Faculty of Medicine

Respiratory System

Occupational health of the respiratory system- Pneumoconiosis

Pulmonary Tuberculosis (TB)

By

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MD  MPH  JBCM  PhD

16 - 11- 2017
Misusing and overusing ANTIBIOTICS puts us all at risk

CAUSES OF ANTIBIOTIC RESISTANCE

Antibiotic resistance happens when bacteria change and become resistant to the antibiotics used to treat the infections they cause.

- Over-prescribing of antibiotics
- Patients not finishing their treatment
- Over-use of antibiotics in livestock and fish farming
- Poor infection control in hospitals and clinics
- Lack of hygiene and poor sanitation
- Lack of new antibiotics being developed

www.who.int/drugresistance
#AntibioticResistance
Respiratory System and Occupational Diseases

1- Occupational health of the respiratory system
   • 1. Enumerate types of occupational hazards that affect the respiratory system.
   • 2. Understand different types of pneumoconiosis.
   • 3. To familiarize the students with different diagnostic techniques used in occupational medicine.
   • 4. Understand the process of investigating – screening of work related respiratory illness.

2- Pulmonary Tuberculosis (TB)
   • 1- Understand causative agent, transmission and risk factors of TB.
   • 2- Explain Epidemiology of TB globally, regionally and Locally.
   • 3- Understand the main approach of TB treatment, prevention and control.
# Presentation outline

<table>
<thead>
<tr>
<th>Topic</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupational hazards that affect the respiratory system</td>
<td>12:00 to 12:20</td>
</tr>
<tr>
<td>Pneumoconiosis types</td>
<td>12:20 to 12:40</td>
</tr>
<tr>
<td>Diagnosis and Screening of work related respiratory illness.</td>
<td>12:40 to 13:00</td>
</tr>
<tr>
<td>Causative agent, transmission and risk factors of TB. Epidemiology of TB</td>
<td>13:00 to 13:20</td>
</tr>
<tr>
<td>TB management: treatment, prevention and control.</td>
<td>13:20 to 13:40</td>
</tr>
</tbody>
</table>
Occupational Diseases

• Occupational diseases have a long latent period.
• Most occupational diseases cannot be treated.
• All occupational diseases can be prevented.
OCCUPATIONAL HAZARDS

• Physical Hazards
• Chemical Hazards
• Biological Hazards
• Mechanical Hazards
• Psychosocial Hazards
ROUTE OF EXPOSURE

- **INHALATION**
  - Gas, Vapour, Aerosol, Dust, Fume, Smoke, Mist, Fog
- **INGESTION**
  - Eating, Smoking
- **SKIN ABSORPTION**
  - Primary irritants, Allergy, Systemic toxicity
Determinants of inhalational exposure

- Particles size of air contaminants

Particles > 10 - 15 um diameter do not penetrate beyond the nose and throat.

- Particles are divided into three size fractions on the basis of their size character and source.

1. **Coarse-mode fraction** – particles size of 2.5 - 10 um contain crustal elements such as silica, aluminum, and iron. Mostly deposit relatively high in the tracheobronchial tree.

2. **Fine mode fraction** – practical size <2.5 um and carried to the lower airways and get deposited. Fine particles are created by burning of fossil fuels or high temperature industrial process, gases, fumes.

3. **Ultra fine fraction** - <0.1 um in size deposit in the lung and they come in contact with the alveolar walls, however particles of this size range may penetrate into the circulation and be carried to extra pulmonary sites.
Classification

- **Inorganic (mineral) dust/Pneumoconiosis**
  - silica, asbestos, coal, talc, silicates, Fe, barium, tin
- **Organic** - grain dusts, cotton, pollens etc

- **Immunologic**
  - Allergic alveolitis (hypersensitivity pneumonitis)
  - Asthma - feathers, enzymes, cotton, platinum
Principles of Occupational Lung Disease

• Industrial processes change and become increasingly complex.
• We should anticipate the appearance of a wider range of potentially toxic substances in the air.
• It is unlikely that the lung will develop many new ways to react to inhaled substances.
• We’ll see old lung diseases with new causes.
The Spectrum of Occupational Lung Disease

- Rhinitis and laryngitis
- Tracheitis, bronchitis and Bronchiolitis
- Asthma and COPD
- Cancer
- Interstitial Disease
Induction Periods

• Short:
  – Asthma
  – Infections
  – Allergic alveolitis
  – Toxic poisonings

• Long:
  – Pneumoconioses
  – Neoplasms
Types of occupational lung disease

- Respiratory cancers include lung cancer, which may be caused by a range of exposures – such as asbestos, silica, diesel engine exhaust emissions, and mineral oils – and mesothelioma, a cancer of the lining of the lungs which is caused by asbestos.

- Chronic Obstructive Pulmonary Disease (COPD) is a serious long-term lung disease in which the flow of air into the lungs is gradually reduced by inflammation of the air passages and damage to the lung tissue. Chronic bronchitis and emphysema are common types of COPD. A wide range of vapours, dusts, gases and fumes potentially contribute to causing the disease or making it worse.

- Occupational asthma can be defined as adult asthma that is specifically caused by agents that are present in the workplace, however, a wider definition of work-related asthma includes all cases where there is an association between symptoms and work, including cases that are exacerbated by work.

- Pneumoconiosis is a long-term and irreversible disease characterised by scarring and inflammation of the lung tissue. The main types of pneumoconiosis are defined in terms of their causative agents: coal worker’s pneumoconiosis due to coal dust exposure, asbestosis due to exposure to asbestos fibres, and silicosis due to silica dust exposure.

