# The crisis of tuberculosis and silicosis in the South African mining industry

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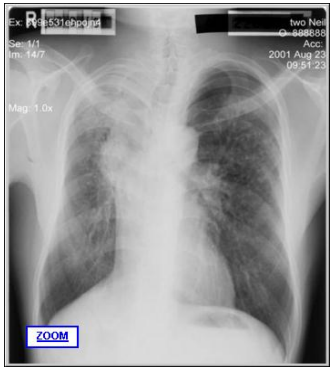
# The crisis and tuberculosis and silicosis in the South African mining industry

1. **What is the current epidemiology of pulmonary tuberculosis (PTB) in miners?**
2. Underlying causes of the TB epidemic in miners
3. Externality: ex-miners and the migrant sick
4. Systemic changes needed



# The autopsy evidence

- South Africa is unique in having a statutory lung autopsy system - the family of any miner or ex-miner who dies is entitled to a lung autopsy to determine whether there is evidence of a compensatable lung disease in the deceased.

- This has resulted in a continuous form of *surveillance* from the 1970s to the present via the automated pathology system at the National Institute for Occupational Health (PATHAUT) in Johannesburg.

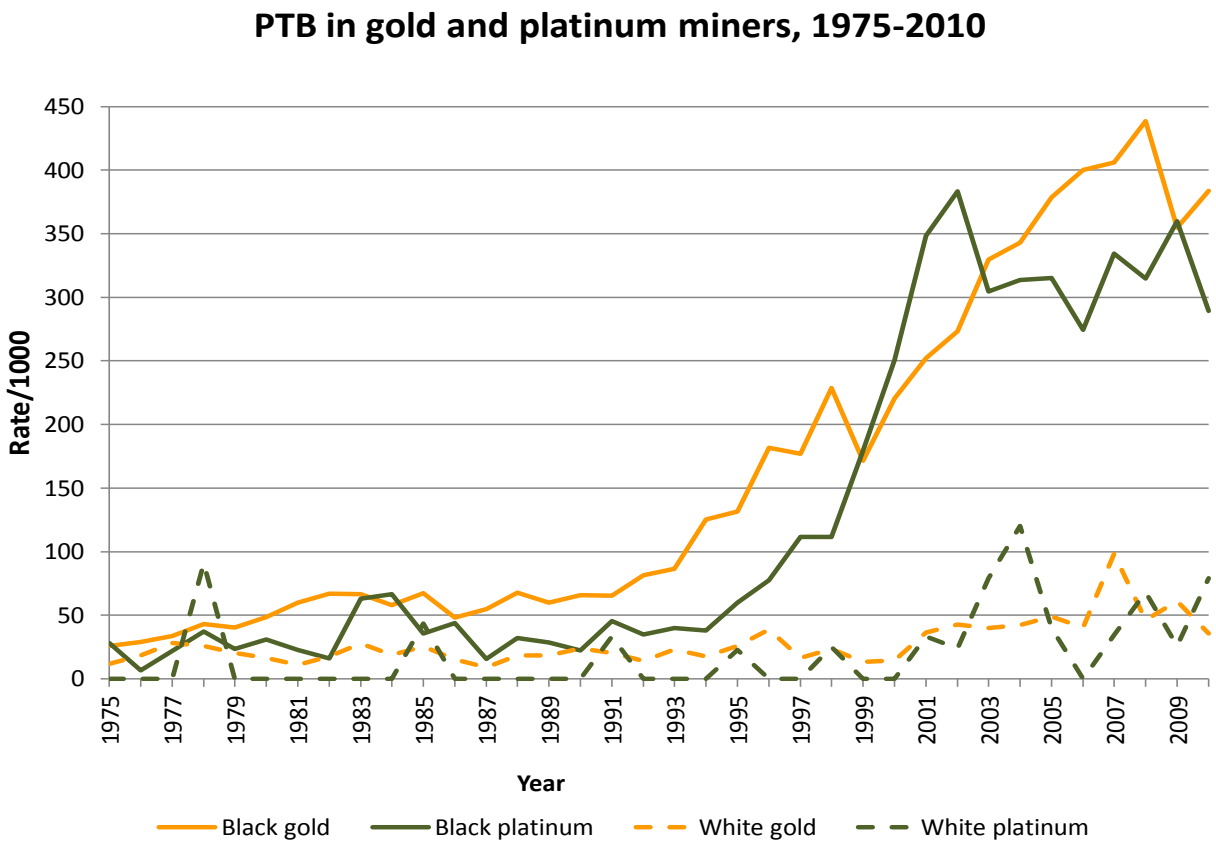
# The autopsy evidence

- The following slide shows the proportion of these autopsies with evidence of *active TB* in deceased gold and platinum miners over a long period. Many of these miners died of unrelated causes, i.e. with undetected TB.

- The figures in the graph indicate a doubling of the proportion with TB between 1975 and 1982, followed by a static period in the mid-1980s before a dramatic increase to the present.

