# THEY GO TO DIE

## ADDRESSING TB, HIV, AND MIGRANCY IN THE SOUTH AFRICAN MINING SECTOR

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# GOALS OF THIS DISCUSSION

1. That it's a problem
2. Why it's a problem
3. How it contributes to the health of the region
4. Why we should overcome it
5. How we can overcome it

# TB IN THE SOUTH AFRICAN GOLD MINING INDUSTRY: A HISTORY OF DISEASE

**1903:** "The extent to which miner's phthisis [TB] prevails at the present time is so great that preventative measures are an urgent necessity, and that such a large number of sufferers in our midst is a matter of keen regret." – *Milner Commission Report*

**1996:** **"**The failure to control tuberculosis in the mining industry must be a matter for grave concern." – *Leon Commission Report*

**2007:** "The S.A. gold mining industry probably has the highest incidence of TB in the world." – *S.A. Ministry of Health*

**2009:** **"**We are writing to call for urgent action to address the public health and human rights crisis presented by the poor management of tuberculosis in the South African mining sector." – *Letter to DME from 16 leading international TB experts*

**2010:** "If HIV/AIDS and TB were a snake, I can assure you the head would be in here South Africa. And I'm repeating this to the mining sector. Because mineworkers come from the whole sub-region. And they come here to our mines to catch TB and HIV and take it back home." *-S.A. Minister of Health 2010*

# BASIC EPIDEMIOLOGY
## CURRENT MINERS

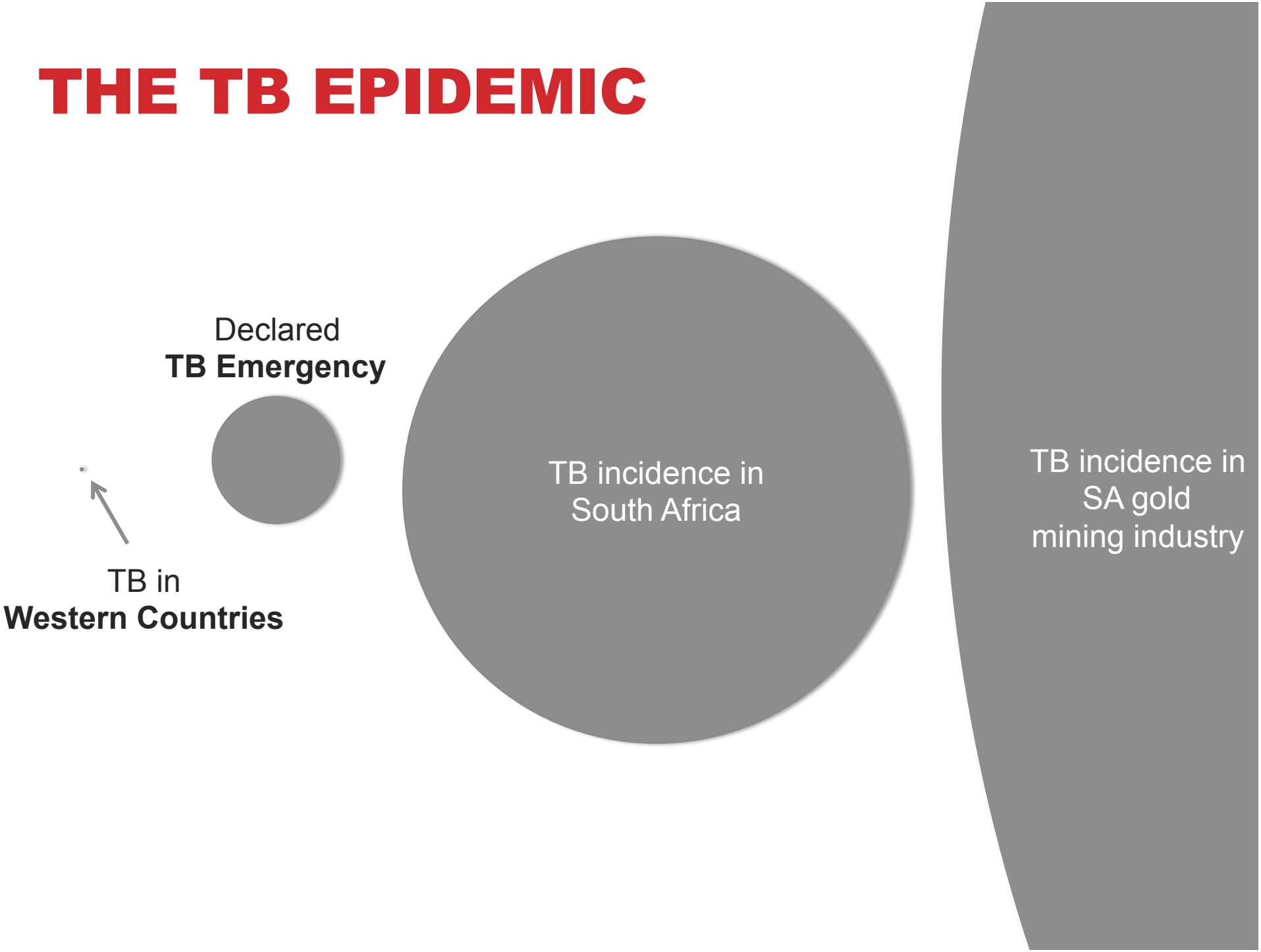
| | |
|---|---|
| Incidence PTB | SA Mines: 3000-7000 per 100000 population<br>**SA gen pop: 971 per 100000 population*<br>*(S.A. Min of Health 2007; WHO 2011)* |
| Prevalence of Latent TB | 89% *(Hafina 2009)* |
| Proportion of MDR-TB | 3.6% among gold miners *(Calver et al 2010)*<br>**1.9% in S.A. general population (SA MoH)* |
| HIV infection | 22-30% *(Corbett 2004; Girdler-Brown 2008)* |
| Recurrence rate, PTB* | HIV+: 19 per 100 person-years<br>HIV-: 7.7 per 100 person-years<br>~4 per 100 PY in SA gen pop<br>*69% of recurrent TB is due to reinfection as opposed to relapse<br>*(Charalambous 2008; SA MoH 2007)* |
| OR, Mortality | 3.6 (miners vs other workers) *(Clark, 2007)* |
| Orphans due to TB/mining | 59,400 *(Osewe, 2012)* |

