TB in Health Care Workers

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Who are health care workers? (HCWs)

- Group of people who work in health care facilities and may be exposed to patients with communicable diseases such as TB (nosocomial TB)
- HCWs are essential in fight against TB and should be protected
- Nosocomial TB may result in temporary or permanent loss of HCWs from the workforce
- WHO strategy to control TB is DOTS (Directly Observed Treatment, Short-Course Chemotherapy) under direct observation to TB patients via HCWs
Most TB cases are in India and China
TB burden in Malaysia

TB notification per 100,000 population by State in Malaysia, 2005
PROPORTION TB CASES (ALL FORMS) BY STATE, MALAYSIA, 2006

- Perlis: 1%
- Kedah: 5%
- P.Pinang: 5%
- Perak: 7%
- Selangor: 15%
- WP KL: 7%
- N Sembilan: 2%
- Melaka: 2%
- Johor: 9%
- Pahang: 5%
- Terengganu: 4%
- WP Labuan: 0%
- Sabah: 21%
- Sarawak: 10%
Kes setiap 100,000 penduduk

- > 201
- 101 - 200
- < 100

SABAH – 114 kes setiap 100,000 penduduk

SABAH – 119 kes setiap 100,000 penduduk

SABAH – 155 kes setiap 100,000 penduduk

1999

2004

2005
# MDR TB IN SABAH

<table>
<thead>
<tr>
<th>Year</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>SABAH</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

NB: Sabah State TB Lab (Makmal Kesihatan Awam) Kota Kinabalu - operational since 2006

A major issue is: MDR results are known after more than 5 months

e-results
Introduction

- Nearly one third of global population is infected with *Mycobacterium tuberculosis*

- More than 90 percent of global TB cases and deaths occur in developing world, 75 percent in age 15-54 years

- Increasing trend of TB among HCWs has been observed based on studies performed in developing/resource-limited countries

- Studies in industrialized countries with low incidence have also shown health care workers (HCWs) with patient contact are at increased risk for TB
### Studies from resource-limited countries

<table>
<thead>
<tr>
<th>Study</th>
<th>Site</th>
<th>Study Period</th>
<th>TB Outcome Measured</th>
<th>Population</th>
<th>Results (rates)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harries et al.</td>
<td>Malawi</td>
<td>1993-1994</td>
<td>Disease</td>
<td>Nurses (n=510)</td>
<td>Medical/TB ward nurses (13%) vs other nurses (3%)</td>
</tr>
<tr>
<td>Wilkinson et al.</td>
<td>South Africa</td>
<td>1993-1995</td>
<td>Disease</td>
<td>HCWs</td>
<td>15 cases of TB among nurses 1 case of nosocomial transmission documented by RFLP</td>
</tr>
<tr>
<td>Kaasim et al.</td>
<td>Ivory Coast</td>
<td>1996</td>
<td>Infection</td>
<td>HCWs (n=512)</td>
<td>HCWs with patient contact (70%) vs other HCWs (45%)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>HCWs working ≥1 year (80%) vs HCWs working &lt;1 year (61%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 HCWs with active TB disease</td>
</tr>
<tr>
<td>Do et al.</td>
<td>Thailand</td>
<td>1996</td>
<td>Infection</td>
<td>HCWs (n=911)</td>
<td>HCWs with patient contact (72%) vs other HCWs (63%)</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>HCWs working ≥1 year (60%) vs HCWs working &lt;1 year (50%)</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>7 HCWs with active TB disease</td>
</tr>
<tr>
<td>Garrett et al.</td>
<td>Brazil</td>
<td>1997</td>
<td>Infection</td>
<td>HCWs (n=542)</td>
<td>HCWs with patient contact (49%) vs other HCWs (25%)</td>
</tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>Medical ward HCWs (51%) vs other HCWs (27%)</td>
</tr>
<tr>
<td>Kritski et al.</td>
<td>Brazil</td>
<td>1994-1997</td>
<td>TST conversion</td>
<td>HCWs (n=351)</td>
<td>HCWs (8%) vs general population (1%)</td>
</tr>
<tr>
<td>Perkins et al.</td>
<td>Brazil</td>
<td>1994</td>
<td>Infection</td>
<td>Medical students (n=411)</td>
<td>Classroom students (12%), pre-clinical students (16%), and clinical students (23%) vs engineering students (6-9%)</td>
</tr>
<tr>
<td>Kritski et al.</td>
<td>Brazil</td>
<td>1997</td>
<td>Infection</td>
<td>Medical students (n=455)</td>
<td>Classroom students (2%), pre-clinical students (6%), and clinical students (16%) vs engineering students (4-6%)</td>
</tr>
</tbody>
</table>
## Nosocomial TB