- Other non-cancerous respiratory diseases include diffuse pleural thickening and pleural plaques (non-malignant diseases of the lung lining caused by asbestos), allergic alveolitis (inflammation of the air sacs within the lungs due to an allergic reaction to organic material), and byssinosis (an asthma like disease in which the air passages become constricted in reaction to exposure to cotton dust).
FOUR TYPES

- Diseases only *occupational in origin* (pneumoconiosis)

- Where occupation as *one of the causal factors* (bronchogenic carcinoma)

- Occupation as A (*contributary factor chronic bronchitis*)

- Occupation *aggravating pre-existing* condition (asthma)
Lung Diseases Caused by Dust

Depends on chemical composition, particulate size, concentration, shape, specific gravity & body’s reaction

• **Pneumoconiosis**
  – Asbestosis
  – Silicosis
  – Coal workers pneumoconiosis

• **Lung diseases caused by dust of organic origin**
  – Byssinois (exposure to cotton dust)
  – Mushroom workers lung
  – Suberrosis (Cork فن dust)
  – Bird breeders lung (chickens, parrots, pigeons)
  – Man made fibers

• **Occupational asthma**
  – Flour insects and pollens: linseed, soya beans, teak wood, hair, fur, etc: isocyanates, poly urethane, amines, metals
Diseases associated with occupational exposure

Clinical manifestations of lung diseases are the same irrespective of the etiology

Airway diseases
- Asthma (reversible)
- Chronic obstructive lung disease (irreversible)
- Cancer

Parenchymal diseases
- Hypersensitivity pneumonitis (reversible)
- Diffuse fibrosis (irreversible)
  eg. silicosis, asbestosis
% occupational asthma in occupational lung diseases

<table>
<thead>
<tr>
<th></th>
<th>UK (1989)</th>
<th>BC, Canada (1992)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td>26.4</td>
<td>52.0</td>
</tr>
<tr>
<td>Pneumoconiosis</td>
<td>15.4</td>
<td>17.8</td>
</tr>
<tr>
<td>Others</td>
<td>58.2</td>
<td>30.2</td>
</tr>
</tbody>
</table>
Mesothelioma in Great Britain: annual actual and predicted deaths

Substantial increase in annual deaths due to asbestos exposures prior to 1980.

Projected: 2,500 per year until 2020.
Lung disease contributing to estimated current annual deaths

- Chronic Obstructive Pulmonary Disease (COPD) 33%
- Non-asbestos related lung cancer 23%
- Mesothelioma 20%
- Asbestos related lung cancer 20%
- Other disease 5%
Occupational asthma: Causal agents most commonly reported by chest physicians during 2012-2016

- Isocyanates
- Flour
- Cleaning products
- Wood dusts
- Enzymes, Amylase
Recognize and establish work-relatedness

- Aware and suspect
- Occupational history
- Medical history suggesting work-relatedness
  - Symptoms started after employment
  - Improvement of symptoms during weekends and holidays
  - Worsening of symptoms on returning to work
- Objective testing
History

• A history suggestive of work-relatedness is very sensitive but...:
  • Predictive value of questionnaire

• A history of asthma at work, even in the presence of a known sensitizer, does not confirm the diagnosis of occupational asthma

• The diagnosis needs to be confirmed objectively
Objective testing to confirm work-relatedness

- **Pre and post-shift** measurement of lung function
- Monitoring **of PEF at** and off work, each for a period of 2 weeks with and without measurement
- Specific inhalation challenges or occupational type of exposure tests - "gold standard"
Monitoring of PEF - How to do it?

- At least **2 weeks at work and off work**
  - ✓ (often longer...)
- At least 4 times daily, preferably every 2 hours
- Medication allowed:
  - ✓ keep constant & at minimum dose...
  - ✓ beta-2 agonist on demand only
  - ✓ continue inhaled steroids/theophylline
  - ✓ avoid, if possible, long-acting beta-2-agonist

**Spirometry**
- • at and away from work
- • cross-shift
Algorithm for investigation of occupational asthma

Compatible clinical history and exposure

Skin testing and/or specific IgE (if possible)

Assessment of NSBH

Normal

Increased

Subject still at work

Subject no longer at work

Subject still at work

Laboratory challenge tests

Positive

Consider return to work

Positive

Workplace challenge tests

PEF monitoring, or both

Positive

Occupational asthma

Negative

Non occupational asthma

Use of other means (induced sputum, exhaled NO)

No asthma

Chan Yeung M, Malo JL. NEJM 1995; 333:107
- Evaluation

• Initial:
  – Complete History & Physical Exam
  – Routine Labs
  – CXR

• Secondary
  – Serologies
  – PFTs
  – ABG
  – High Resolution Chest CT
Asthma

• Approximately 7.5% of all US adults have a diagnosis of asthma

• **Work-related asthma is the most commonly reported occupational lung disease in the United States**

• Work-related asthma is often under recognized and misdiagnosed

Occupational Asthma

- Symptoms usually begin several weeks after exposure begins.
- Early in the syndrome, the patient may just notice a dry cough.
- Patient may not be continuously exposed to provoking antigen.
- A portable peak-flow meter and a diary is very helpful in determining if a workplace antigen is responsible.
Primary prevention of Occ Asthma

- Reduce exposure
- Pre-employment screening
  - Atopy
  - Genetic factors
- Education
- Screen for potential respiratory sensitizers
COPD is a disease characterized by airflow obstruction that is not reversible. The airflow obstruction is usually progressive and associated with abnormal inflammatory response of the lungs to noxious particles and gases.