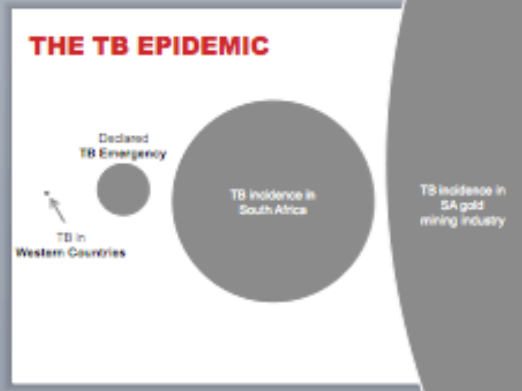
# INFECTION PRESSURE FOR CURRENT MINERS

**The infection pressure at the mine is so great that it leads to incredible phenomena:**

- Tertiary care exceeding the 85 percent WHO target for TB cure rates remains **insufficient** for interrupting TB transmission *(Godfrey-Faussett, 2000)*
- Community-level IPT had **no effect** on TB incidence, TB prevalence or all-cause mortality in the population *(Churchyard/Aurum Institute, 2012)*
- Treatment adherence of 95-98% **did not impede** an increase in drug resistant TB cases *(Calver 2010)*

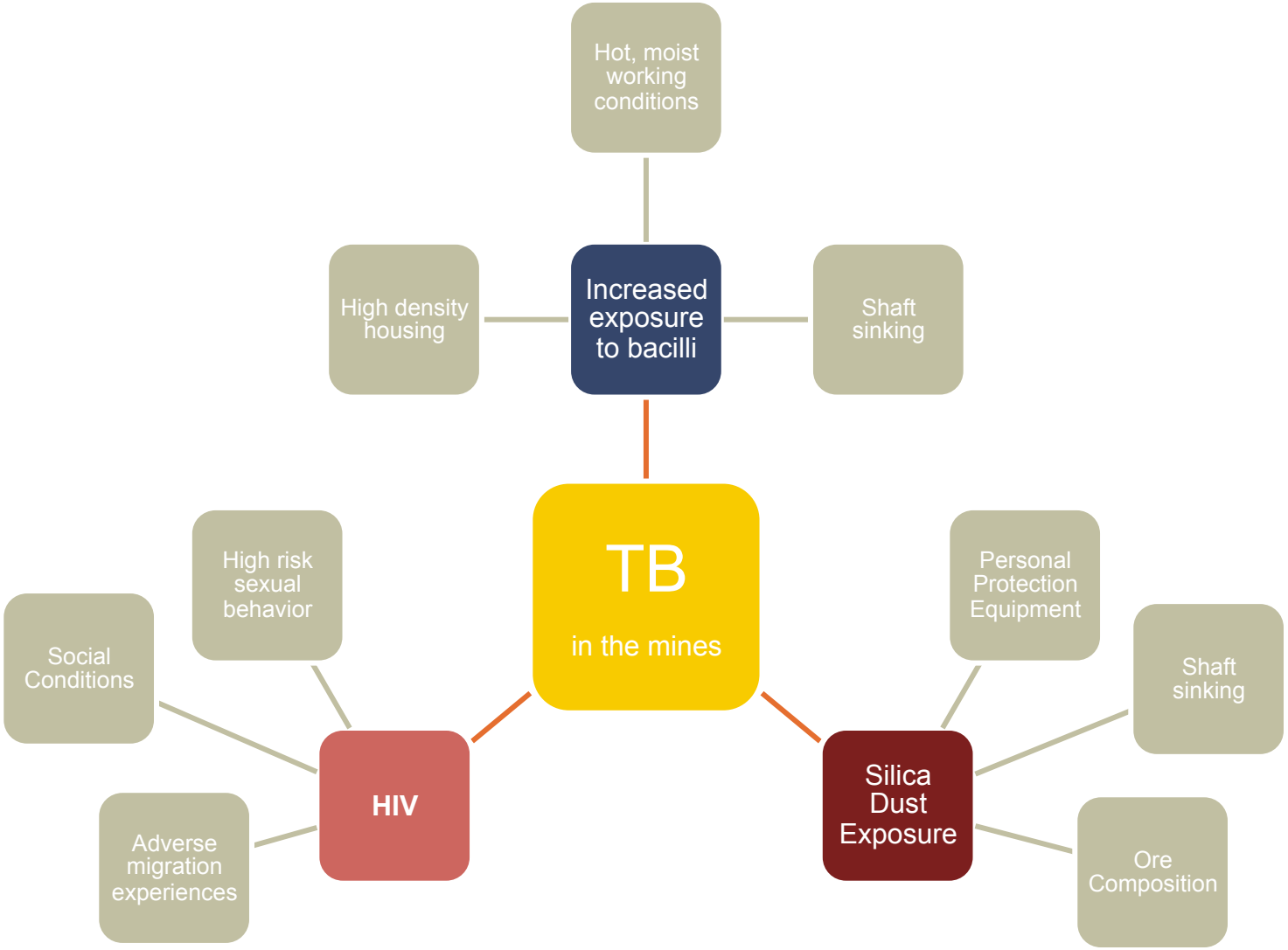
# THE TB EPIDEMIC






TB incidence in
SA gold
mining industry

# WHY ARE MINERS IN SOUTH AFRICA AT HIGHER RISK OF DISEASE AT THE MINE?



# SILICA DUST EXPOSURE AND SILICOSIS

Silica Dust Exposure

**Ore composition and mining circumstances expose miners to high levels of silica dust underground:**

- Silica dust exposure impairs the alveolar macrophage
  - Leads to silicosis, extensive lung damage
  - RR of clinical TB for miners with silicosis vs miners without silicosis: 2.8 *(Girdler-Brown 2008)*
  - Current miners with silicosis: 18-31% *(Girdler-Brown 2008)*
- Host lung unable to eradicate dust particle
  - Increased susceptibility for the duration of one's life; fibrosis worsens with age
  - No treatment for lung damage – debilitating disease