<table>
<thead>
<tr>
<th></th>
<th>TST positive</th>
<th>adjust. ODDS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>degree of patient contact</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequent</td>
<td>72%</td>
<td>1.7</td>
</tr>
<tr>
<td>occasional</td>
<td>78%</td>
<td>1.8</td>
</tr>
<tr>
<td>rare</td>
<td>63%</td>
<td>ref</td>
</tr>
<tr>
<td><strong>length of employment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1 year</td>
<td>69%</td>
<td>2.7</td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>50%</td>
<td>ref</td>
</tr>
<tr>
<td><strong>BCG scar</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>71%</td>
<td>1.9</td>
</tr>
<tr>
<td>No</td>
<td>58%</td>
<td>ref</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>65%</td>
<td>ref</td>
</tr>
<tr>
<td>Male</td>
<td>79%</td>
<td>2.3</td>
</tr>
</tbody>
</table>

*Thailand (Do et al)*
Risk factors of tuberculosis among health care workers in Sabah, Malaysia


aSabah Health Office, Tuaran, Sabah, Malaysia
bCommunicable Diseases Unit, Sabah, Malaysia

Tuberculosis 2004; 84:19-23
Summary  Tuberculosis (TB) is one of the main public health problems in Sabah; 30% of the total number of TB cases reported in Malaysia every year occur in Sabah. The average incidence of TB among health care workers over the past 5 years is 280.4 per 100,000 population (1, Annual Report of Sabah State TB Control Programme, 1998). At present, there are no specific measures for the prevention of TB transmission in health care facilities.

A case-control study was conducted among health care workers in Sabah in 2000–2001. Cases were health care workers with TB diagnosed between January 1990 and June 2000. Controls were health care workers without TB and working in the same facility as cases during the disease episode. The study attempted to identify risk factors for TB among the study population. Data were collected through structured interviews and review of patients’ records.

The notification rate of TB among health care workers was significantly higher than that to the general population (Z = 4.893; p<0.01). The average notification rate of TB among health care workers over the last 5 years was two times higher than in the general population (280.4/100,000 compared to 153.9/100,000). Regression results showed that ethnicity, designation, family contact and TB related knowledge did not significantly contribute to the risk of contracting TB in this study. However, after controlling for the above factors, age, gender, history of TB contact outside the workplace (other than family contact), duration of service and failure to use respiratory protection when performing high-risk procedures, were the main risk factors of TB among health care workers.

This study succeeded in identifying some of the risk factors of TB among health care workers. We managed to include the large ratio of controls to case (3:1) and those cases spanned over a period of 10 years. However, the findings from the study have to be applied with caution due to the limitations of this study, which include recall bias, dropouts, and small sample size. Based on the study findings, we recommend that health care workers in the first 10 years of service should take extra precautions, such as using respiratory protection when performing procedures that are considered to be of high risk with respect to TB infection. They should also undergo TB screening at least once every 2 years and, if symptomatic, offered prophylactic treatment. The Respiratory Protection Programme should be fully implemented to help reduce the risk of TB among health care workers in Sabah.

Tuberculosis 2004; 84:19-23
Risk of TB is elevated in following occupational groups:

1. Hospital employees in wards with tuberculosis patients
2. Nurses in hospitals
3. Nurses of HIV-positive or drug-addicted patients
4. Pathology and laboratory workers
5. Respiratory therapists and physiotherapists
6. Physicians in internal medicine, anaesthesia, surgery and psychiatry
7. Non-medical hospital personnel in house keeping and transport work
8. Funeral home employees and prison employees

*Respiration* 2005; 72: 431-446
HCWs in Malaysia - scenario

- Number of TB cases among HCWs has increased steadily from 31 cases in 2002 to 123 cases in 2006
- Most of cases were smear positive pulmonary TB
- TB cases higher among HCWs who had frequent contact with TB cases (nurses, attendants and doctors)
- Almost 60 percent of TB cases in HCWs in age group 20 – 34 years
HCWs in Malaysia - scenario

- Number of TB cases in HCWs is small but it is increasing and associated with morbidity (fibrosis, bronchiectasis, pneumothorax) if not mortality

- Some HCWs may have contracted TB from outside health care facilities (Difficult to clarify causal relationship between occupation and TB when HCWs have no obvious contact with TB patients)

- Majority of them have contracted TB while working in health care facilities
TB CASES AMONG HEALTH CARE WORKERS BY TYPE OF TB
YEAR 2002-2006

SOURCE: TBIS

PULMONARY TB  EXTRA PULMONARY TB
TB CASES AMONG HCW BY AGE GROUP
2002-2006


73, 17%
98, 23%
78, 19%

SOURCE: TBIS
Increasing trend: Nurse/trainee nurse, medical officer, attendant.

