Tuberculosis and the Healthcare worker
Focus on Respiratory Protection

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2014 Global TB Burden

- Estimated only about 63% of TB cases are notified.
  - About 3.6 Million

9.6 million new cases of TB (1.5% decline since 2000)
- 1.2 Million HIV+
- Women
  - Top five killers of women
- Men
  - 5.4 Million new cases
- Children
  - 1 Million new cases

1.5 million TB deaths
- 400K HIV+
- Women 480K
- Men 890K
- Children 140K

TB Incidence
- 126/100,000
2014 Global Drug Resistant TB Burden

- **MDR-TB**
  - 3.3% of new cases are MDR-TB
  - 20% of Previously treated cases
  - 480K people
    - 123K new cases
      - Only 41% of global estimate
    - 190K deaths
  - Cure rate = 50%

- **XDR-TB**
  - Present in 105 countries in 2015
  - 9.7% of MDR-TB people have XDR-TB
  - Cure rate = 18%
Estimated TB incidence rates, 2014

Estimated new TB cases (all forms) per 100,000 population per year:
- 0–9.9
- 10–19
- 20–49
- 50–124
- 125–299
- 300–499
- ≥500

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.


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Number of multidrug-resistant tuberculosis cases estimated to occur among notified pulmonary TB cases, 2014.

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MDR-TB Cases per 100K population
Number of patients with laboratory-confirmed XDR-TB started on treatment in 2014

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Estimated TB incidence: top-ten countries, 2014

![Graph showing estimated TB incidence rates in top-ten countries for 2014 with countries listed vertically from highest to lowest incidence: Lesotho, South Africa, Swaziland, Djibouti, Namibia, Mozambique, Timor-Leste, Gabon, DPR Korea, Papua New Guinea. The rates are shown in a horizontal bar graph with the x-axis representing rate per 100,000 population per year.]
Three HBC lists
South Africa

Tuberculosis profile 2014

• The population of South Africa makes up 0.7% of the world’s population and yet contributes 28% of the number of HIV-positive TB cases worldwide and 33% of HIV positive TB cases in Africa

• SA has one of the highest incidence of TB among the HBCs per capita
  - 1003/100,000 ppyr in 2012
  - 860/100,000 ppyr in 2013
  - 834 /100,000 ppyr in 2014

• TB cases living with HIV
  - WHO 61%
  - South African Department of Health reports 73% of TB patients are HIV positive

• An estimated 80% of the South African population has latent TB

• Second-largest number of diagnosed MDR-TB cases (after India)
  - 18734 in 2014

• Highest number of diagnosed XDR-TB cases
  - 1 596 in 2012
Cost of DR-TB in SA 2012

- Despite drug-resistant TB comprising only 2.2 percent of South Africa’s case burden, it consumed 32% of the total estimated 2011 national TB budget

- Assuming adherence to national DR-TB management guidelines, the per patient cost of:

  - XDR-TB = $26,392 (R282,996) four times greater than

  - MDR-TB = $6772 (R72,613), and 103 times greater

  - DS-TB = $257 (R 2755).
Financing TB Control in 2014

<table>
<thead>
<tr>
<th>Financing TB control 2014</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>National TB programme budget (US$ millions)</td>
<td>162</td>
</tr>
<tr>
<td>% Funded domestically</td>
<td>84%</td>
</tr>
<tr>
<td>% Funded internationally</td>
<td>16%</td>
</tr>
<tr>
<td>% Unfunded</td>
<td>0%</td>
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</tbody>
</table>

Data: [www.who.int/tb/data](http://www.who.int/tb/data)  Generated: 2015-07-21
Facts On TB amongst Healthcare Workers in SA

• Prevalence of TB among the HCWs per capita:
  - 1133/100,000

• HCW TB Incidence
  - 2% vs 0.9% of general population
  - 5-6 fold increase in hospital admissions for HCW are DR-TB
  - ½ of HCW with DR-TB dies
  - HCW Living with Aids incidence are 20x higher to contract TB

• Attributing Factors:
  - Occupational exposure (Nature of the Job)
  - TB Patient Load
  - Lack of Infection Control Measures

Transmission Depends upon
  - Number of organisms expelled in the air
  - Concentration of organisms in the air
  - Length of time an exposed person breathes in the contaminated air
  - Immune status of the exposed individual
  - Misdiagnosed or inappropriately treated cases
When are HCW at highest risk of TB exposure?