- For most of this period, the proportion with TB at autopsy among *gold* miners has been higher than in *platinum* miners. (The likely reason is that gold miners are exposed to much more silica than platinum miners – see later.)

# Proportion of deceased gold and platinum miners with PTB at *autopsy,* 1975-2010




National Institute for Occupational Health, 2012 - unpublished

# What about living (gold) miners? (See next slide)

- Nearly 90% have evidence of previous ("latent") infection with TB (this is not active disease).
- About a quarter are HIV infected.
- The annual incidence of active TB is between 1 and 7 per 1000. (The *national* incidence of TB was 0.97 per 1000 in 2009).
- Gold miners have high recurrence rates, particularly those HIV infected.
- Drug resistance is common.

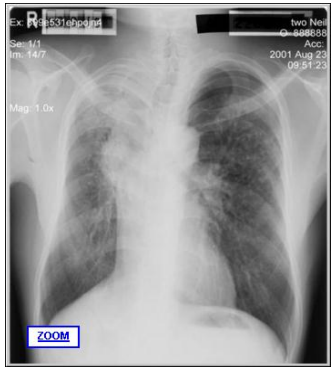
⇒ *The epidemic of pulmonary TB is out of control in gold miners.*

# Pulmonary tuberculosis/HIV in gold miners

| **Measure** (study) | **Rate or proportion** |
|---|---|
| Prevalence of latent TB infection (Hanifa et al. 2009) | 89% |
| HIV infection (e.g. Corbett et al. 2004, Girdler Brown et al. 2008) | 22-30% |
| Incidence (e.g. Glynn et al. 2010) | Approx. 3 per 100 p-y<br>(range 1-7 per 100 p-y)<br>SA general: 0.97 per 100 p-y. |
| Recurrence rate of PTB (Glynn et al. 2010) | HIV+: 19 per 100 p-y<br>HIV- : 7.7 per 100 p-y |
| Proportion of drug resistant cases (Calver et al. 2010) (Van Halsema et al. 2012) | MDR: 4% → 20-25%<br>XDR: 0.2% ? |

# The crisis of tuberculosis and silicosis in the South African mining industry:

1. Current epidemiology of pulmonary tuberculosis in miners
2. **What are the underlying causes of the TB epidemic in miners?**
3. Externality: ex-miners and the migrant sick
4. Systemic changes needed



The underlying preventable causes we will consider are:

- HIV infection
- TB infection, reactivation and re-infection
- Silicosis
- Silica dust inhalation

# HIV

- HIV is a powerful risk factor for tuberculosis.

- Multiple partnerships are part of the migrant miner experience in Southern Africa.

- “ Corno et al. (2012) found that: “migrant miners (in Lesotho) aged 30-44 are 15 percentage points more likely to be HIV positive and having a migrant miner as a partner increases the probability of infection for *women* by 8 percentage points”.

- Miners employed by large companies have access to HIV counselling and treatment at mine medical services – but a recent platinum mine study showed disappointing results of one such programme for TB control.

# TB infection, reactivation and recurrence

- Since 90% of miners LTBI positive, and given the high HIV prevalence, miners are at high risk of *reactivation TB* i.e. "flaring up" of the infection. Many have had more than episode of active TB.

- Moving between high TB prevalence settings (both mines and home communities ), they are also at high risk of new or "*reinfection" TB.*

- Many opportunities for mine related transmission – transport to and from mines, crowded mine hostels, underground cages (lifts), underground work, recreational sites.

# TB infection, reactivation and recurrence (cont.)

- A recent mass trial of isoniazid TB prophylaxis at a number of mines was *not* effective in reducing *community incidence* of TB, probably due to high rates of reinfection.

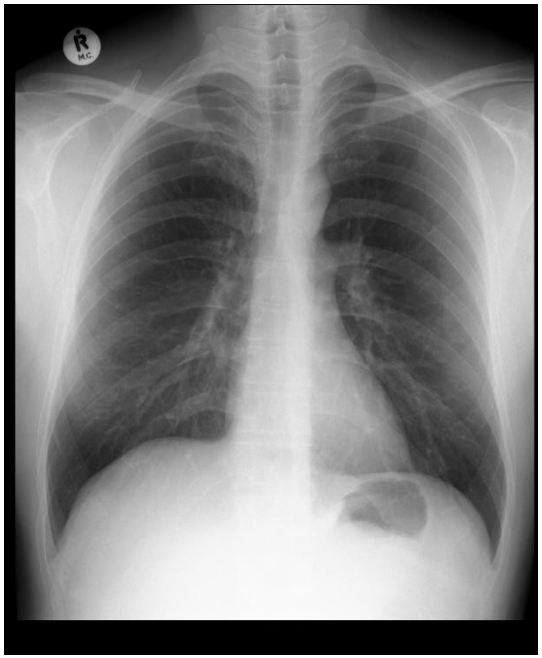
- *Age* is also a strong risk factor for TB recurrence.

