The Challenges of TB Infection Control in Southern Africa

Prashini Moodley

University of KwaZulu-Natal &
KZN Department of Health
South Africa

Infectious Disease Cycle of Transmission

- a reservoir for the organism
- a susceptible host
- transmission from one to the other

- each of these is a target where we can prevent infections from occurring

- transmission of TB
  - droplet
  - airborne

TB control

- **decreasing infectiousness of patients/ reservoir**
- **prevention of transmission**
  - **infection prevention in health care facilities**
  - **infection prevention in public transport and buildings**
  - **infection prevention at home**
- **prophylaxis for the non-infected/ susceptible host**
  - **vaccination**
  - **prophylactic medication**

TB control

- **decreasing infectiousness of patients**
- **prevention of transmission**
  - **infection prevention in health care facilities**
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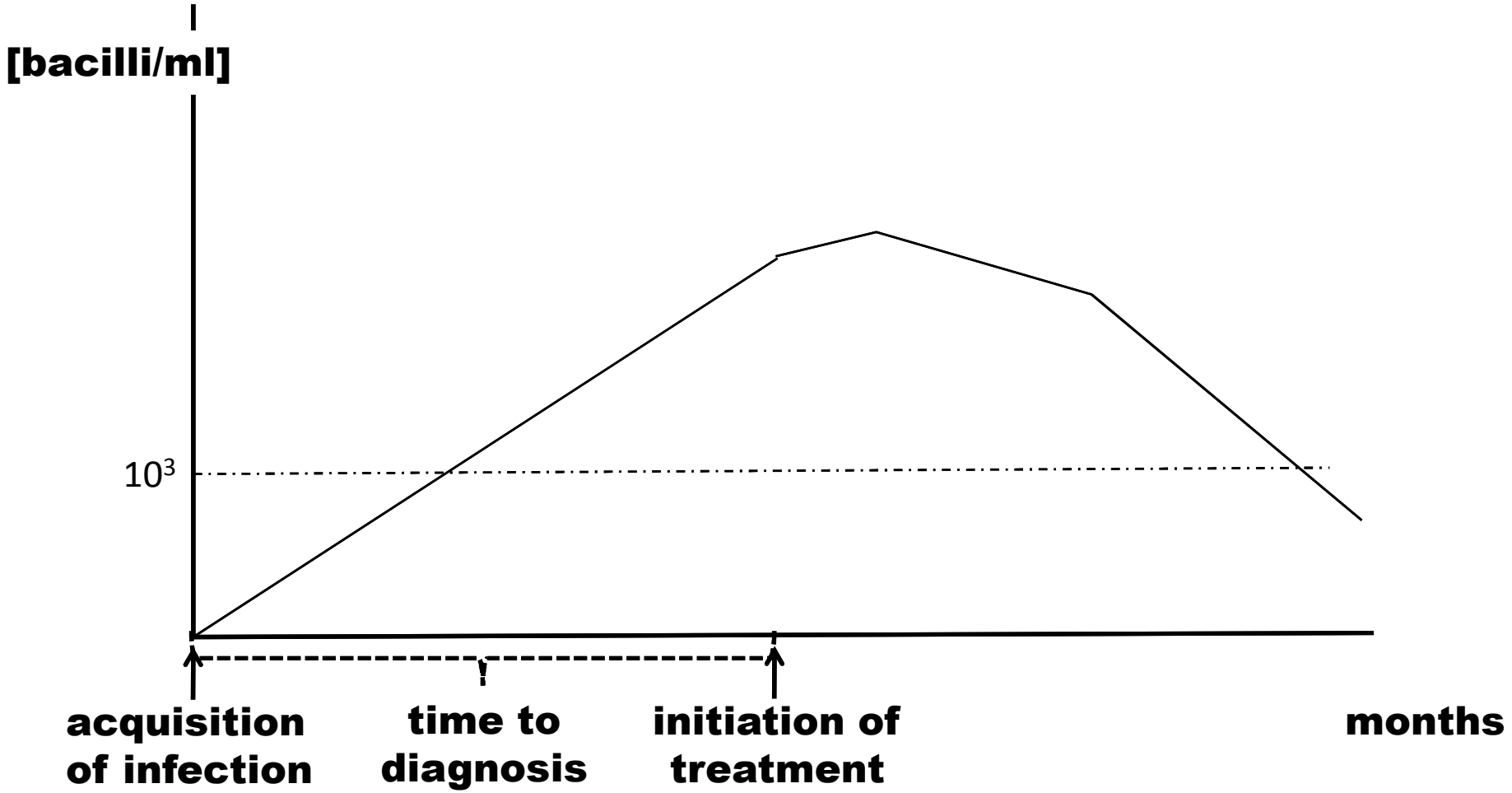
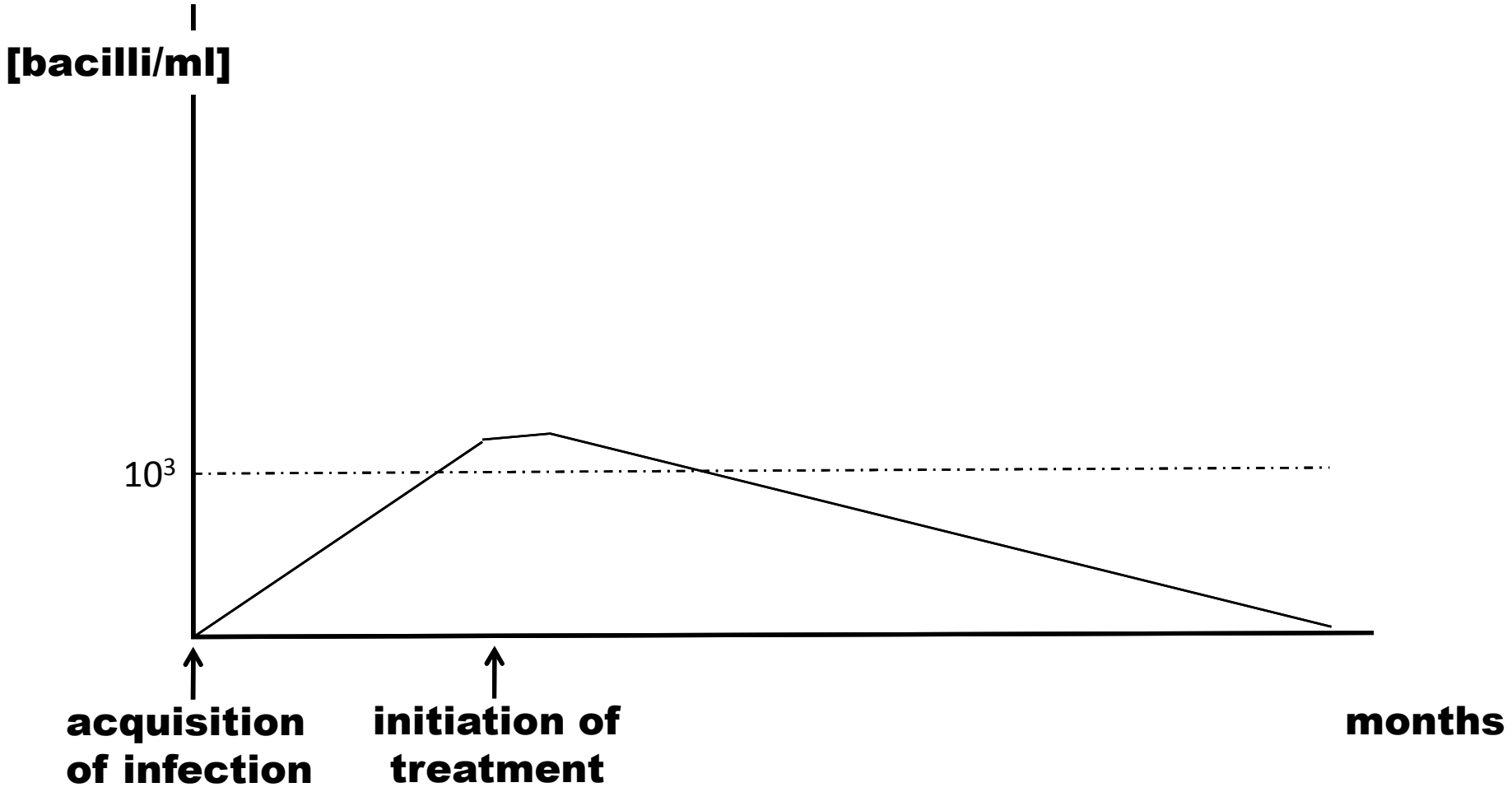
- **prophylaxis for the non-infected part of the population**
  - **vaccination**
  - **prophylactic medication**

