TB disease

Types of TB Disease

TB disease

Non-respiratory TB

24% of cases in Canada

Note: 2011 data provisional until release of Tuberculosis in Canada, 2011
Source: Public Health Agency of Canada. Tuberculosis in Canada 2011 – Pre-Release. Ottawa (Canada): Minister of Public Works and Government Services Canada; 2012

TB Lymphadenitis

- 13% of all TB cases*
- 55% of non-respiratory cases*
- Single or multiple nodes
- Cervical nodes most often affected

Note: 2011 data provisional until release of Tuberculosis in Canada, 2011
*Source: Public Health Agency of Canada. Tuberculosis in Canada 2011 – Pre-Release. Ottawa (Canada): Minister of Public Works and Government Services Canada; 2012

Types of TB Disease

TB disease

Non-respiratory TB	Respiratory TB
droplet nuclei can be released under some circumstances*	typically contagious prior to treatment

Latent TB Infection vs. TB Disease

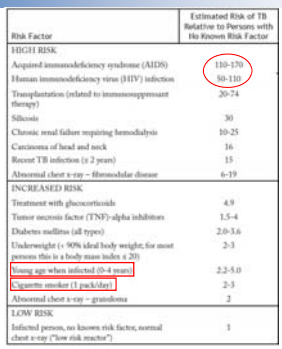
LATENT TB INFECTION

- TB bacteria in the body; bacteria are inactive (latent)
- Does not feel sick; no symptoms
- **NOT contagious**
- Could develop TB disease if TB bacteria become active and begin to multiply
- Treatment can **PREVENT** development of TB disease in future

TB DISEASE

- TB bacteria in the body; bacteria are active and multiplying
- Feels sick; symptoms such as fever, weight loss, fatigue
- **Could spread TB bacteria if contagious** form of disease
- Almost always curable if diagnosed in time and treated appropriately

Who is at Risk for TB Disease?



Risk Factor	Estimated Risk of TB Relative to Persons with No Known Risk Factor
HIGH RISK	
Acquired immunodeficiency syndrome (AIDS)	110-170
Human immunodeficiency virus (HIV) infection	50-110
Transplantation (related to immunosuppressant therapy)	20-74
Silicosis	30
Chronic renal failure requiring hemodialysis	10-25
Carcinoma of head and neck	16
Recent TB infection (< 2 years)	15
Abnormal chest x-ray – fibronodular disease	6-19
INCREASED RISK	
Treatment with glucocorticoids	4.9
Tumor necrosis factor (TNF)-alpha inhibitors	1.5-4
Diabetes mellitus (all types)	2.0-3.6
Underweight (< 90% ideal body weight; for most persons this is a body mass index < 20)	2-3
Young age when infected (0-4 years)	2.2-5.0
Cigarette smoker (1 pack/day)	2-3
Abnormal chest x-ray – granuloma	2
LOW RISK	
Infected person, no known risk factor, normal chest x-ray ("low risk reactor")	1

What does "High Risk" Look Like?

Positive TB skin test/IGRA or recent exposure **AND** :

- **HIV/AIDS**
- Chronic renal failure - hemodialysis
- Cancer of head, neck (or lung)
- Transplant
- Silicosis
- Chest X-ray findings = fibronodular disease
- Under 5 years of age*

What does "Increased Risk" Look Like?

Positive TST/IGRA less than 2 years ago **AND**:

- Under 5 years of age*
- Underweight
- Chest x-ray findings = granuloma
- Diabetes
- Immune suppressing treatment (e.g., prednisone, Embryl, Remicade, chemotherapy - can cause false negative TST)
- Smoking