⇒ *The above combination of factors suggests that miners/ex-miners need lifelong surveillance/screening for TB.*

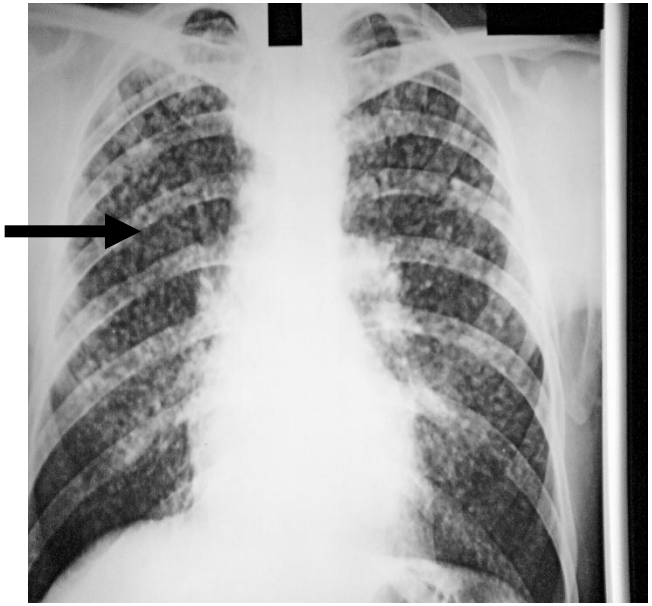
# Silicosis

Irreversible nodular fibrosis of the lungs due to inhaling silica particles. *Silicosis is a strong risk factor for pulmonary TB*

Normal x-ray

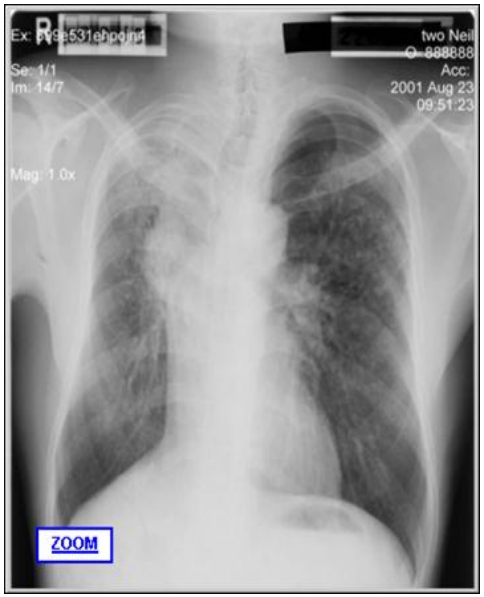


Extensive silicosis



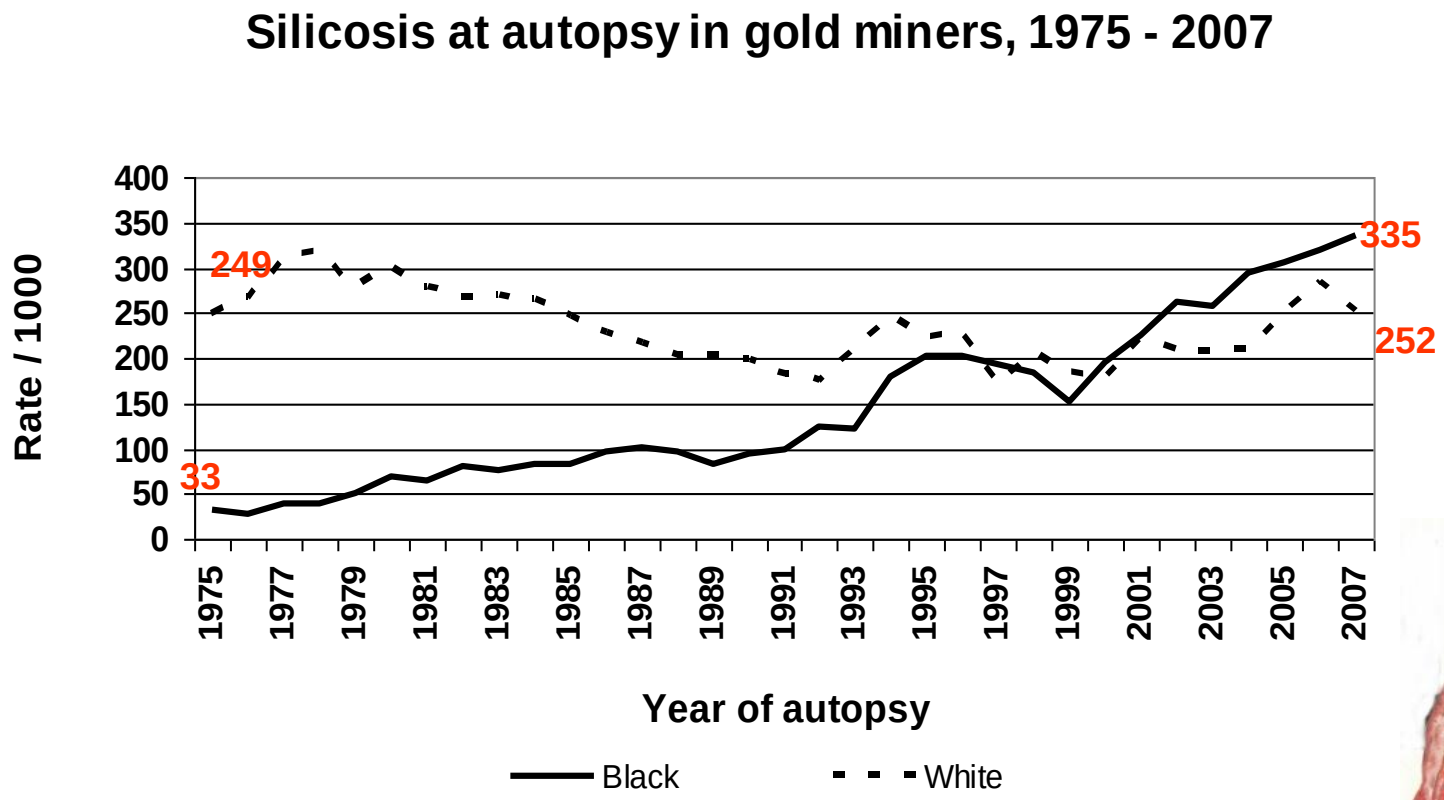
Small nodules distributed through both lungs

