Asbestos Related Diseases

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Outline

• Definition of asbestos related diseases (ARD)
• Disability-Adjusted Life Year (DALY) definition
• Diseases related to asbestos
• ARD: Asbestosis
• ARD: Asbestos related Pleural abnormality
• ARD: Mesothelioma
• ARD: Lung cancer
• National Census/statistics (National Cancer Registry)
• Asbestos related health and economic studies in Malaysia
# ROUTE OF EXPOSURE & BIOLOGIC FATE

<table>
<thead>
<tr>
<th>Exposure Route</th>
<th>Biologic Fate</th>
</tr>
</thead>
</table>
| Inhalation     | Gets lodged in lung tissue  
|                | Some move to pleural or peritoneal spaces or mesothelium |
| Ingestion      | Most pass through unchanged; cleared in faeces  
|                | Some stay in peritoneal cavity  
|                | Others enter bloodstream and into kidneys; some eliminated unchanged in urine |
| Dermal         | Could get lodged in skin; may form callus or corn |
RISK OF ILLNESS

• Depends on:
  • Amount & type of fibers breathed in
  • Duration & frequency of exposure
  • Other risk factors (smoking and co-morbidity)

• Risk continues even after no longer exposed
• Symptoms may manifest years after exposure
• Not everyone exposed will develop health problem

<table>
<thead>
<tr>
<th>TYPE OF FIBER</th>
<th>TYPE OF INDUSTRY</th>
<th>AGE</th>
<th>SMOKING STATUS</th>
<th>HEALTH STATUS</th>
</tr>
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<tbody>
<tr>
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<td>60</td>
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WHAT IS THE BURDEN OF DISEASE?

• According to WHO, globally about **125 million people are still exposed to asbestos at the workplace.**

• Approximately **half of deaths from occupational cancer are estimated to be caused by asbestos.**

• Estimated **several thousand deaths annually can be attributed to exposure to asbestos in the home.**

• In 2004, **asbestos-related diseases such as lung cancer, mesothelioma and asbestosis from occupational exposures resulted in 107,000 deaths and 1,523,000 Disability Adjusted Life Years (DALYs)**

  (Prüss-Ustün et al, 2011)
What is a disability adjusted life year?

It’s a measure of the overall burden of disease – it adds the years of life lost due to early death and years spent living with disability or ill-health together.
ASBESTOS RELATED DISEASES

• Diseases caused by exposure to asbestos.
• After exposure, body could get rid of some of asbestos fibers.
• Fibers that are not rid off causes inflammation and DNA damage that leads to diseases decades later
• Exposure to asbestos may cause:

<table>
<thead>
<tr>
<th>Noncancerous Conditions</th>
<th>Cancers</th>
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<tbody>
<tr>
<td>➢ Asbestosis</td>
<td>➢ Mesothelioma</td>
</tr>
<tr>
<td>➢ Pulmonary hypertension</td>
<td>➢ Lung cancer</td>
</tr>
<tr>
<td>➢ Cor Pulmonale</td>
<td>➢ Ovarian cancer</td>
</tr>
<tr>
<td>➢ Pleural Plaques</td>
<td>➢ Laryngeal cancer</td>
</tr>
<tr>
<td>➢ Pleural effusion</td>
<td></td>
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<tr>
<td>➢ Diffuse pleural thickening</td>
<td></td>
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<tr>
<td>➢ Rounded atelectasis</td>
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</tbody>
</table>
LUNG DISEASES RELATED TO ASBESTOS
Asbestosis

- Due to consistent inhalation of asbestos containing materials.
- Asbestos builds up in body
- Diffuse interstitial pulmonary fibrosis (scarring of lung tissue)
- Long latency period (usually 10-20 years) between exposure and develop symptoms.
- Not curable.
- Progressive
- Not a type of cancer but patients has increased risk of Asbestos-related cancer
SYMPTOMS ASBESTOSIS

• Insidious
• Progressive shortness of breath (dyspnea)
• Persistent dry cough
• Chest tightness & pain
• Fatigue
• Loss of weight & appetite
• Crackling sound when breathing