COPD should be considered in any patient presenting with cough, sputum production and breathlessness. The diagnosis is confirmed by spirometry. The presence of post bronchodilator FEV1 of < 80% the predicted and FEV/FVC of <70% confirms the presence of airflow limitation that is not reversible.
Occupational exposure and chronic obstructive pulmonary disease (COPD)

Long-term exposure to

• Inorganic dust
• Organic dust
• Chemicals - vapors, irritants, fumes
Occupational COPD

• 15% of COPD is attributable to occupation
  • Long term exposure
  • Dusts: (inorganic) and organic; chemicals
  • Chemicals-vapors irritants, fumes
  • increased risk for COPD - number of industries: rubber, plastics, leather manufacturing; utilities; building services; textile manufacturing; construction
What about interstitial lung disease

- Hypersensitivity pneumonitis: allergic alveolitis
- Pneumoconiosis (mineral dusts)
- Beryllium
- Hard metal disease
Hypersensitivity pneumonitis

Hypersensitivity pneumonitis is a spectrum of granulomatosus, interstitial, and alveolar-filling lung diseases that result from repeated inhalation of and sensitization to a wide variety of organic dusts.
Pneumoconioses

• Group of interstitial lung diseases caused by the inhalation of certain dusts and the lung tissue’s reaction to the dust

• Primary pneumoconioses are asbestosis, silicosis, and coal dust

• Other forms aluminum, antimony, barium, graphite, iron, kaolin, mica, talc, among other dusts. There is also a form called mixed-dust pneumoconiosis.

• Typically many years usually >10 years

• Some cases – silicosis, particularly – rapidly progressive forms can occur after only short periods of intense exposure
Pneumoconiosis is defined as the accumulation of dust in the lungs and the tissue reactions to its presence.

- For clinical pneumoconiosis to develop, 3 essential factors are required:
  - Exposure to specific substance: coal, appear relatively inert and may accumulate in considerable amounts with minimal tissue response; while silica and asbestos, have potent biologic effects.
  - Particles of appropriate size to be retained in lung (1-5\(\mu\)m)
  - Exposure for a sufficient length of time (usually around 10 years)
CLASSIFIED

fibrotic
(focal nodular, diffuse fibrosis)

1. silicosis - Nodular fibrosis
2. coal worker pneumoconiosis
3. asbestosis - Diffuse fibrosis
4. berylliosis - Granulomatous reaction

nonfibrotic
(particle-laden macrophages, no fibrosis)

1. siderosis
2. stannnosis
3. baritosis
An abnormal chest x-ray shows severe scarring (arrows) in the lungs (L) caused by progressive massive fibrosis. This finding is seen in severe black lung disease caused by exposure to coal dust.
Asbestos-related diseases

Benign

Malignancy
1. Malignant mesothelioma
2. Bronchogenic carcinoma

Pleural diseases
1. plaques
2. diffuse pleural thickening
3. effusion
4. calcification

Parenchymal diseases
1. Asbestosis [parenchymal fibrosis caused by asbestos inhalation]
2. Rounded atelectasis
3. Benign fibrotic masses
4. Transpulmonary bands
Crystalline silica

- At least 1.7 million U.S. workers are exposed to respirable crystalline silica in a variety of industries and occupations, including construction, sandblasting, and mining.
- Silicosis, with occupational exposure to the material, which also is known as silica dust.
- Occupational exposures to respirable crystalline silica are associated with the development of silicosis, lung cancer, pulmonary tuberculosis, and airways diseases.
- May be related to development of autoimmune disorders, chronic renal disease
Simple silicosis

There is a profusion of small rounded densities, predominantly within the upper lung zones.

Courtesy of Dr. E. L. Petsonk.

Graphic 70007 Version 3.0

Progressive massive fibrosis (PMF)

Patient with end-stage silicosis complicated by respiratory failure. There is upward retraction of hila, and the lower zones are hyperinflated.

Courtesy of Dr. J. Parker.
Coal workers pneumoconiosis

- Inhalation and deposition of silica-free coal dust particles that induce the formation of coal macules, once they reach the alveoli.

- Radiographic features to silicosis, but is classified as a separate disease due to its rather characteristic pathologic findings.
Asbestos exposure

• Asbestosis = parenchymal disease interstitial fibrosis

• Malignant mesothelioma (pleural, parietal, testicular - (tunica vaginalis not shown to be related)

• Lung cancer: all types
Hard metal disease

• Cobalt-tungsten carbide alloy – sintered
• Abrasion resistance - high temperature machine cutting tools-cut through stainless steel, bridal jewelry, surgical instruments, armor piercing ammunition,
• Pneumoconiosis (fibrosis)- dust and fumes

Figure 1 - In a), chest X-ray revealing bilateral interstitial infiltrate (1996); in b), HRCT showing areas of ground-glass attenuation, traction bronchiectasis, and interposed cystic images (2006).
Lung Cancer Epidemiology

**Occupational Exposure**
- Several occupational carcinogens
- Attributable risk 7.4% males and 3.1% females

**Environmental exposures**
- Outdoor particulate matter
- Residential radon exposure (attributable risk 7% in US)
- Environmental tobacco smoke
- Environmental exposure to occupational carcinogens
- Low dietary intake; other factors