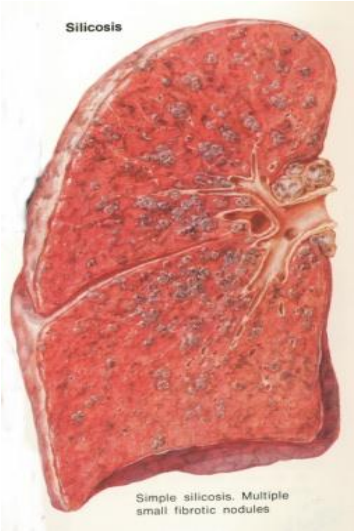
Silico-tuberculosis




Upper part of right lung contracted after TB has healed

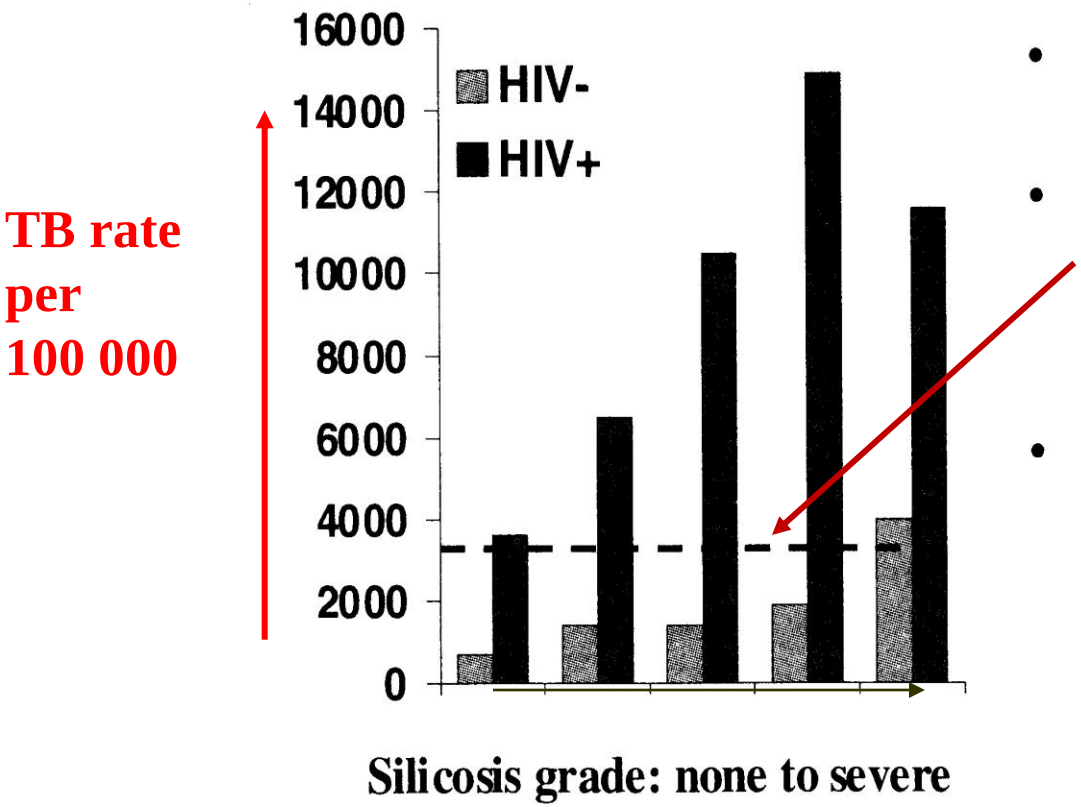
# Silicosis detected at autopsy increased ten-fold between 1975 and 2007