STAGES AND EVOLUTION OF ASBESTOSIS

EXPOSURE > INHALATION OF ASBESTOS FIBERS > LATENT PERIOD > SHORTNESS OF BREATH WITH EXERTION > SHORTNESS OF BREATH AT REST > DIFFICULTY SWALLOWING > REDUCTION OF LUNG FUNCTION > LUNG/HEART FAILURE
CHEST RADIOGRAPH

- Small, irregular or linear opacities distributed throughout the lung fields but more prominent in the lower zones
- Loss of definition of the heart border and hemidiaphragms
- Bilateral pleural thickening
- Diaphragmatic or pericardial calcification

Normal Chest X-ray

Asbestosis
CHEST RADIOGRAPH

- Perfusion 3/3+
- Bilateral mixed irregular linear and small nodular opacities
- Large opacity type A and
- Emphysematous change
HIGH RESOLUTION CT SCAN

• Most sensitive imaging method for detecting early asbestosis.

• Thickened septal lines (white arrows)

• Small, rounded, subpleural, intralobular opacities (black arrow).

• Calcified diaphragmatic pleural plaque on the left.
HIGH RESOLUTION CT SCAN

- Multiple pulmonary nodules in both lungs with small mediastinal adenopathy
- Multiple subpleural blebs in both lungs
- Pulmonary emphysema in both lower lobes
TREATMENT

• No treatment for asbestosis.
• Lead healthy lifestyle
  • Eat balanced diet and stay hydrated
  • Exercise regularly
  • Prevent lung infections by getting flu and pneumonia vaccines
  • Hand hygiene
  • Avoid area with polluted air
• Supportive treatment only
• Removed from further asbestos exposure.
• Regular screening for TB.
• Advice stop cigarette smoking.
• Scar tissue in interstitium constricts arteries
• Heart has to work harder to pump blood out from heart into lungs without increasing pressure.
• Potential to lead earlier problems with coronary artery disease and congestive heart failure (cor pulmonale)
ASBESTOS-RELATED PLEURAL ABNORMALITIES

• Includes: -
  • Pleural plaques:
    • Affects 60% of workers exposed
    • Plaques commonly undergoes calcification
  • Pleural effusion
    • Usually 1 side
    • Occurs 15-45 years after exposure
  • Diffuse pleural thickening
    • May be an extension of pulmonary fibrosis or nonspecific reaction to pleural effusion
    • May cause restrictive defect
  • Rounded atelectasis
    • Manifestation of pleural thickening in which it invagination of pleura into lung parenchyma entraps lung tissue and cause atelectasis
MESOTHELIOMA

- Cancer of mesothelium (thin layers surround lungs, abdominal cavity, chest cavity and area around heart)
- Rare
- Can be caused by very low exposure to asbestos
- Takes 30-40 years after exposure to develop
- Incidence higher in men compared to women (4:1 for pleural mesothelioma and 1.5:1 for peritoneal mesothelioma)
- Spreads very fast
- Painful and always fatal
MESOTHELIOMA

• Incidence of mesothelioma increasing despite international efforts to ban the mining and manufacture of asbestos.

• Worldwide, estimated number of asbestos-related cancer deaths in workers is 100,000–140,000 annually.

• In Western Europe, North America, Japan, and Australia, 20,000 new cases of lung cancer and 10,000 cases of mesothelioma result every year from exposures to asbestos.

• In UK, mesothelioma death rate is now highest in the world, accounting for 1 in 40 of all male cancer deaths.
SYMPTOMS

• May be entirely absent or minimal at the time of onset of the disease
• Persistent gnawing chest pain on the involved side, which may radiate to the shoulder and arm
• Dyspnea on exertion
• Dry cough (±haemoptysis)
• Weight loss
• ±Low-grade fever
SIGNS

- Pleural effusion
- Local tumor growth may depress the diaphragm and displace the liver or spleen
- Enlargement of the affected hemithorax
- Pericardial or pleuropericardial rub
- Mediastinal lymph node enlargement
- Clubbing
SIGNS

• Subcutaneous nodules in the chest wall
• Vocal cord paralysis
• Horner syndrome (oculosympathetic paresis)
• Congestion and edema may develop in the upper trunk or lower limbs secondary to compression of the superior or inferior vena cava
LABORATORY FINDINGS

- Nonspecific
- May include anemia and thrombocytosis

IMAGING: CHEST X-RAY

- Unilateral pleural effusion
- Thickening or nodularity, seen usually at the bases