Occupational lung cancer agents

- Arsenic
- **Asbestos**
- BCME
- Beryllium
- Cadmium
- Chromium 6
- **Silica dust**
- Nickel
- Ionizing radiation
- Occupational exposure to strong inorganic acids
- Sulfur mustard
- Polycyclic aromatic hydrocarbons
- Soot
- Coal tar pitch
- Diesel exhaust

Source: IARC
Occupational lung cancer occupations

- Aluminium production
- Coal gasification
- Coke production
- Hematite mining
- Iron and steel founders
- Painting
- Rubber production

Source : IARC
The Occupational History

• All jobs held in their lifetime and the duration.
• Do symptoms improve with weekends and vacations?
• The longer they have had symptoms from occupational asthma, the less clear the connection between symptoms and work
• What they did, not their title:
  – “brusher” drills into hard rock
  – “caulker” uses electric arc equipment to gouge and fuse metal plates
The Occupational History

• Toxic exposures can produce airway symptoms or an alveolitis.

• If everyone in the workplace is affected in a dose-dependent manner, the etiology is likely to be toxic rather than immunologic.

• Toxic reactions can occur on the first exposure. Immunologically-mediated diseases require re-exposure
Toxic Gases and Fumes

• **Asphyxiating gases** displace oxygen in the alveolus, on the hemoglobin molecule, or prevent oxygen utilization by the cytochrome

• **Irritants are** noticed quickly by the patients and create symptoms proximally to distally. (chlorine and ammonia)

• **Toxins that attack the alveolar membrane** (phosgene and nitrogen dioxide)
RADS: the Reactive Airways Dysfunction Syndrome

• The onset of an asthma like syndrome after a single severe exposure to a respiratory irritant.

• Not immunologically mediated

• Positive methacholine challenge test

• Symptoms of asthma may persist for more than one year after the event.
Sick Building Syndrome

• Reports began to appear about the time that new, “tighter”, more energy efficient office buildings were built.

• Hundreds of organic compounds have been identified in indoor air.

• Formaldehyde is an ubiquitous indoor organic that is a mucosal irritant.
DRUG RESISTANCE

ONLY 1 IN 5 PEOPLE NEEDING TREATMENT FOR MULTIDRUG-RESISTANT TB IN 2016 ACTUALLY RECEIVED IT

ONLY HALF OF THOSE WHO STARTED MDR-TB TREATMENT WERE CURED

BETTER PREVENTION, DETECTION AND CURE WILL ADDRESS THE MDR-TB CRISIS

World Health Organization
TB IS THE TOP INFECTIOUS DISEASE KILLER IN THE WORLD

IN 2016

1.7 MILLION PEOPLE DIED FROM TB
INCLUDING NEARLY 400,000 PEOPLE WITH HIV-ASSOCIATED TB

10.4 MILLION PEOPLE FELL ILL FROM TB

TB IS THE MAIN CAUSE OF DEATHS RELATED TO ANTIMICROBIAL RESISTANCE AND THE LEADING KILLER OF PEOPLE WITH HIV

EACH DAY - 4700 PEOPLE LOSE THEIR LIVES AND 28,500 PEOPLE FALL ILL DUE TO TB

World Health Organization
Webinar in lead up to World TB Day 2017

24 MARCH 2017
#WorldTBDay

2.4 BILLION people have TB
that equals 1/3 of the world's population

TB is the world's most deadly infectious disease, killing 3 people every minute

IN 2015...
1.8 MILLION died from TB worldwide

& 1 MILLION children fell ill with TB

1 in 5 of them died in 2015

#WorldTBDay
Tuberculosis

- Infectious disease cause by the bacterium, *Mycobacterium tuberculosis*.
- Spread by airborne droplets, “droplet nuclei,” which may be generated when a person with TB disease coughs, sneezes, speaks or sings.
Tuberculosis

- *Mycobacterium* T.B. can present itself in the human body in different forms-effecting any where from “the intestines, bones, joints, skin, and the genitourinary, lymphatic, and nervous systems.” (20%)
TB Epidemiology Outline

• Introduction
• Global Burden of TB
  – Morbidity
  – Deaths
  - TB and HIV
  - Drug resistant TB
• • TB Epidemiology Jordan
• • TB Prevention and Control
Global Burden
Of Tuberculosis

“Tuberculosis is a social problem with a medical aspect”

Sir William Osler, 1904
Beware of data....
# Global Burden of TB, 2015

WHO Global TB Report, 2015

<table>
<thead>
<tr>
<th></th>
<th>Estimated Number of Cases</th>
<th>Estimated Number of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>All forms of TB</td>
<td>9.6 million</td>
<td>1.5 million*</td>
</tr>
<tr>
<td>HIV-Associated TB</td>
<td>1.2 million (12%)</td>
<td>400,000</td>
</tr>
<tr>
<td>Multidrug-resistant TB (MDR-TB)</td>
<td>480,000</td>
<td>~150,000</td>
</tr>
</tbody>
</table>

- Approx. 1/3 of the world (2 billion people) is infected with *M. tb*
- Estimated that 43 million lives were saved between 2000 and 2014 through effective diagnosis and treatment
- *In Children 1,000,000 cases and 140,000 deaths a year
- **Fewer than 25% of those thought to have MDR TB were detected**
  *including deaths among PLHIV*
Increasing burden of noncommunicable diseases and injuries
change in rank order of DALYs for the 15 leading causes
(baseline scenario)

DALY = Disability-adjusted life year

Source: WHO Evidence, Information and Policy, 2000
22 countries account for 80% of the global burden
## Estimated TB Burden, 2014 ---- 22 high burden countries *