Nelson G and Murray J. Presentation, ICOH Congress, Cape Town, 2009 (unpublished)

# There is a powerful *interaction* between HIV and silicosis on the risk of PTB

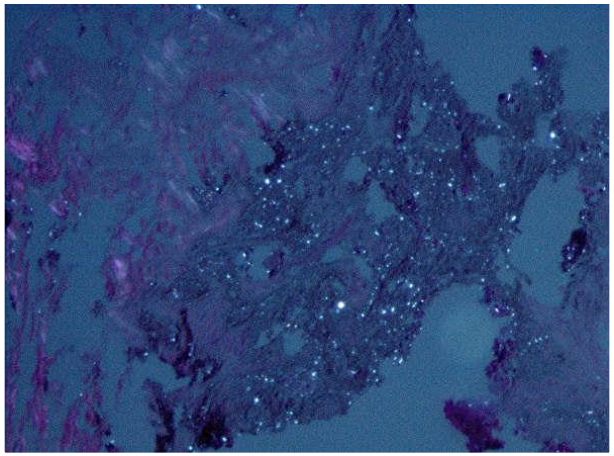



Data from Corbett et al 2000

- Both HIV and silicosis are strong TB risk factors
- Comparison with HIV+ve Ugandans shown by dashed line (Whalen et al 1997)
- Silicosis significantly increases risk of TB in HIV+ve miners
  - risks multiply

Corbett et al. 2000

# What about silica dust (without silicosis) ?



"Birefringent" particles
of silica visible in lung
specimen under polarising light

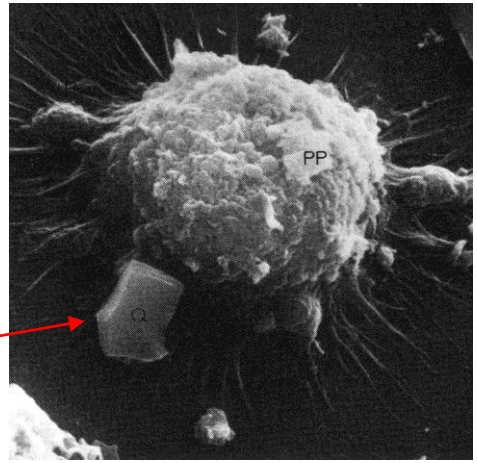
⇒ *Even without silicosis, it is likely that cumulative silica exposure increases risk of PTB*

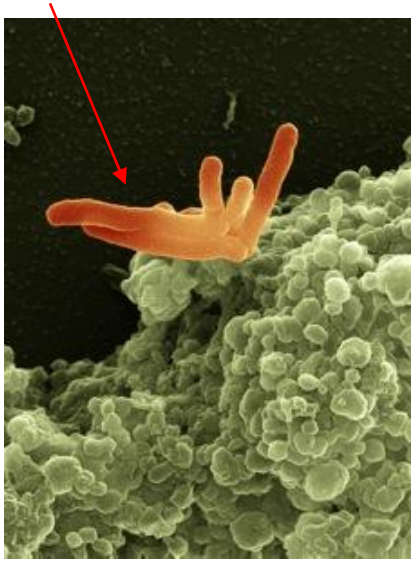
# Silica impairs the lung's defence against TB