- 63 year old lady
- Complaint of chest pain
- Chest radiograph: lobulated left pleural-based mass (white arrow) and small pleural effusion (black arrow)
- Lobulated mass confirmed as malignant mesothelioma on biopsy
IMAGING: CT SCAN

• Most sensitive test for evaluating pleural surface

• May show
  • Thickened tumor along the chest wall
  • Compressed lung surrounded on all sides by a tumor 2–3 cm thick
  • Extrapeural extension can result in soft-tissue masses or radiologic evidence of rib destruction
  • Signs of asbestosis such as interstitial pulmonary fibrosis, pleural plaques, and calcification may be present
Computed tomography scan of normal chest

Mesothelioma that extends into chest wall. Note the concentric left pleural thickening, pleural effusion, reduction in volume of the left hemithorax, and the tumor nodules within the chest wall.
**TREATMENT**

**Surgical Measures**
- Increases longevity, although it is not curative.
- Surgical resection of all visible disease is believed to be the treatment of choice.

**External Radiotherapy**
- Radiation therapy clearly has been shown to be of benefit in controlling pain and pleural effusion in mesothelioma.

**Chemotherapy**
- Chemotherapy is not curative.
- Pemetrexed, cisplatin, gemcitabine, methotrexate, and other drugs, sometimes in combination, have been used.
COURSE AND PROGNOSIS

• Approximately **75% of patients die within 1 year after diagnosis**
• An average **survival** after diagnosis of **8–10 months**
• Factors associated with improved survival in mesothelioma:
  • Patients with tumors in pleura survive twice as long as compared to peritoneal tumors
  • Survival is longer for patients with epithelial types than for those with mixed or fibrosarcomatous types
  • Survival is longer for younger patients (< 65 years old), respond well to chemotherapy and able to undergo surgical resection
LUNG CANCER

- Leading cause of cancer-related death in North America and Europe.
- Accounts for 33% of new cases and 25–30% of deaths in the United States.
- 5–7% of all lung cancers are potentially attributable to occupational exposures to asbestos.
- NIOSH estimates 5 in 1,000 workers die from lung cancer after a lifetime work exposure to occupational asbestos.
- Major asbestos-related disease, accounting for 20% of all deaths in asbestos-exposed cohorts.
- Latency period: approximately 20 years after exposure before majority of cases seen.
- Asbestos exposure increases the risk of dying from lung cancer:
  - 5.2 fold in non-smokers
  - 28 fold in smokers
RISK FACTOR COMBINATIONS INCREASE ODDS OF LUNG CANCER

- **NO RISK FACTORS**: Normal risk of cancer
  - Ten percent (17,000 cases) of lung cancer occur in non-smokers.

- **ASBESTOS EXPOSURE**: 6x the risk
  - Non-smokers living with a smoker have a 24% increase in risk of developing lung cancer.

- **SMOKER**: 11x the risk
  - Primary lung cancer occurs 50 to 100 times more frequently in asbestos-exposed individuals who smoke than in the

- **SMOKER + ASBESTOS**: 59x the risk

National Cancer Institute, American Cancer Society
SYMPTOMS

• 75–90% are symptomatic at diagnosis.

• Presentation depends on
  • Type and location of tumor
  • Extent of spread
  • Presence of distant metastases and any paraneoplastic syndromes

• Anorexia, weight loss, and asthenia in 55–90%.

• New or changed cough in up to 60%.

• Hemoptysis in 5–30%.

• Pain, often from bony metastases, in 25–40%
SIGNS

• Local spread may result in endobronchial obstruction and postobstructive pneumonia, effusions, or a change in voice due to recurrent laryngeal nerve involvement
• Superior vena cava (SVC) syndrome
• Horner syndrome
• Liver metastases are associated with asthenia and weight loss
• Possible presentation of brain metastases
INVESTIGATION

• Laboratory and imaging procedure findings in occupational lung cancer same as lung cancers of nonoccupational etiology.

• In some cases, an imaging or other finding may suggest a particular etiology
  • The presence of pleural plaques, in conjunction with a lung tumor, would suggest heavy asbestos exposure as the cause.