# HIV AND TB AT THE MINE

HIV

**Why are miners in South Africa at higher risk of TB than miners in the UK?**

- 1 in 3 HIV negative miners will become HIV positive within 18 months of working on the mine *(Deloitte 2006)*
- HIV increases the likelihood that the individual will:
  - Progress from latent to active TB
  - Die
  - PTB will be undetected
  - Develop atypical TB manifestations
- HIV infection and silicosis multiplicatively increase TB risk

# SOCIAL CONTEXT FOR TRANSMISSION OF HIV

HIV

- **High-density single sex hostels**
  - No room for intimacy or meaningful relationships
    - "…miners were "adamant" that [relationships at the mine] failed to reconcile the loss of female partners and children at their rural home."
    - "…absent families were never far away in [miner's] accounts of their lives and their health" *(Mager 2003)*
  - High density, squalid conditions
    - 5.1m$^2$ per individual
    - "The appalling living conditions under which black mine workers were made to live… led to a myriad of social ills, including the destruction of the social fabric of communities, substance abuse, as well as the contraction and spread of diseases, particularly HIV/AIDS." (*SA Dept of Minerals and Energy, 2009)*
- **Adverse experiences in migration**
  - Isolation
  - Separation from family and social structure
    - "Black workers must not be burdened with superfluous appendages like women and children" - *G.F. van L. Froneman, 1964*
  - Depression/mental health
    - "This [drinking] is part of my job"
  - Hazardous working conditions
    - "If I may die of a rock fall tomorrow, why should I wear a condom today?"

# EXPOSURE TO TB BACILLI AT THE MINE

Increased exposure to bacilli

**Working Conditions**

- Deepest mine shafts in the world
- Shaft-sinking
  - Air from bottom must travel up the working shaft
- High temperature (~40 C) and high humidity (avg. 92.3%)