SOURCE: TBIS
TB CASES AMONG HCW BY SOURCE OF INFECTION. 2002-2006

YEAR

2002 2003 2004 2005 2006

NO OF CASES

Health care facilities
Outside health care facilities
Not Known

SOURCE: TBIS
NOTIFICATION OF TB (BY TYPE) AMONG HEALTH CARE WORKERS, 2003-2006, SABAH
NOTIFICATION OF TB AMONG HEALTH CARE WORKERS BY WORKPLACE, 2003-2006, SABAH
NOTIFICATION OF TB AMONG HEALTH CARE WORKERS BY DESIGNATION, 2003-2006, SABAH

![Bar chart showing notification of TB among health care workers by designation from 2003 to 2006 in Sabah.](chart.png)

- **Nurses**: 16, 5, 6, 9
- **Other MOH staff**: 2, 6, 2
- **Health attendant**: 1, 1, 0, 4
- **Medical lab technician**: 1, 2, 0, 1
- **Private health care worker**: 0, 3, 0, 0
- **Medical assistant**: 2, 2, 1, 3
- **Medical officer**: 0, 3, 1, 1
Under the **OCCUPATIONAL SAFETY AND HEALTH ACT 1994 (OSHA)**, employers, employees and self employed persons in Malaysia have a duty of care towards their own safety and health, and to that of others at their workplace. Under **OSHA 1994** employers now also have an obligation to identify workplace hazards, to assess the associated risks and to control those risks.
Therefore...

- It is important to create a safer working environment to reduce the number of TB cases among HCWs
What have we done? Guidelines...

- Ministry of Health (MOH), Malaysia initiated a project to produce National guidelines to reduce TB cases in HCWs
- First meeting held in historical Malacca on 13-15 March this year to produce draft of the guidelines
- Guidelines being finalised (internet discussions)
Rationale

- Increasing incidence of TB among MOH workers
- The increasing incidence of TB among MOH workers is likely to be work related, since investigation showed the source of infection was found to be more from health care facilities than from outside
- Currently no specific TB prevention program in health care facilities
- Current TB program emphasizes more on case detection and treatment but less emphasis on prevention program at the workplace to protect HCWs
Objectives of guidelines

General Objective
- To provide guide in the prevention and control of TB infections among HCWs

Specific Objectives
- To prevent occupation-related TB among HCWs
- To reduce the risk of TB transmission between patients to HCWs and vice versa in a health-care setting
- To promote and improve TB control measures in health-care setting
Hierarchy of Infection Control
Measures to prevent TB in health care workers

1. Administrative controls – greatest impact
2. Environmental controls
3. Personal Respiratory Protection
First and most important level of control to prevent droplet nuclei from being generated and thus reducing the exposure of HCWs and patients to MTB

Without effective administrative controls, environmental measures and personal respiratory protection are of limited value

Measures include early diagnosis, early isolation and prompt initiation of anti-TB treatment

Assessment of risk of transmission in facility

Development of effective TB infection control plan
TB Infection Control Plan

- **Cough-Inducing Procedures (sputum induction, bronchoscopy)**
  1. Do not perform such procedures unless absolutely necessary
  2. Perform such procedures in areas that have local exhaust ventilation devices (e.g., Booth of special enclosures)

- **HCW TB training and education**
  1. All HCWs should receive periodic TB education appropriate for their work responsibilities and duties
  2. Training should describe work practices that reduce likelihood of transmitting MTB

- **Patient education**
  1. Cough etiquette – to minimise generation of infectious droplet nuclei

![Graph showing number of droplets produced by different maneuvers](image)

Number of Droplets produced by Different Aerosol Producing Maneuvers

- Coughing: 50000
- Talking: 30000
- Singing: 10000

Risk of Nosocomial Infection Related to:

Risk of spread from a source:
- Organism load
- Ventilation of working environment
- Protective measures by HCWs
- Duration of exposure

Size of risk:
- Type of health care setting
- Prevalence of TB in the community
- Patient population served
- Area of work of HCW e.g. Ward, lab
- Effectiveness of TB infection control interventions
Transmission of TB to HCWs dependent on:

1. No. of patients with active TB in contact with the HCW
2. Infectiousness of the index case
3. Ventilation in area of exposure
4. Duration of exposure
5. Air-exchange rate in the interior space
Factors facilitating Nosocomial Transmission of TB

1. Inefficient infection control measures
   
   A. Delayed suspicion and diagnosis
      
      - Clustering of patients with unsuspected TB in susceptible immunocompromised patients with AIDS on wards of large urban hospitals
      - Delayed recognition of TB in HIV-infected patients because of “atypical” presentation or low clinical suspicion leading to misdiagnosis
      - Failure to isolate patients with active pulmonary disease
   
   B. Failure to recognize ongoing infectiousness of patients

2. Laboratory delays in identification and susceptibility testing of MTB isolates

3. Inadequate respiratory isolation facilities
   - Lack of respiratory isolation rooms
   - Recirculation of air from isolation rooms to other parts of the hospital

4. Delayed initiation of effective anti-TB therapy
### Major Current Goals in the Control and Prevention

1. **Respiratory isolation** of patients as soon as TB is suspected, whether during emergency care or on admission to the institution.