<table>
<thead>
<tr>
<th># of new cases</th>
<th># of new cases</th>
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<tbody>
<tr>
<td>1,683,915</td>
<td>102,087</td>
</tr>
<tr>
<td>1,000,000</td>
<td>91,354</td>
</tr>
<tr>
<td>826,155</td>
<td>89,294</td>
</tr>
<tr>
<td>318,193</td>
<td>81,512</td>
</tr>
<tr>
<td>316,577</td>
<td>71,618</td>
</tr>
<tr>
<td>267,436</td>
<td>63,151</td>
</tr>
<tr>
<td>196,797</td>
<td>63,151</td>
</tr>
<tr>
<td>141,957</td>
<td>46,171</td>
</tr>
<tr>
<td>136,168</td>
<td>43,738</td>
</tr>
<tr>
<td>119,592</td>
<td>32,712</td>
</tr>
<tr>
<td>116,894</td>
<td>32,016</td>
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</table>

*Ranks based on numbers of smear-positive cases

WHO Update, 2015
Global

WHO MEMBER STATES 194
OTHER COUNTRIES AND TERRITORIES 22

Estimates of TB burden, 2016

<table>
<thead>
<tr>
<th></th>
<th>Number (thousands)</th>
<th>Rate (per 100 000 population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (excludes HIV+TB)</td>
<td>1 300 (1 160–1 440)</td>
<td>17 (16–19)</td>
</tr>
<tr>
<td>Mortality (HIV+TB only)</td>
<td>374 (325–427)</td>
<td>5 (4.4–5.7)</td>
</tr>
<tr>
<td>Incidence (includes HIV+TB)</td>
<td>10 400 (8 770–12 200)</td>
<td>140 (118–164)</td>
</tr>
<tr>
<td>Incidence (HIV+TB only)</td>
<td>1 030 (915–1 150)</td>
<td>14 (12–15)</td>
</tr>
<tr>
<td>Incidence (MDR/RR-TB)</td>
<td>601 (541–664)</td>
<td>8.1 (7.3–8.9)</td>
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</tbody>
</table>

Estimated TB incidence by age and sex (thousands), 2016

<table>
<thead>
<tr>
<th></th>
<th>0–14 years</th>
<th>&gt; 14 years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>493 (304–683)</td>
<td>3 220 (1 920–4 520)</td>
<td>3 710 (2 220–5 200)</td>
</tr>
<tr>
<td>Males</td>
<td>555 (342–769)</td>
<td>6 140 (3 670–8 600)</td>
<td>6 690 (4 020–9 370)</td>
</tr>
<tr>
<td>Total</td>
<td>1 050 (646–1 450)</td>
<td>9 360 (5 590–13 100)</td>
<td>10 400 (8 770–12 200)</td>
</tr>
</tbody>
</table>

TB case notifications, 2016

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Total cases notified</td>
<td>6 624 523</td>
</tr>
<tr>
<td>Total new and relapse</td>
<td>6 309 134</td>
</tr>
<tr>
<td>% with known HIV status</td>
<td>57%</td>
</tr>
<tr>
<td>% pulmonary</td>
<td>85%</td>
</tr>
<tr>
<td>% bacteriologically confirmed among pulmonary</td>
<td>57%</td>
</tr>
</tbody>
</table>

POPULATION 2016 7.4 BILLION
WHO Eastern Mediterranean Region

WHO MEMBER STATES
21
OTHER COUNTRIES AND TERRITORIES
1

Estimates of TB burden, 2016

<table>
<thead>
<tr>
<th>Category</th>
<th>Number (thousands)</th>
<th>Rate (per 100,000 population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (excludes HIV+TB)</td>
<td>82 (69–95)</td>
<td>12 (10–14)</td>
</tr>
<tr>
<td>Mortality (HIV+TB only)</td>
<td>3 (2–5)</td>
<td>0.45 (0.27–0.68)</td>
</tr>
<tr>
<td>Incidence (includes HIV+TB)</td>
<td>766 (573–985)</td>
<td>114 (86–147)</td>
</tr>
<tr>
<td>Incidence (HIV+TB only)</td>
<td>10 (6–15)</td>
<td>1.5 (0.89–2.2)</td>
</tr>
<tr>
<td>Incidence (MDR/RR-TB)</td>
<td>41 (31–52)</td>
<td>6.2 (4.7–7.8)</td>
</tr>
</tbody>
</table>

Estimated TB incidence by age and sex (thousands), 2016

POPULATION 2016 0.67 BILLION
### Estimated TB incidence by age and sex (thousands), 2016

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–14 years</td>
<td>39 (25–53)</td>
<td>43 (27–59)</td>
<td>82 (52–112)</td>
</tr>
<tr>
<td>&gt; 14 years</td>
<td>294 (187–402)</td>
<td>389 (248–531)</td>
<td>684 (435–933)</td>
</tr>
<tr>
<td>Total</td>
<td>333 (211–455)</td>
<td>433 (276–590)</td>
<td>766 (573–985)</td>
</tr>
</tbody>
</table>

### TB case notifications, 2016

- **Total cases notified**: 527,693
- **Total new and relapse**: 514,449
  - % with known HIV status: 16%
  - % pulmonary: 76%
  - % bacteriologically confirmed among pulmonary: 53%

### Universal health coverage and social protection

- **TB treatment coverage (notified/estimated incidence), 2016**: 67% (52–90)
- **TB patients facing catastrophic total costs**:
Why Is TB Increasing?