When the diagnosis of TB is not suspected!

When a patient is: coughing, sneezing, shouting, crying

At resuscitations, intubation, extubation, open suctioning

Aerosolised TB bacilli can remain suspended in the air for hours
Fate of droplets

Organisms Liberated
- Talking 0-200
- Coughing 0-3500
- Sneezing 4,500-1,000,000

Droplets can remain suspended in the air for hours.

“droplet”: droplet nuclei vs large droplets: there is a difference
Small droplets evaporate to droplet nuclei in this zone.

Droplet nuclei carried in air currents for minutes to hours.

Large droplets settle to ground in a few seconds.

2 m

4 m
What about TB transmission risk to HCW?

HCW compared to the general population:

- Increased risk of latent TB and TB disease
- 6 x more likely to get MDR-TB; 4 x XDR-TB
- Increased risk in OPD and Paeds wards
- Increased risk with HIV
- High mortality (12 - 32%)
Facts On TB amongst Healthcare Workers in SA

• A study presented at the 2014 annual meeting of the American Association for the Advancement of Science (AAAS) has revealed that neglectful working habits increase South African hospital workers' risk of contracting TB, HIV, and hepatitis.

• According to the World Health Organization (WHO), South Africans are 300 times more likely to contract TB than Americans.

• Of the 1,000 hospital workers participating in the study, 68% had not been screened for TB and upward of 20% had neglected to receive the hepatitis vaccination.

• Another 55% of the participants admitted to not wearing respiratory protection while caring for an infectious patient.
Tuberculosis infection control practices in primary healthcare facilities

An Investigative Study

- Limited implementation of World Health Organization infection control measures was identified.

- In terms of administrative controls
  - 43.3% of the clinics did not have an infection control committee
  - 40.9% did not have a clinic specific infection control plan
  - 94.5% of clinics did not have the tuberculosis signs and symptoms screening tool
  - 48.8% did not separate coughing patients from other patients
  - only 35.4% provided coughing patients with masks or tissues.

- In terms of environmental controls
  - only 18.9% of the clinics had an open window register.

- In terms of personal protection,
  - there was a dire shortage of N95 respirators.

- In addition, only a third of the professional nurses and 1 in 10 community health workers had received training on infection control practices.
Use of N95 respirators and masks to prevent tuberculosis infection

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N95 respirators used by</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients with drug-resistant tuberculosis</td>
<td>27</td>
<td>33.3</td>
</tr>
<tr>
<td>Clinic staff</td>
<td>23</td>
<td>28.4</td>
</tr>
<tr>
<td>Nurses</td>
<td>19</td>
<td>23.5</td>
</tr>
<tr>
<td>Nurses treating patients with drug-resistant tuberculosis</td>
<td>12</td>
<td>14.8</td>
</tr>
<tr>
<td><strong>Surgical masks used by</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthcare workers</td>
<td>33</td>
<td>27.3</td>
</tr>
<tr>
<td>Coughing patients with tuberculosis</td>
<td>28</td>
<td>23.1</td>
</tr>
<tr>
<td>Patients with drug-resistant tuberculosis</td>
<td>16</td>
<td>13.2</td>
</tr>
<tr>
<td>Nurses</td>
<td>18</td>
<td>14.9</td>
</tr>
<tr>
<td>Nurses treating patients with drug-resistant tuberculosis</td>
<td>11</td>
<td>9.1</td>
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<tr>
<td>Clinic staff</td>
<td>8</td>
<td>6.6</td>
</tr>
<tr>
<td>Community health workers</td>
<td>7</td>
<td>5.8</td>
</tr>
</tbody>
</table>
Tuberculosis infection control practices in primary healthcare facilities

An Investigative Study

Recommendation:

Tuberculosis infection control training for PHC clinic staff, as well as the appropriate implementation of simple and inexpensive infection control measures, is required.
We all face occupational hazards

Bullet proof?  Fire proof?
Anyone can get TB...even you!
Facing the ‘White Plague’ in a white coat

An Opinion

• Dr Dalene von Delft contracted MDR-TB as a medical student. She and her husband have started an organisation, TB Proof, to advocate on behalf of health care workers.