Large mass at the right hilum (yellow arrows). Calcified pleural plaque adjacent to the medial aspect of the right hemidiaphragm (orange arrow), indicating previous asbestos exposure.
T1 tumor – A typical T1 tumor in the left lower lobe, completely surrounded by pulmonary parenchyma.
T3 tumor - A typical T3 tumor in the right upper lobe with invasion of the chest wall.
PREVENTION

• Avoidance of exposure to lung carcinogens
  • Primary prevention: identification of etiologic agents in the workplace, adherence to strict workplace standards, and worker education

• Aggressive anti-smoking campaigns in the workplace

• Medical monitoring in the workplace as a method of secondary prevention to aid in early detection
  • Serial chest radiographs have been more useful than sputum cytologic examinations in detecting lung cancer
Treatment & Prognosis

• Therapy of occupationally-induced lung cancers is no different from treatment for each of the specific cell types of lung cancer that may be seen in other settings.

• In general, even in patients with localized disease, long-term survival is the exception rather than the rule.
Lung cancer is the second most common cancer among males and fifth among females in Malaysia.

The incidence increased with age and the peak of age-specific incidence rate was at the age of 70 and above.

Most of lung cancer cases were detected at late stage (stage III and stage IV) for both sexes.

The lifetime risk for males was 1 in 55.
- Indian: 1 in 103
- Malay: 1 in 62
- Chinese: 1 in 43

The lifetime risk for females was 1 in 135.
- Indian: 1 in 255
- Malay: 1 in 185
- Chinese: 1 in 97

The male to female ASR ratio was 2.4:1.
**Ten Most Common Cancers**

**Malaysia, 2007-2011**

- **Breast**: 17.7%
- **Colorectal**: 13.2%
- **Trachea, Bronchus, Lung**: 10.2%
- **Lymphoma**: 5.2%
- **Nasopharynx**: 4.9%
- **Leukaemia**: 4.4%
- **Cervix Uteri**: 4.2%
- **Liver**: 4.0%
- **Ovary**: 3.4%
- **Stomach**: 3.3%
AGE-STANDARDISED RATE OF 10 COMMON CANCERS BY SEX, MALAYSIA, 2007-2011

**Male**
- Colorectal: 14.6
- Trachea, Bronchus, Lung: 14.4
- Prostate: 6.6
- Nasopharynx: 6.4
- Liver: 5.6
- Lymphoma: 5.5
- Leukaemia: 4.2
- Stomach: 3.9
- Bladder: 2.9
- Other Skin: 2.7

**Female**
- Breast: 31.1
- Colorectal: 11.1
- Cervix Uteri: 7.6
- Trachea, Bronchus, Lung: 6.0
- Ovary: 5.9
- Corpus Uteri: 3.8
- Lymphoma: 3.8
- Leukaemia: 3.4
- Thyroid: 2.9
- Stomach: 2.6
AGE SPECIFIC LUNG CANCER INCIDENCE RATE BY GENDER 2007-2011
LUNG CANCER BY GENDER AND STAGE

Trachea, Bronchus, Lung: Stage by sex

Male (n = 4,189)
- Stage 1: 4%
- Stage 2: 7%
- Stage 3: 23%
- Stage 4: 66%

Female (n = 1,769)
- Stage 1: 3%
- Stage 2: 7%
- Stage 3: 19%
- Stage 4: 71%
GLOBAL ECONOMIC BURDEN OF ARDS

Annual Total Economic Burden of Asbestos (USD 11.92 billion)

- Management of 3 Common ARDs (USD 4.34 bil) - 36%
- Cost of compensation (USD 4.28 bil) - 36%
- Value of asbestos consumed (USD 2.93 bil) - 25%
- Loss of earning due to hospital visits and admissions (USD 0.37 bil) - 3%
BURDEN OF ARDS TREATMENT

• The cost to treat 43,000 patients of mesothelioma by pneumonectomy i.e. surgery, was estimated at USD 120 million.