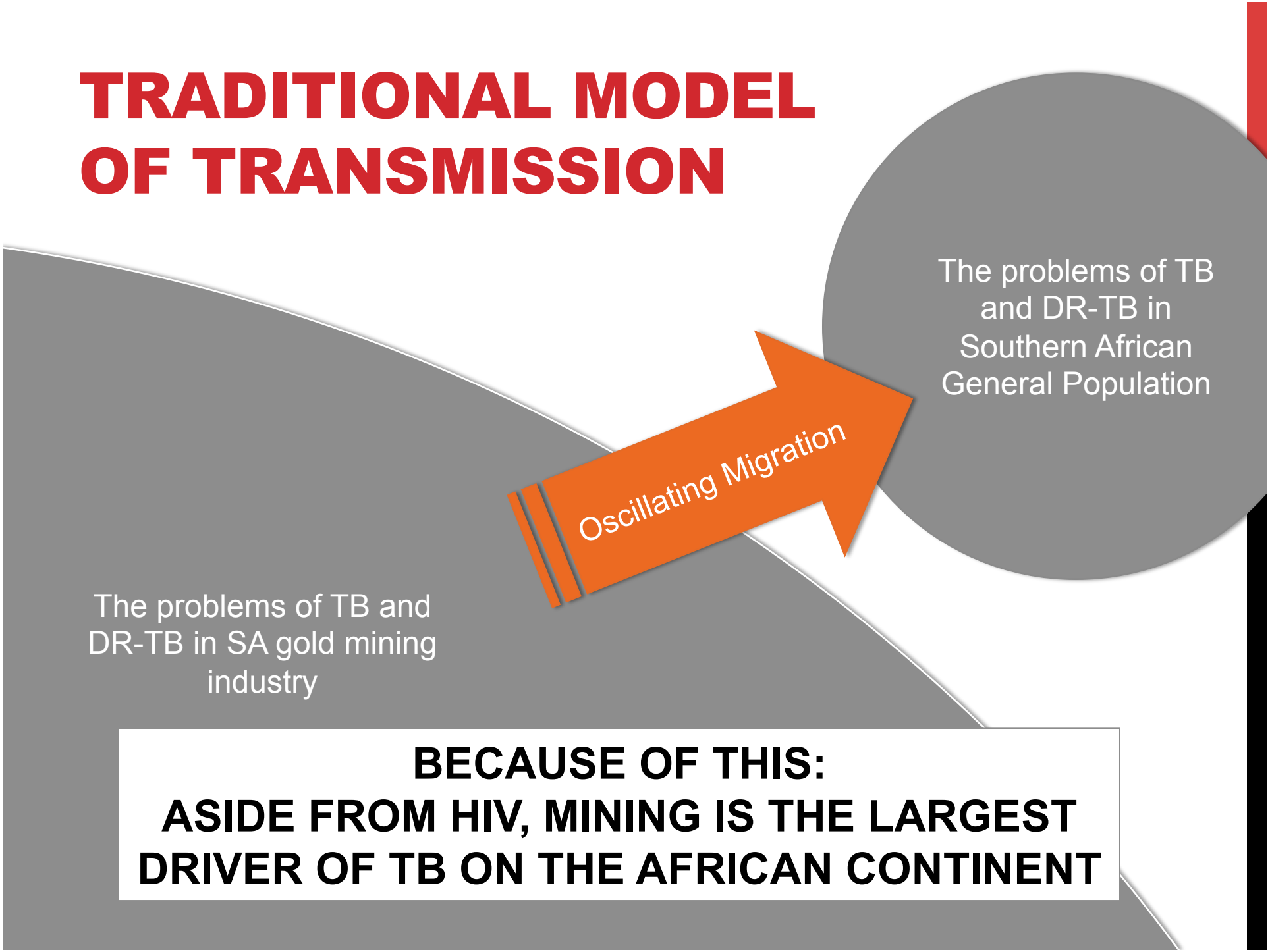
**Living Conditions**

- High-density single sex hostels
  - 4-16 men per room; poor ventilation
  - "[Inspectors were] shocked by the conditions…with conditions so squalid as to shock the most hardened." – *Inspectorate into compliance with the Leon Commission, 1996*
- Informal settlement areas around the mine often breeding ground for disease

# CIRCULAR MIGRANCY: A RIVER OF DISEASE

- **500,000 migrant miners in SA** *(Basu 2009; Chamber of Mines, 2010)*
  - 134,000 migrant gold mine workers
  - Over 100,000 come from beyond SA's borders
- **Oscillating or circular migration pattern**
  - In place for well over a century, since late 1800s
- **60% of migrant miners travel home at least 1-2 times a month** *(ARASA 2008)*
- **Mining results in 760,000 cases of TB in the *general* population of the region each year** *(Stuckler, 2010)*

# TRADITIONAL MODEL OF TRANSMISSION




**BECAUSE OF THIS:**
**ASIDE FROM HIV, MINING IS THE LARGEST DRIVER OF TB ON THE AFRICAN CONTINENT**

THE MINING SECTOR,

D

MIGRANT LABOUR IN

SOUTHERN AFRICA

**The production of consumption: addressing the impact of mineral mining on tuberculosis in southern Africa**

Sanjay Basu*[1,2], David Stuckler[3], Gregg Gonsalves[4] and Mark Lurie[5]

**HIV infection and silicosis: the impact of t factors on the incidence of mycobacteri South African miners**

# Mining and Risk of Tuberculosis in Sub-Saharan Africa

David Stuckler, PhD, MPH, Sanjay Basu, MD, PhD, Martin McKee, MD, DSc, and Mark Lurie, PhD