The lung macrophage is
part of the lung's primary
defence against silica and TB

Silica impairs
the ability of the
macrophage
to clear the TB bacillus

Silica
particle

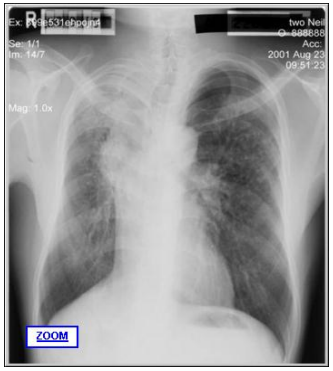


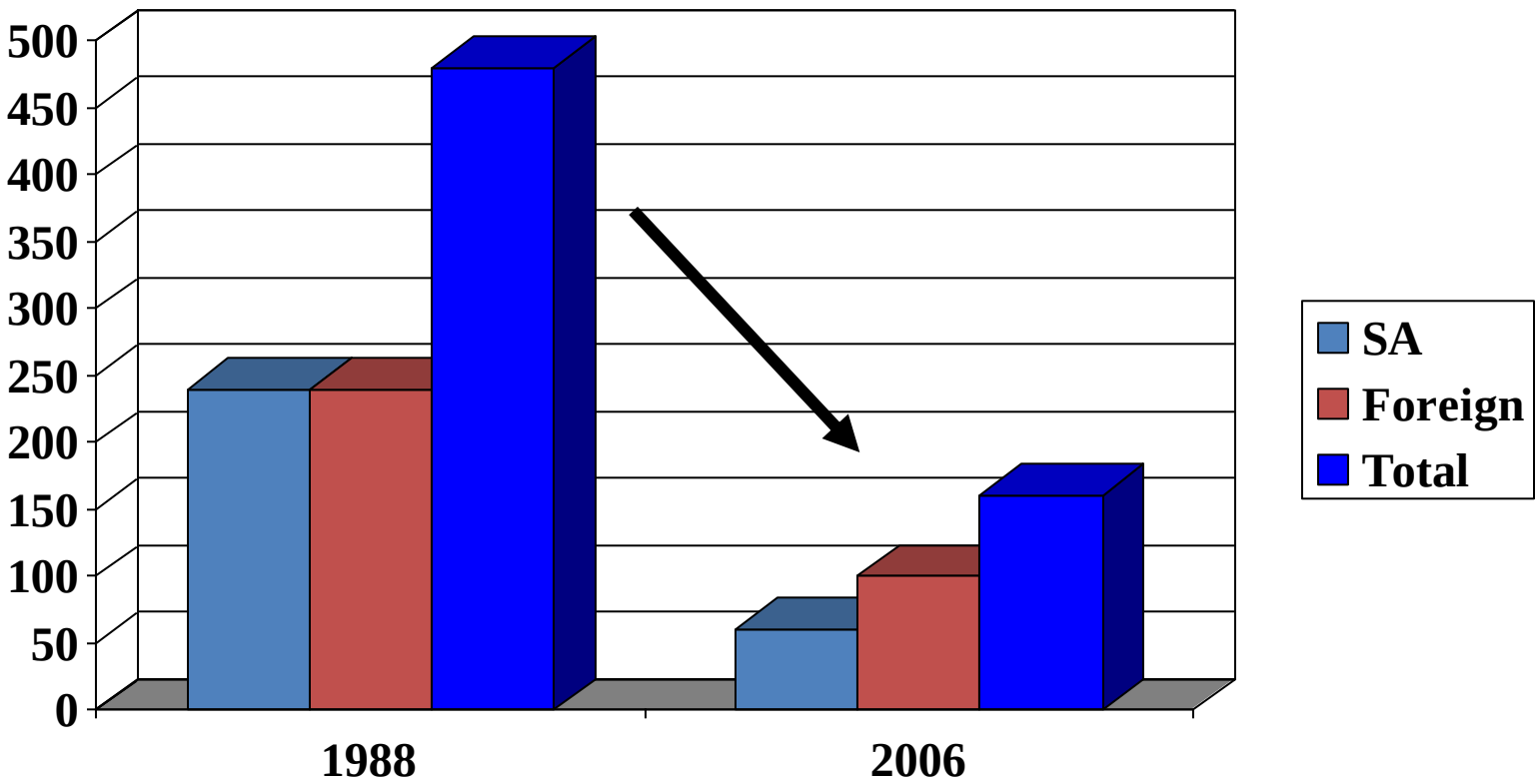
*Silicosis and probably a "silica dusted" lung is a form of "acquired immune deficiency" vis-a-vis TB*

# The crisis of tuberculosis and silicosis in the South African mining industry:

1. Current epidemiology of pulmonary TB in miners
2. Underlying causes of TB epidemic in miners
3. **“Externalisation”: shifting the burden of disease to ex-miners**
4. Systemic changes needed