• The annual global cost of chemotherapy i.e. treatment with anti-cancer medicines at rate of USD 54,380 per case was about USD 2.33 billion.
## ESTIMATED COST OF TREATMENT FOR ARD

<table>
<thead>
<tr>
<th>Source</th>
<th>Type of disease</th>
<th>Treatment modality</th>
<th>Cost per case in USD</th>
<th>Number of patients</th>
<th>Annual cost in USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driscol; HUKM</td>
<td>Mesothelioma</td>
<td>Pneumonectomy/Surgery</td>
<td>2 803.36</td>
<td>43 000</td>
<td>120 million</td>
</tr>
<tr>
<td>Driscol; Asukai</td>
<td></td>
<td>Chemotherapy/Medication</td>
<td>54 380.00</td>
<td>43 000</td>
<td>2.33 billion</td>
</tr>
<tr>
<td>Driscol; HUKM</td>
<td>Radiotherapy</td>
<td></td>
<td>4 569.64</td>
<td>43 000</td>
<td>196.5 million</td>
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<tr>
<td>Driscol; HUKM</td>
<td>Asbestosis</td>
<td>Medical</td>
<td>1 584.62</td>
<td>26 650</td>
<td>42.23 million</td>
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<tr>
<td>Driscol; HUKM</td>
<td>Lung Cancer</td>
<td>Pneumonectomy/Surgery</td>
<td>2 803.36</td>
<td>26 650</td>
<td>74.7 million</td>
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<td>Driscol; Asukai</td>
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<td>Chemotherapy/Medication</td>
<td>54 380.00</td>
<td>26 650</td>
<td>1.449 billion</td>
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<td>Driscol; HUKM</td>
<td>Radiotherapy</td>
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<td>4 569.64</td>
<td>26 650</td>
<td>121.78 million</td>
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<td><strong>Total Cost 4.34 billion</strong></td>
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HUKM : Hospital Universiti Kebangsaan Malaysia, USD: United States Dollar
LOSS OF WORKDAYS

• The annual loss of earnings for ONE case of lung cancer and asbestosis, including the visits to primary care clinic is about USD 13,320.37.

• The annual global loss of earnings for cases of asbestosis is USD 9.33 million.
## ANNUAL LOSS OF EARNING DUE TO HOSPITAL VISITS AND ADMISSIONS IN ARDS

<table>
<thead>
<tr>
<th>Description</th>
<th>Type of Disease</th>
<th>Amount in USD</th>
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<tbody>
<tr>
<td>Visits to primary care clinic per case</td>
<td>Lung cancer</td>
<td>9,063.04</td>
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<tr>
<td></td>
<td>Asbestosis</td>
<td>3,122.58</td>
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<tr>
<td>Visits to primary care clinic by 26,650 cases</td>
<td>Lung cancer</td>
<td>241.53 million</td>
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<td></td>
<td>Asbestosis</td>
<td>83.21 million</td>
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<tr>
<td>Hospital stay by 43,000 cases</td>
<td>Mesothelioma</td>
<td>17.19 million</td>
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<tr>
<td>- Rate of USD 399.84 each</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital stay by 26,650 cases</td>
<td>Asbestosis</td>
<td>9.33 million</td>
</tr>
<tr>
<td>- Rate of USD 350.33 each</td>
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<tr>
<td>Stay in medical ward by 26,650 cases</td>
<td>Lung cancer</td>
<td>10.24 million</td>
</tr>
<tr>
<td>- Rate of USD 384.60 each</td>
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<tr>
<td>Stay in surgical ward by 26,650 cases</td>
<td>Lung cancer</td>
<td>10.65 million</td>
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<tr>
<td>- Rate of USD 399.84 each</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>372.15 million</strong></td>
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Source: Hospital Universiti Kebangsaan Malaysia, World Bank
COST OF COMPENSATION

• For every USD of asbestos consumed, the global economy has to pay USD 1.46 for annual compensation and USD 1.61 for cost of treatment of ARDs and loss of earnings due to these conditions.

• In total for every USD of asbestos consumed, global economy loses USD 4.07 due to health consequences.
CONCLUSION

• Asbestos-related lung diseases are diseases caused by exposure to asbestos.

• All forms of asbestos are carcinogenic to humans.

• Exposure to asbestos causes asbestosis, mesothelioma, lung cancer, and others.

• In 2004, asbestos-related diseases such as lung cancer, mesothelioma and asbestosis from occupational exposures resulted in 107,000 deaths and 1,523,000 Disability Adjusted Life Years (DALYs).
REFERENCES


Thank you