Multiple contributing factors:

• Homelessness
• Intravenous drug use
• Overcrowding in institutional settings
• HIV infection
• **Drug-resistant strains of TB**
• **Reduced TB control** and treatment resources
• Immigration from high TB prevalence areas
“Worst-Case” TB Scenarios

Co-infection between TB and HIV

- Multidrug-resistant TB
- Extensively-drug-resistant TB
- Totally drug-resistant TB?
Transmission of *M. Tuberculosis*

- Spread by droplet nuclei (1-5 µm)
- Expelled when person with infectious TB coughs, sneezes, speaks, or sings
- Close contacts at highest risk of becoming infected
- Transmission occurs from person with infectious TB disease (not latent TB infection)
Not Everyone Exposed Becomes Infected

• Probability of transmission depends on:
  – Infectiousness
  – Type of environment
  – Length of exposure

• 10% of infected persons will develop TB disease at some point in their lives
  – 5% within 1-2 years
  – 5% at some point in their lives
Factors determining transmission of *M. tuberculosis* and TB RISK FACTORS

- Contagiousness of the TB patient
- The environment the exposure occurred in
- Length of exposure
- Crowding
- Decreased access to health care
- Lower socio-economic status
- HIV
- Race
The Natural History of TB Infection

Exposure to TB

- Non-Infection (70-90%)
  - Dormant TB (90%) well
    - never develop TB
    - NOT infectious

- Infection (10-30%)
  - Active TB (10%) ill
    - 5% develop TB within 2 years
    - 5% develop TB many years later

Untreated
  - 50% die within 2 years

Treated
  - Cured

Diagnostic **algorithm** for pulmonary tuberculosis

- Cough for 2 weeks or more
  - 2 sputum smears
    - 1 or 2 positives
    - 2 negatives
      - Antibiotics 10-14 days
      - Cough persists
        - Repeat 2 sputum examination
          - 1 or 2 positives
          - 2 negatives
            - X-ray chest
              - Suggestive of TB
              - Negative for TB
                - Sputum positive PTB Anti-TB treatment
                - Sputum negative PTB Anti-TB treatment
                - Non-TB
TB Infection

- People with a positive PPD test (TB skin test) have been exposed to the TB germ.
- They...
  - Have a **TB Infection**
  - Do not look or feel sick
  - Cannot infect others
  - May or may not develop TB Disease (Active TB)
  - May take medication to prevent TB Disease from developing
TB Disease (Active TB)

• May have these symptoms...
  – A cough for more than two weeks
  – Coughing up blood
  – Night sweats
  – Fever
  – Loss of appetite
  – Weight loss
Primary Care Management of Latent Tuberculosis Infection

LTBI is the presence of *M. tuberculosis* organisms (tubercle bacilli) without symptoms or radiographic evidence of active TB disease
Flow Chart for Latent TB Infection (LTBI) in Primary Care

Patient with risk factors for LTBI

TST (PPD)

Note: Evaluate patient for LTBI testing and treatment regardless of BCG status

Rule out active TB disease before treatment for LTBI is started

Negative

No treatment; Document status in medical record

Positive

History/HIV risk, physical exam, chest x-ray

Normal

Refer to TB clinic for evaluation of active TB

Abnormal

Positive

Treatment of active TB by TB clinic

Negative

Candidate for LTBI Treatment
Other Groups At High Risk for TB

<table>
<thead>
<tr>
<th>Groups</th>
</tr>
</thead>
</table>
| • Close contacts of Active TB cases  
  – Usually taken care of by TB clinic |
| • Healthcare workers who serve high risk clients |
| • Residents & employees of congregate settings |
| • Medically underserved/low-income groups:  
  – Homeless  
  – Migrant workers  
  – Street drug users  
  – Children with parents who have risk factors |
# Medical Conditions that Put People at High Risk for TB

<table>
<thead>
<tr>
<th>Medical Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV +</td>
</tr>
<tr>
<td>Renal dialysis</td>
</tr>
<tr>
<td>Immunocompromised</td>
</tr>
<tr>
<td>(≥15 mg prednisone qd for 1 month or more)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
</tr>
<tr>
<td>Silicosis</td>
</tr>
<tr>
<td>Cancer of the head and neck</td>
</tr>
<tr>
<td>Hematologic and reticuloendothelial diseases</td>
</tr>
<tr>
<td>Intestinal bypass or gastrectomy</td>
</tr>
<tr>
<td>Chronic malabsorption syndromes</td>
</tr>
<tr>
<td>Low body weight</td>
</tr>
<tr>
<td>Organ Transplant</td>
</tr>
</tbody>
</table>
Who needs repeat LTBI testing?

- Healthcare workers
- Close contacts to infectious TB cases
- Frequent travelers to abroad
  - If baseline TST is negative, consider retesting your patients that have extended travel to high risk areas.
  - Do symptom review upon return and possibly retesting 8-10 week after return.
Most important to remember:
A person with TB Disease (Active TB) can infect others!
Including HW!!!!
Infectiousness - 1

• Patients should be considered infectious if they:
  – Are undergoing cough-inducing procedures
  – Have sputum smears positive for acid-fast bacilli (AFB) and:
    • Are not receiving treatment
    • Have just started treatment, or
    • Have a poor clinical or bacterial response to treatment
  – Have cavitary disease

• Extrapulmonary TB patients are not infectious
Infectiousness - 2

- Patients are not considered infectious if they meet all these criteria:
  - Received adequate treatment for 2-3 weeks
  - Favorable clinical response to treatment
  - 3 consecutive negative sputum smears results from sputum collected on different days
Diagnosis

Diagnosis is based on:

- Symptoms
  - Producing cough, chest pain, night sweats, fatigue, fever
- Medical history
- TB tests
  - Tuberculin Skin Test
  - Blood Tests
- Chest X-Rays
- Diagnostic microbiology
  - Sputum smear – acid-fast bacilli
TB and HIV

At least one-third of people living with HIV worldwide in 2013 were infected with TB bacteria, although they did not become ill with active TB.