Infectiousness in relation to bacterial load



Infectiousness in relation to bacterial load



- **fast tracking of diagnosis**
  - **turn a patient non-infectious through treatment**
    - **decrease the number of exposed people**
    - **decreasing the likelihood of transmission/exposure**

XDR in KZN = TDR

isoniazid	**R**
rifampicin	**R**
pyrazinamide	**R**
ethambutol	**R**
streptomycin	**R**
ethionamide	**R**
ofloxacin	**R**
moxifloxacin	**R**
kanamycin	**R**
amikacin	**R**
capreomycin	**R**
PAS	**S**
linezolid	**S**
meropenem/clavulanic acid	**S**

TB control

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  - **infection prevention in health care facilities**
  - infection prevention in public transport and buildings
  - infection prevention at home
- prophylaxis for the non-infected
  - vaccination
  - prophylactic medication

Prevention of transmission in health care facilities

- **patient management and staff practice**
  - **triage and separation**
  - **cough education**
  - **fast tracking care and diagnosis**
- **infrastructure**
  - **ventilation systems**
  - **negative pressure**
  - **size of OPD/wards vs patient volumes**
- **personal protective equipment**
  - **N95 respirators**

Infection prevention for tuberculosis

- **patient management and staff practice**
  - **triage and separation**
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Goals

- **separation to protect non-coughing patients**
- **cough education to protect patients in the coughing group**
  - **mix of TB infected patients (S, MDR, XDR, TDR)**
  - **HIV infected and uninfected**

Risk assessment in specialised TB facilities in KZN

Challenges with triage

- **at which point in the patient flow?**
- **what to do with (many) coughing patients?**