• During my years of training as a medical student, we had very limited teaching in infection prevention and control practices and were not encouraged to protect ourselves from TB.

• “Our senior doctors claimed it would not help to wear masks as we had all been infected with latent TB, or a dormant form of the disease, already. We were supposedly “TB proof” in any case.”

• Health care facilities should be places of healing, not contagion, and it is imperative that medical staff and the population they serve, are protected.

• This starts with an acknowledgement that TB could happen to anybody; it is nothing to be ashamed of. In fact, surviving TB, particularly drug-resistant TB, is a feat of endurance worth celebrating.
How can we prevent TB transmission?

Core elements of TB Infection Prevention and Control

Isolation
- N95 Respirator
- Ventilation

Surgical masks for patients
TB as an Occupational disease

• Recognized since 1950 as an Occupational Hazard
  - List of Occupational diseases, R194, Revised 2010
    – Schedule 3: Compensation for Occupational Injuries and diseases (COIDA)
  - OSHA No 85 of 1993
    ▪ Hazardous Biological Agents Group 3
  - Hazardous Biological Regulations, 2001
    ▪ Assessment must be done every 2 years
    ▪ Information and training

TB in Healthcare Workers; Dr Muzi Zungu (NIOH) Muzimkhulu.zungu@nioh.nhls.ac.za
National Core Standards for Health Establishments in South Africa

The main purpose of the National Core Standards is to:

• Develop a common definition of quality care which should be found in all health establishments in South Africa, as a guide to the public and to managers and staff at all levels;

• Establish a benchmark against which health establishments can be assessed, gaps identified and strengths appraised; and

• Provide for the national certification of compliance of health establishments with mandatory standards
National Core Standards for Health Establishments in South Africa

Domain 2: Patient Safety, Clinical Governance and Clinical Care

- Sub-domain
  2.6 Infection prevention and control

  - Standard 2.6.2
    Specific precautions are taken to prevent the spread of respiratory infections

  - Criteria 2.6.2.1
    A programme for the prevention and control of respiratory infections is in place (eg for tuberculosis)
Infection Control is the KEY

You may have the newest or best facility, structurally but if appropriate infection control measures and mechanisms are not in place you are failing staff and patients
Fundamentals of Infection Control

Administrative Controls

Environmental Controls

Respiratory Protection
Respiratory Protection Controls

• Reduce the risk of exposure

• Implement Respiratory Protection program

• Train HCWs in RP
  - Respirator masks
  - Correct donning
  - Correct removal
  - Correct disposal

• Train patients in respiratory hygiene
Respiratory Protection Controls

Personal protection for staff

- Personal particulate respirators (N95 or FFP 2 masks) are very different than surgical masks.
- Protects the wearer of from Airborne particles that are 1 – 5 µm in diameter.
- Can be worn continuously for 8 hours.
- N95 masks are single use only, discard into medical waste directly after removal, decontaminate hands.
- Make sure of mask fit

Surgical masks are not effective to prevent TB transmission
What is a surgical N95 respirator?

A surgical N95 respirator is a NIOSH-approved N95 respirator that has also been cleared by the Food and Drug Administration (FDA) as a surgical mask.

Who is NIOSH?

- The National Institute for Occupational Safety and Health (NIOSH) is the U.S. Government agency responsible for the certification and approval of respiratory protective devices for occupational use.

Who is the FDA?