People living with HIV are 26 to 31 times more likely to develop active TB disease than people without HIV.

HIV and TB form a lethal combination, each speeding the other's progress.

In 2013 about 360 000 people died of HIV-associated TB. Approximately 25% of deaths among HIV-positive people are due to TB.

In 2013 there were an estimated 1.1 million new cases of TB amongst people who were HIV-positive, 78% of whom were living in Africa.

WHO recommends a 12-component approach of collaborative TB-HIV activities, including actions for prevention and treatment of infection and disease, to reduce deaths.
Multidrug-resistant TB

Multidrug-resistant tuberculosis (MDR-TB) is a form of TB caused by bacteria that do not respond to, at least, isoniazid and rifampicin, the two most powerful, first-line (or standard) anti-TB drugs.

The primary cause of MDR-TB is inappropriate treatment. MDR-TB is treatable and curable by using second-line drugs.

Extensively drug-resistant TB, XDR-TB, is a form of multidrug resistant tuberculosis that responds to even fewer available medicines, including the most effective second-line anti-TB drugs.

About 480,000 people developed MDR-TB in the world in 2013.

More than half of these cases were in India, China and the Russian Federation. It is estimated that about 9.0% of MDR-TB cases had XDR-TB.
## Causes of MDR

<table>
<thead>
<tr>
<th>Health-Care Providers: Inadequate Regimens</th>
<th>Drugs: Inadequate Supply or Quality</th>
<th>Patients: Inadequate Drug Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inappropriate guidelines</td>
<td>Poor quality</td>
<td>Poor adherence (or poor DOT)</td>
</tr>
<tr>
<td>Noncompliance with guidelines</td>
<td>Unavailability of certain drugs (stock-outs or delivery disruptions)</td>
<td>Lack of information</td>
</tr>
<tr>
<td>Absence of guidelines</td>
<td>Poor storage conditions</td>
<td>Lack of money (no treatment available free of charge)</td>
</tr>
<tr>
<td>Poor training</td>
<td>Wrong dose or combination</td>
<td>Lack of transportation</td>
</tr>
<tr>
<td>No monitoring of treatment</td>
<td></td>
<td>Adverse effects</td>
</tr>
<tr>
<td>Poorly organized or funded TB control programmes</td>
<td></td>
<td>Social barriers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Malabsorption</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Substance dependency disorders</td>
</tr>
</tbody>
</table>

**Patient mismanagement**
Pediatric Tuberculosis
• A high index of suspicion is the first step in diagnosis. Tuberculosis should be suspected among children with presenting symptoms of prolonged/unexplained fever and/or cough for more than 2 weeks, with no weight gain or history of failure-to-thrive. The diagnosis is further based on sputum examination wherever possible, CXR and Mantoux test.

Extrapulmonary Tuberculosis
• The diagnosis of extrapulmonary tuberculosis is based upon clinical suspicion, examination of appropriate specimens from the sites of involvement, by microscopy, culture and histopathological examination. In addition, examination of sputum and X-ray chest may also be useful, especially in patients with HIV infection.
Prevention of tuberculosis

- Early detection
- Treatment of contacts
- Good hygiene and healthy lifestyle
- Patient education
- Spreading awareness
- BCG vaccine
TB Screening Program

• All PPD skin test negative individuals will have a repeat PPD test according to the following schedule:
  – Every Year
    • Emergency and Radiology Departments clinical staff and physicians
    • Respiratory Care Department clinical staff and Bronchoscopists
    • Ambulatory Services clinical staff
    • Laboratory microbiology and surgical pathology staff and Pathologists
  – Every Five Years
    • All other job classifications, medical staff and allied health professionals
### Interpreting Tuberculin Skin Test Reactions

<table>
<thead>
<tr>
<th>5 mm or greater</th>
<th>10 mm or greater</th>
<th>15 mm or greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV positive persons</td>
<td>Immigrants from high-prevalence areas</td>
<td>No known risk factors</td>
</tr>
<tr>
<td>Recent contacts of persons with active tuberculosis</td>
<td>Injection drug users</td>
<td></td>
</tr>
<tr>
<td>Fibrotic changes on chest radiograph, consistent with tuberculosis</td>
<td>Residents and employees* of high-risk congregate settings</td>
<td></td>
</tr>
<tr>
<td>Patients with organ transplants and other immunosuppressed patients</td>
<td>Personnel in mycobacteriology laboratories</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Persons with clinical conditions that place them at high risk</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Children: &lt;4 years of age; all exposed to adults at high-risk</td>
<td></td>
</tr>
</tbody>
</table>

*(Note: the CDC discourages testing of people at low risk for infection.)*
TB control principles

- Detect, treat and cure
- Isolation, infection control
- BCG (limited efficacy)
- Prophylactic treatment, Post-exposure vaccine

Susceptible → TB disease → Infected
Stop TB Partnership Targets

• **By 2005:**
  – At least 70% people with sputum smear positive TB will be diagnosed.
  – At least 85% cured.