immediate attendence

separate waiting area

where? ← **over-crowding in OPD**

Infection prevention for tuberculosis

- patient management and staff practice
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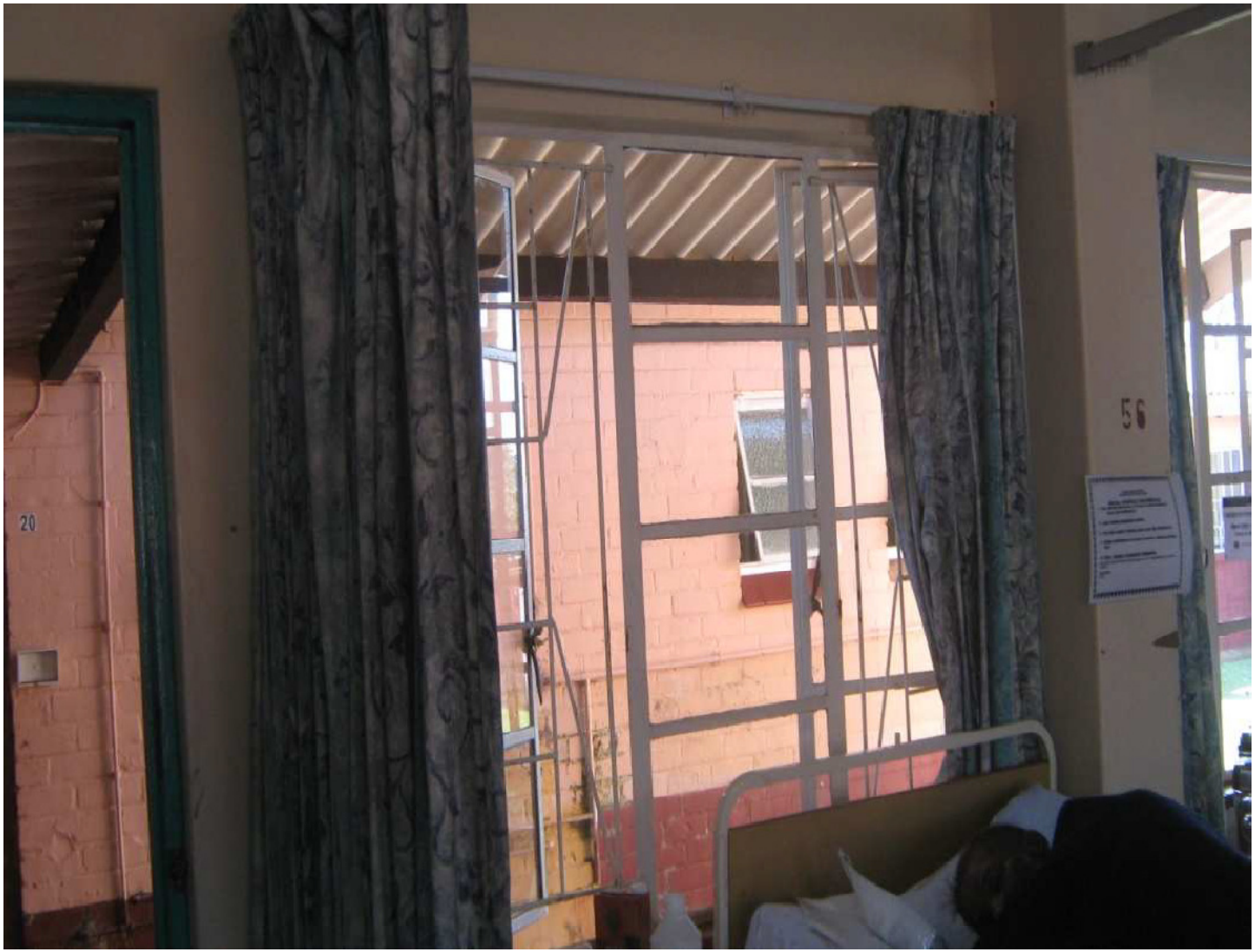
Challenges with environmental control

- **building structure**
  - **ventilation systems**
  - **ceiling height**
  - **isolation wards**
- **overcrowding**
  - **ward**
  - **OPD**
- **cough areas/booths**


20
56


STOP
FLU

Waiting Areas

- **rooms with rapid air changes (6-12/hr) (??dependent on number of people in waiting areas)**
- **and negative pressure**

or

- **structures with roofs only**

What about wards and other areas ?

airflow control in all areas with (potential) TB patients

Ventilation systems

- **air changes**
  - → **at least 6 changes per hour**
- **air flow**
  - **controlled**
  - **HEPA filtered**
    - **(Highly Effective Particulate Air filter)**
  - **UV irradiated**