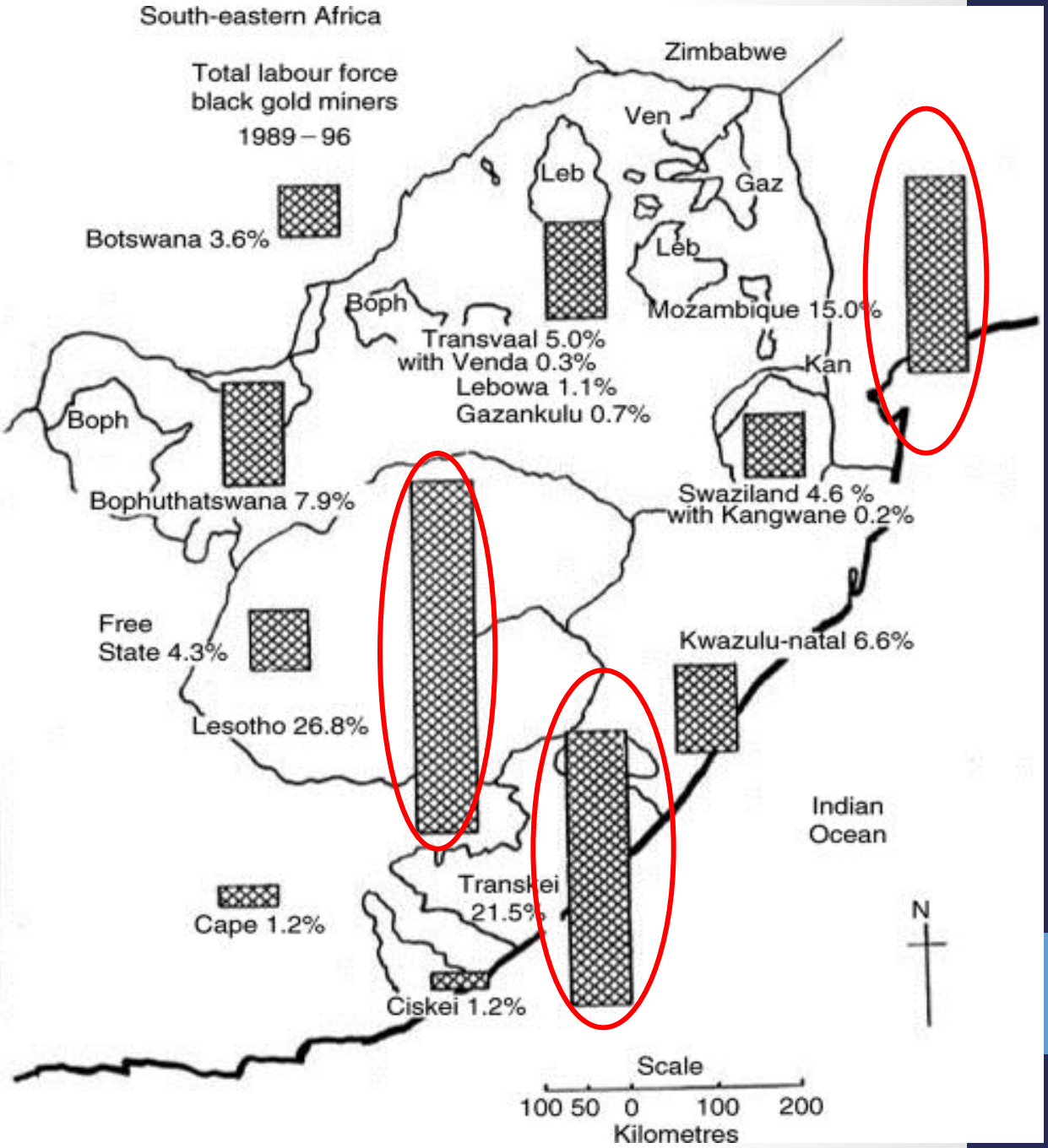
# Employment on the SA gold mines declined sharply between 1988 and 2006




*There are now more ex-gold miners than active miners*

Harington et al. 1984; Rees et al. 2001

Countries/ areas of origin- black gold miners 1989-96




**McGlashan et al. 2003**

# Prevalence of silicosis and previous PTB is high in former gold miners

| Study | Silicosis | PTB history* |
|---|---|---|
| Botswana (ex-) (Steen et al. 1997) | 31% | 29% (Rx) |
| Transkei (ex-) (Trapido et al. 1998) | 24-36% | 51% (Rx) |
| Recently employed, older Basotho (Girdler-Brown et al. 2008) | 24% | 26% (hx) |

* Miners who reported previous treatment or an episode of TB.

# The risk of PTB persists among ex-miners

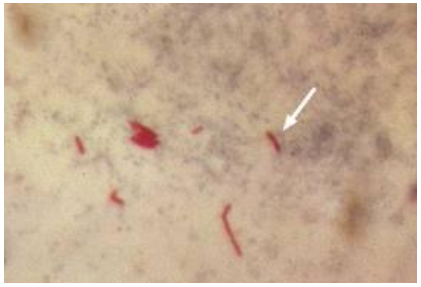
Basotho ex-miners (2-3 years out of service): 3 per 100 p-y[1]

Active TB prevalence: 6% !

(Annual HIV incidence: 5.4% !)

*White* miner cohort: 99/120 (85%) PTB cases were diagnosed *after* leaving mine service. *Average* duration from last exposure was 8 years.[2]

There has never been a *long term* follow up study of black miners after they have left mining service.



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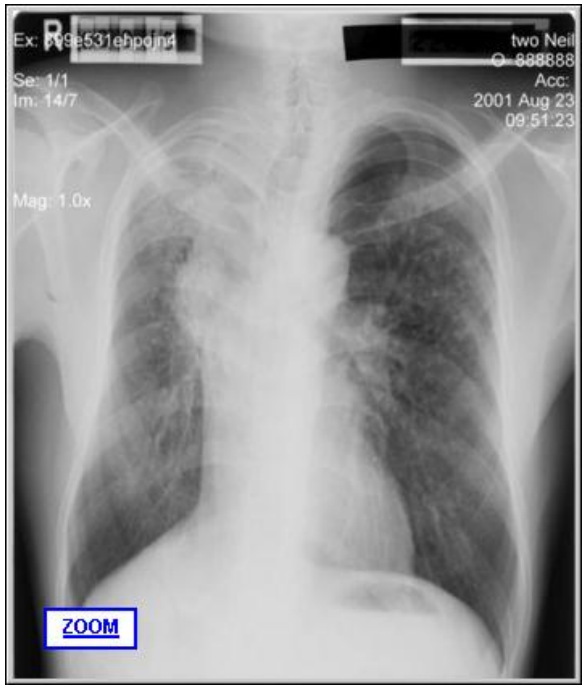
[1]Park et al. 2009; [2]Hnizdo and Murray 1998