**Returning home to die: Circular labour migration and mortali**

**South Africa[1]**

**SAMUEL J. CLARK[1,2], MARK A. COLLINSON[2], KATHLEEN KAHN[2], KYLE DRULLING** and **STEPHEN M. TOLLMAN[2]**

# BUT… CAN THE MIGRATION ALSO CONTRIBUTE IN ANOTHER WAY?

***"The search to overcome TB [in the South African mining industry] has always been on ways of interrupting this relentless cycle of new labor, short contracts, recruit more, examine them, and so on.***

***And all of the time, the real problem was not the people who came back to the mine, but the people who didn't. And we have no knowledge of what happens to them."***

***-Dr. Tony Davies, National Institute of Occupational Health, South Africa, 2011***

# THE TEMPORAL EFFECTS OF MINING AND MIGRATION

- **Host lung is unable to eradicate silica dust particle from lung**
  - Progressive; fibrosis worsens with time → risk of TB increases with time
- **Risk of TB increases with age**
- **TB incidence rate among former miners is as high or higher than current miners** *(Park 2009)*
- **Between 20-30% of former miners suffer from clinical silicosis** *(Steen 1997; Trapido 1998)*
  - Former miners have **higher** rate of silicosis than current miners *(Steen, 1997; Trapido, 1998; Churchyard, 2004)*
- **91.9% of former miners living in the community have been exposed to moderate to high levels of silica dust** *(Girdler-Brown, 2008)*

# THE LIFELONG EFFECTS OF MINING AND MIGRATION

- **About 50% of former miners are actively affected by occupational lung disease** *(Girdler-Brown, 2008)*
- **Risk of HIV infection is similar among former miners and in-service miners** *(Park 2009)*
- **Silica dust and HIV create a multiplicative relationship**
  - TB incidence in HIV+ silicotic *miners* is **15x higher risk of TB** than incidence in HIV- non-silicotic *miners (Corbett 2000)*
  - Much higher among contemporaries not in the industry
- **Number of former miners dispersed in the community far outnumber current miners** *(Ehrlich, 2012)*
  - Some estimates 10:1 – ~1,000,000 former miners

# AN OVERLOOKED POPULATION

**Lets take a group of men working in the mine from 1975 to 1995. They may not readily identify as miners, but have an increased predisposition to TB, and are in their home communities.**

- Are they a sleeping driver of the the present-day TB epidemic in the general population?
- How much and in what proportion?
- Do you attribute that increase to mining?
- How do we solve it?
- Whose responsibility is it to solve?
- Where should we place accountability?

# "THOSE WHO DON'T RETURN"

**The past mentioned scenario is a very real issue:**

- **Shrinking workforce over past 30-40 years**
  - 1970s and 80s: approximately 480,000 gold miners in South Africa *(Harrington, 2004)*
  - 1986 to 1992: one out of every three miners became retrenched and sent back home *(Harrington 2004)*
  - 2006: only estimated 160,000 gold miners *(CoM 2006)*
- **Limited studies show cause for concern:**
  - 85% of PTB cases were diagnosed *after* leaving the mine (Hnizdo and Murray 1998)
  - Active PTB prevalence in Basotho men only 2-3 years out of service: 6% (!) (Park 2009)
- **There has never been a long term follow up study on the health outcomes of miners once they leave the mine**

# ADDRESSING THE GENERAL TB EPIDEMIC THROUGH MINING

**Could finding and treating miners in the community not only lower TB incidence and prevalence in the ex-miner population, but also lower population-level TB rates?**

# RECAP: DUAL IMPACT OF MIGRANCY ON THE TB EPIDEMIC

- **Current miners: "River of disease" to rural community**
  - Fairly well-researched, strong epidemiological backing
  - Need research, interventions, and policy addressing current migrant miners

- **Former Miners: Potentially "time bombs" in the rural community**
  - Dearth of research, weak epidemiological backing
  - Much larger population – large potential threat
  - Need research, interventions, and policy addressing former migrant miners