Ventilation systems

- **air changes**
- **air flow**
  - **controlled**
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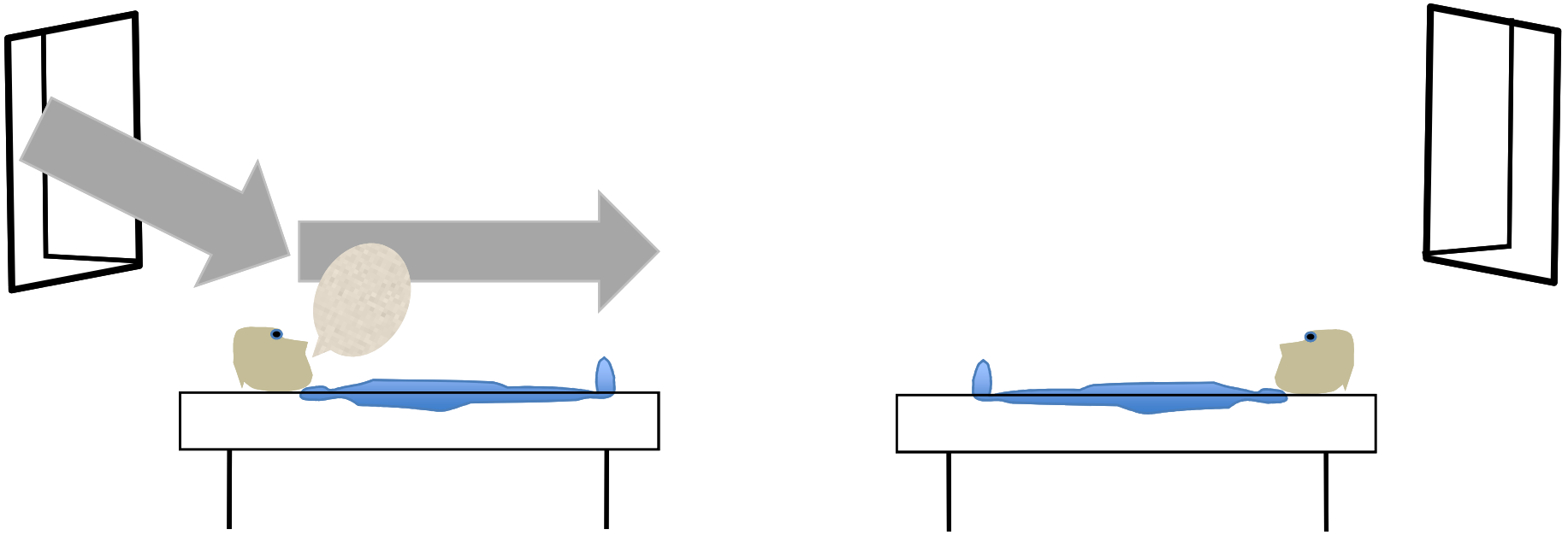
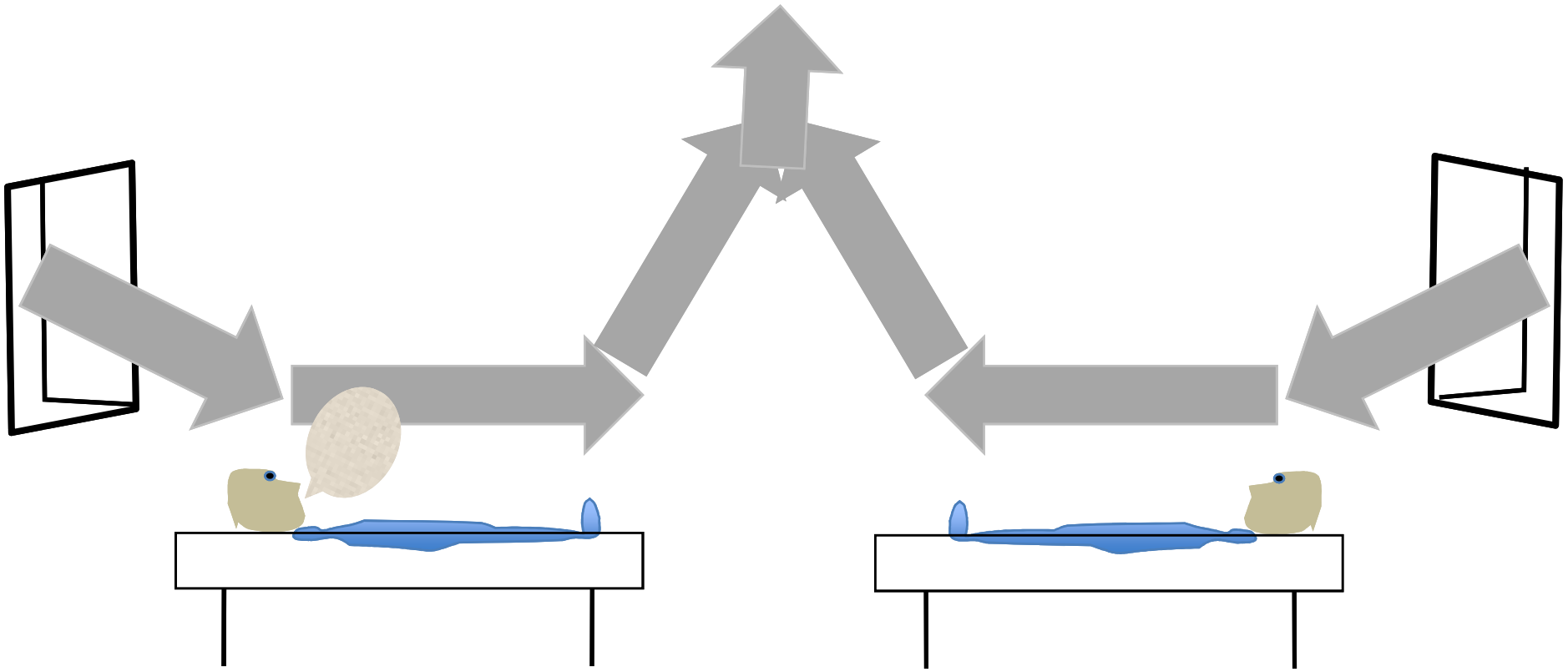
In most provincial hospitals .....