# Even if treatment successfully completed, PTB is chronic disease in miners




- ↑ lung fibrosis after treatment
- permanent lung function loss
- ↑ risk of TB recurrence

*A TB diagnosis in a miner is a lifelong diagnosis*

# Mining has an impact on general population risk of TB in Southern Africa, making it a *public health* issue

- 10% increase in mining production → 1% increase in TB incidence (23 000 cases)[1].

- ..”mining not only increases the hazards of TB among directly exposed individual miners but significantly increases the risks of TB spread to the general community in sub-Saharan African countries”.[1]

➡ *Huge health system challenges of treating a very large silica exposed/silicotic migrant population across a number of countries, against a background of rising drug resistance*.

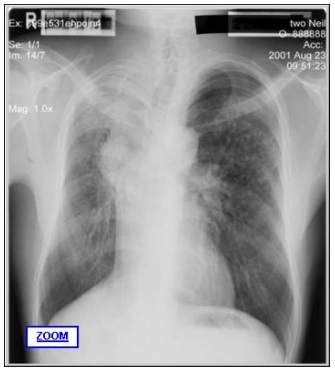
[1]Stuckler, et al. 2011

# In particular, treatment continuity in the migrant mining population is a huge challenge

- Poor continuity of care/medical record if miners interrupt treatment in mine medical services to return home.
- Underdeveloped and overburdened rural and neighbouring country health services.
- Little monitoring of the situation, although there is increasing awareness among SADC ministries of the impact of mining on TB in the affected countries.

# The crisis of tuberculosis and silicosis in the South African mining industry

1. Current epidemiology of pulmonary TB in miners
2. Underlying causes of TB epidemic in miners
3. Externality: ex-miners and the migrant sick
4. **Systemic changes are needed, particularly for ex-miners:**
    1. Governance
    2. Elimination of silicosis/dust control
    3. Specific services for ex-miners
    4. Compensation



# "Governance"[1]- who is taking responsibility?

- Traditional triad of state/industry/unions insufficient – international agencies, NGOs and activists trying to fill the gap
- Cross-border (regional) coordination needed.[2]
- Need to overcome fragmentation of responsibility *within* country.
- Need to make explicit the concept of mineworker "entitlement" – both a legal and political commitment.

[1] Stuckler et al. 2010 ; [2] Aids Alliance for Research in Southern Africa 2008.

# Can dust be controlled so as to eliminate silicosis?

- Mining industry has committed itself to elimination of silicosis (2003 “undertaking”).

- This is unlikely at target dust levels. Although the occupational exposure limit (protective standard) is unknown for TB, current standard would need to be lowered to eliminate silicosis.

- Control of dust and silicosis needs to be seen as essential part of TB control programme at company, national and regional level

# Ex-miners need specific services

1. For diagnosis of lung disease (silicosis, TB) and HIV.
2. For treatment of these diseases.
3. Isoniazid prophylactic therapy for those HIV positive, and ideally for those with silicosis alone.
4. Compensation assistance (statutory entitlement and poverty relief).

These services could be provided by:

- Regional mutually supported network of clinics
- A doctor run node and nurse run satellites
- Under a specialised vertical programme

*Who will or should fund them?*

# Compensation system for miners' lung disease – Occupational Diseases in Mines and Works Act - is in crisis and needs urgent reform[1]

- Underfunded, understaffed
- There is a massive backlog of *current* claims – 18 000
- Poor access by black former miners - to medical examinations and claims process. True number of entitled claimants unknown.
- There are pressures to merge with general workers' compensation system (COIDA), but opposed by industry because of cost. (Also, COIDA itself is dysfunctional).
- 3 lawsuits in progress against mining companies


*Policy stasis*

[1]Ehrlich 2012

# Compensation reform – some suggestions

1. National Dept. of Health should focus on examination of former miners.

2. *Administration* of compensation should be privatised. Compensation Fund (not Dept. of Health as at present) should pay for administration.

3. Need to educate miners, particularly migrant workers, about the system.

4. Link benefit examinations to HIV/TB services and surveillance

5. Financial benefits inadequate – will need to increase.

# “Failed by the system”

**JAINE ROBERTS: Mail and Guardian,** Jul 08 2009

“Thandile Qwalela died in the tuberculosis (TB) ward of his Eastern Cape district hospital at the age of 48.

He was an underground miner from age 20 who served 17 years as a stoper and winch driver on the gold mines. ……

He was unaware he was entitled to medical benefits under the Occupational Diseases in Mines and Works Act. He died of tuberculosis a and went to his grave without the autopsy that legislation requires”

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