2. Start **empirical** anti-TB as soon as TB is suspected with an appropriate regimen.

3. **Comply with isolation procedures** during the patient’s hospitalization until lab and clinical evidence eliminates the possibility of TB or the risk of transmission.

4. Conduct **lab studies** as soon as possible to confirm or exclude the presence of TB.

5. Enhance **occupational health services** to monitor for infection and disease in HCWs.

6. **Discharge** TB patients from acute care **only** when they are no longer infectious.

7. Cooperate closely with **public health** and other **community agencies** to provide resources that ensure the completion of therapy (DOTS).

8. TB-related **HCW education**

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2. Environmental Controls

- Second line of defense for prevention of nosocomial TB
- Reduce concentration of infectious droplet nuclei in the air
- Will not eliminate risk if inadequate administrative controls
- Measures include increasing natural ventilation (e.g. opening windows) and controlling direction of airflow (e.g. use of fans) to prevent contamination of adjacent areas
2. Environmental Controls

Aim: Remove and dilute air

1. Maximize natural ventilation - open environment, ceiling fans

2. Mechanical ventilation - window fans to facilitate movement of air flow from and to open windows

3. Negative pressure rooms - costly and requires ongoing maintenance
Natural Ventilation

Figure 2. Natural ventilation; free flow of ambient air in and out through open windows

Direction of air flow under the door
2. Complex and costly Environmental Controls

Air filtration with HEPA filters
- (removal efficiencies: 90-99.9% depending on no of air exchanges per hour)
- Air-tight room = more risk of infection E.g. air conditioned room use HEPA filtration

HEPA: High Efficiency Particulate Air

Air disinfection with UV germicidal irradiation (UVGI)
- controversial
- CDC, ATS recommends as a supplementary measure for TB control and not as a substitute to HEPA filters
- (30W provides > 20 air exchanges per hour, however high humidity (>60%) limits their efficacy
- uses: open air with less risk of infection E.g. waiting rooms, corridors, emergency rooms, other central areas of an institution where undiagnosed tuberculosis patients may contaminate the air with droplet nuclei
3. Personal Respiratory Protection (respirators)

- Is the last line of defense for HCWs against nosocomial M. tuberculosis
- Without administrative and environmental controls, respirators will NOT adequately protect HCWs from infection
- Expensive and require specialised equipment to determine proper fit
3. Personal Respiratory Protection (respirators)

- Should be used on limited basis in specified high risk areas in conjunction with administrative and environmental control measures such as:
  1. Isolation rooms for TB patients
  2. Sputum induction rooms
  3. Bronchoscopy suites
  4. Autopsy areas
  5. Spirometry rooms
  6. Emergency surgery on potentially infectious TB patients
Surgical (face) mask vs Respirator

**Surgical masks**
- Has large pores and lacks airtight seal around edges
- Do prevent spread of microorganisms from wearer to others by capturing large wet particles near nose and mouth
- Do not provide protection to the wearer from inhaling infectious droplet nuclei in the air (does not protect HCWs)

**Respirators**
- Has tiny pores which block droplet nuclei and relies on airtight seal around entire edge
- Do provide protection to wearer if fitted correctly
- If not fitted correctly (leakage around edges), infectious droplet nuclei can enter airways
Respirator fitting

- Respirators come in different sizes
- Recommended HCWs be “fit tested” to ensure appropriate selection (size and shape) of respirator
- Beards and facial hair do not allow proper sealing of respirators to the face since any leak between face and mask is a potential entry point for infectious droplet nuclei
Fit Testing

Fit Testing in Thailand
Conclusion

- Key to reduction of nosocomial risk for HCWs is early diagnosis, early isolation and prompt initiation of treatment.

- Although effective infection-control measures can greatly decrease the risk of nosocomial *tuberculosis* infection, the risk of *tuberculosis* exposure and infection among health-care workers will always be present to some extent.

- Complete elimination of risk among HCWs – unrealistic goal.
Highlights:

1. **Pleuroscopy – The Sabah experience by Dr Kunji Kannan**
2. **Rigid bronchoscopy with hands on**
3. **Autofluorescence bronchoscopy – Dr Hidetoshi Honda (Japan)**
4. **Live video procedures – pleuroscopy, autofluorescence, cryotherapy**
Further reading: GUIDELINES FOR THE PREVENTION OF TUBERCULOSIS IN HEALTH CARE FACILITIES IN RESOURCE-LIMITED SETTINGS (WHO 1999)