• **By 2015:**
  – Global burden of TB (prevalence and death rates) will be reduced by 50% relative to 1990 levels.
    • Reduce prevalence to <150 per 100000 population
    • Reduce deaths to <15 per 100000 population
  – Number of people dying from TB in 2015 should be less than 1 million, including those co-infected with HIV

• **By 2050:**
  – Global incidence of TB disease will be less than or equal to 1 case per million population per year
What Is DOTS? DOT vs. DOTS

Directly Observed Therapy

- Governmental commitment to TB control
- System for registration and follow-up of TB cases
- Reliable supply of TB drugs
- Microbiologic confirmation of TB diagnosis
- Supervision of at least the initial phase of TB therapy
  - Supervision of all doses of TB medication by a health team member
  - WHO policy for TB control, with programmatic imperatives to strengthen TB control efforts
Existing TB Vaccine Ineffective

- **BCG unreliable** against pulmonary TB, which accounts for most TB disease worldwide

- **BCG is not known to protect against latent TB**

- **BCG is not recommended for use in infants infected with HIV - increased risk for severe BCG-related complications**

- Despite wide use, BCG has had no apparent impact on the growing global TB epidemic

- **BCG does reduce risk of severe pediatric TB disease, so it should continue to be used until a better TB vaccine is available**

BCG introduced in 1921
### Jordan

**Population 2016**: 9.5 million

#### Estimates of TB burden*, 2016

<table>
<thead>
<tr>
<th></th>
<th>Number (thousands)</th>
<th>Rate (per 100 000 population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (excludes HIV+TB)</td>
<td>0.013 (0.013–0.015)</td>
<td>0.15 (0.15–0.16)</td>
</tr>
<tr>
<td>Mortality (HIV+TB only)</td>
<td>&lt;0.01 (&lt;0.01–&lt;0.01)</td>
<td>0 (0–0)</td>
</tr>
<tr>
<td>Incidence (includes HIV+TB)</td>
<td>0.53 (0.41–0.67)</td>
<td>5.6 (4.3–7.1)</td>
</tr>
<tr>
<td>Incidence (HIV+TB only)</td>
<td>&lt;0.01 (&lt;0.01–&lt;0.01)</td>
<td>0.01 (0.01–0.02)</td>
</tr>
<tr>
<td>Incidence (MDR/RR-TB)**</td>
<td>0.039 (0.012–0.067)</td>
<td>0.41 (0.12–0.7)</td>
</tr>
</tbody>
</table>

#### Estimated TB incidence by age and sex (thousands)*, 2016

<table>
<thead>
<tr>
<th></th>
<th>0-14 years</th>
<th>&gt; 14 years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>0.025 (0.019–0.032)</td>
<td>0.19 (0.14–0.24)</td>
<td>0.22 (0.16–0.27)</td>
</tr>
<tr>
<td>Males</td>
<td>0.026 (0.02–0.033)</td>
<td>0.29 (0.21–0.36)</td>
<td>0.31 (0.23–0.39)</td>
</tr>
<tr>
<td>Total</td>
<td>0.051 (0.039–0.064)</td>
<td>0.48 (0.36–0.6)</td>
<td>0.53 (0.41–0.67)</td>
</tr>
</tbody>
</table>

#### TB case notifications, 2016

- Total cases notified: 437
- Total new and relapse: 424
  - % tested with rapid diagnostics at time of diagnosis: 39%
  - % with known HIV status: 96%
  - % pulmonary: 64%
  - % bacteriologically confirmed among pulmonary: 35%

#### Universal health coverage and social protection

- TB treatment coverage (notified/estimated incidence), 2016: 80% (63–100)
structure of TB control programme in Jordan
Structure of the Tuberculosis Control in Jordan

The National TB (NTP) in Jordan is a vertical Programme

- At the Central level the Chest Disease Division (in Amman City), responsible for Tuberculosis control program throughout the country including supplying medicines. The main role is planning, coordination and supervision of the control activities.

- At the peripheral level, there are 12 chest centers covering the whole country.
Distribution of Diagnostic TB Centers in Jordan
CONCLUSIONS

Successful TB Elimination

Reaching Global Target

Highest level of political support

Community compliance

Support of other concerned departments & sectors

Support of concerned international organization

Support and collaboration of governorate health authorities
Global Plan to Stop TB 2016-2020

Stop TB Partnership
28th October, 2014 | Barcelona, Spain
• First Global Plan to Stop TB: 2001-2005
• A ten-year Global Plan: 2006-2015
• 5-year Global Plan: 2011-2015

The next 5-year Global Plan: 2016-2020
Reaching MDGs and STOP TB Targets by 2015?

.glob

- 2015 MDGs related targets on TB prevalence and mortality may not be reached in all regions
- TB incidence declining far too slowly

Source: Global Tuberculosis Report 2014
The Challenge

Projections to 2035 compared with current trends

- Current global trend: -2%/year
- Average -10%/year
- Average -5%/year
- Average -17%/year

Optimize current tools, pursue universal health coverage and social protection

Introduce new vaccine, new prophylaxis

Global Plan for 2016-2020

Rate per 100,000/year

2015 2020 2025 2030 2035
Global Plan 2016-2020 challenges

- Estimated 3 million people with TB missing
- Gaps in addressing TB/HIV co-epidemics
- Only 1 in 5 MDR-TB receiving treatment
- Insufficient tools to combat the disease
- Weak health policies, systems and services
- Social and economic determinants maintain TB
- Funding not secure