The Food and Drug Administration (FDA) is the U.S. Government agency that oversees most medical products, foods, and cosmetics. This includes surgical masks and surgical N95 respirators.
<table>
<thead>
<tr>
<th>Oil resistance</th>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not oil resistant</td>
<td>N95</td>
<td>Filters at least 95% of airborne particles</td>
</tr>
<tr>
<td></td>
<td>N99</td>
<td>Filters at least 99% of airborne particles</td>
</tr>
<tr>
<td></td>
<td>N100</td>
<td>Filters at least 99.97% of airborne particles</td>
</tr>
<tr>
<td>Oil Resistant</td>
<td>R95</td>
<td>Filters at least 95% of airborne particles</td>
</tr>
<tr>
<td></td>
<td>R99*</td>
<td>Filters at least 99% of airborne particles</td>
</tr>
<tr>
<td></td>
<td>R100*</td>
<td>Filters at least 99.97% of airborne particles</td>
</tr>
<tr>
<td>Oil Proof</td>
<td>P95</td>
<td>Filters at least 95% of airborne particles</td>
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<td>P99</td>
<td>Filters at least 99% of airborne particles</td>
</tr>
<tr>
<td></td>
<td>P100</td>
<td>Filters at least 99.97% of airborne particles</td>
</tr>
</tbody>
</table>
If a particulate filtering face piece respirator does not have these markings as identified above and does not appear on one of the NIOSH lists, it has not been certified by NIOSH for occupational use.

## European Standards EN 149

<table>
<thead>
<tr>
<th>Class</th>
<th>Filter penetration limit (at 95 L/min air flow)</th>
<th>Inward leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFP1</td>
<td>Filters at least 80% of airborne particles</td>
<td>&lt;22%</td>
</tr>
<tr>
<td>FFP2</td>
<td>Filters at least 94% of airborne particles</td>
<td>&lt;8%</td>
</tr>
<tr>
<td>FFP3</td>
<td>Filters at least 99% of airborne particles</td>
<td>&lt;2%</td>
</tr>
</tbody>
</table>
CDC Guidelines

• Performance Criteria for Protection Against TB:
  - Mask must filter 0.3 micron particle with 95% Efficiency

• Must be Fit Tested

• Must be Able to Fit Different Facial Sizes
When to discard a respirator?

Replacing Disposable Respirators (OSHA):

- Designed to be disposed after use.
- Once worn in the presence of an infectious individual, the respirator should be considered potentially contaminated with infectious material.
- Touching the outside of the device should be avoided to prevent self-inoculation (touching the contaminated respirator and then touching one's eyes, nose, or mouth).
- A once-worn respirator will also be contaminated on its inner surface by the microorganisms present in the exhaled air and oral secretions of the wearer.
So which respirator???
How do I know what size I need?

• Fit testing is needed to determine if a particular size and model of respirator provides you with an acceptable fit.

• Fit testing is model specific.

• Before you wear a respirator in an occupational setting, you must be fit tested in each respirator model you will wear.
Respirator donning
Respirator Donning
Separate the edges of the respirator to fully open it.
Respirator Donning

Slightly bend the nose wire to form a gentle curve
Respirator Donning

Hold the respirator upside down to expose the two headbands
Respirator Donning

Using your index fingers and thumbs, separate the two headbands
Respirator Donning

While holding the headbands with your index fingers and thumbs, cup the respirator under your chin.
Respirator Donning

Pull the headbands up over your head
Respirator Donning

Release the lower headband from your thumbs and position it at the base of your neck.
Respirator Donning

Position the remaining headband on the crown of your head.
Respirator Donning

Continue to adjust the respirator and secure the edges until you feel you have achieved a good facial fit. Now, perform a Fit Check.
Respirator Donning

Conform the nosepiece across the bridge of your nose by firmly pressing down with your fingers.
User Seal Check

• A user seal check should be conducted every time they are worn.

• Forcefully inhale and exhale several times.

• The respirator should collapse slightly upon inhaling and expand upon exhaling.

• The wearer should not feel any air leaking between his/her face and the respirator.

• The wearer should adjust the respirator until the leakage is corrected.
Tips for Achieving a Good Fit

• Use a mirror while adjusting the respirator.

• Ask someone to look for hair or earrings that might be caught in the seal.

• Make sure the headbands are positioned properly.

• It is especially important that the top headband is on the crown of your head, as it is designed to hold the bottom of the respirator snug against your chin.
Doffing of HYH N95 Respirator

• To be demonstrated
Supporting you in protecting your staff and patients

• Written Respiratory Protection Program
  - WRPP requirements summary
  - WRPP template
  - Medical evaluation questionnaire
  - Fit test record keeping form
  - Checklists for program elements

• “Preventing the Spread of Airborne Infections” Accredited Educational Program

• Respirator User Training

• Qualitative Fit Test Training
Thank You