**Addressing both may potentially lower both TB in the mines and population level TB**

# WHY SHOULD WE FOCUS ON TB IN THE MINING INDUSTRY?

***"It is illogical to attempt to strengthen TB management among the general public without focusing and intensifying efforts in the mining sector, given the recognition of this sector as a hotbed for the propagation of the TB epidemic."***

-Letter to DME from 16 leading international TB experts, 2009

# OVERCOMING THE TB EPIDEMIC: REDUCING RISK AT THE MINE

- **Intensified TB case finding and standardization of care**
  - Patients get treated sooner, better faster
  - Less likely to transmit disease
    - Kamat, *et al*, Madras, India (1960): Effectively treated patients are not a source of ongoing transmission
- **Industry wide use of of Gene Xpert MTB/RIF**
  - Extremely rapid testing; improved detection in PLWHIV
  - DS-TB: 86-90% sensitivity; 97% specificity *(Boehme 2010)*
  - DR-TB: 93% sensitivity; 100% specificity *(Boehme 2010)*
- **Implement robust HIV programs industry-wide**
  - Initiate treatment at diagnosis, not CD4+ 350 threshold
  - Some mines offer excellent HIV services; issue of scale up

# OVERCOMING THE TB EPIDEMIC: REDUCING RISK AT THE MINE

- **Improving and establishing family style housing**
  - "In an unprecedented move for the industry, all common residences for miners were abolished and miners were encouraged into joining a housing scheme. In the long run, the ability for the miners to live with their families led to the group experiencing one of the lowest HIV/AIDS growth rates in the industry." *(Deloitte 2006)*
- **Reduce silica dust exposure**
  - Mines meeting industry target of 0.1 mg/m$^3$ still have 35% past or present TB prevalence (despite sicker workers being removed from the workforce) *(teWaternaude 2006)*
  - Other studies show that dust levels reduced to half OEL standards (0.05 mg/m$^3$) are not protective to the development of silicosis *(Sherson 2002; Churchyard 2004)*

# OVERCOMING THE TB EPIDEMIC: INCREASING CARE AT THE MINE

- **Strive to complete care at the mines**
  - Ensure job security if sick
    - Many men do not self-report for fear of losing job
  - Access to social and family support while on treatment at the mine
- **Expand medical treatment to the greater mining community**
  - Mines are made up of more than the mine itself
  - Responsibility to decrease burden of TB in the community as a whole
- **Continuity of care for migrants**
  - Biometric record lookup (ex. Anglo American's HealthSource)
  - Cross-border management and cohesion
  - Unified leadership

# OVERCOMING THE TB EPIDEMIC: FORMER MINERS

**<u>An old saying in epidemiology:</u>**
**"What we can't count, counts for nothing."**

- **Epidemiological research needed**
  - Geospatial and temporal maps for predicting high-risk zones?
  - Census-level data of proportion of miners in community?
- **Work with what we *do* know - find and treat former miners at high risk of disease in the region**
  - WHO' Stop TB Partnership's TB REACH program
  - Intensify active case finding in the communities
  - Decentralization and strengthening of NTBP
- **Work with what we *do* know - reduce risk in former miners**
  - Ensure access to ARVs for HIV positive former miners
  - IPT for former miners in the community?

# ADDRESSING TB IN THE S.A. MINES FROM THE UK?

**Three explicit ways how individuals in the UK can play a role in overcoming the TB epidemic in the South African mines and elsewhere:**

1. **Use the convening power of civil society organization to maintain accountability among UK and SA owned mines to ensure prevention, treatment, and care for miners and their families**
2. **Urge MPs and other decision makers to have DFID sustain and expand financial support specific to TB REACH**
3. **Ensure the UK government fully funds the Global Fund this upcoming replenishment round**

# THANK YOU!

**Medsin**

**Glasgow University**

**Yale University School of Public Health**

**Yale Global Health Leadership Institute**

**RESULTS UK**