Solution



Ventilation systems

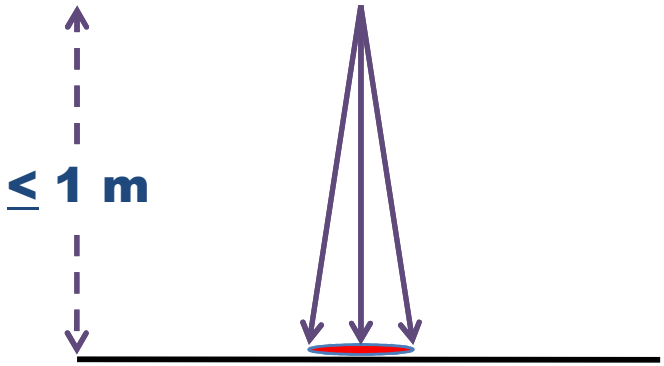
- **Air changes**
  - → **at least 6 chan per hour**
- **Air flow**
  - controlled
  - **HEPA filtered emoval → recirculation**
  - **UV irradi → kill of bacteria**
    - → **assists sub-optimal circulation**

air conditioning ≠ ventilation

UV irradiation

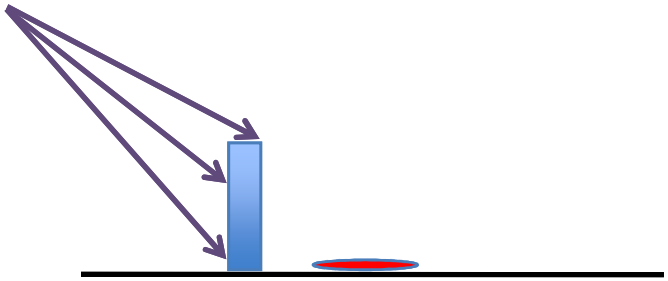
Works only with special devices !

kill

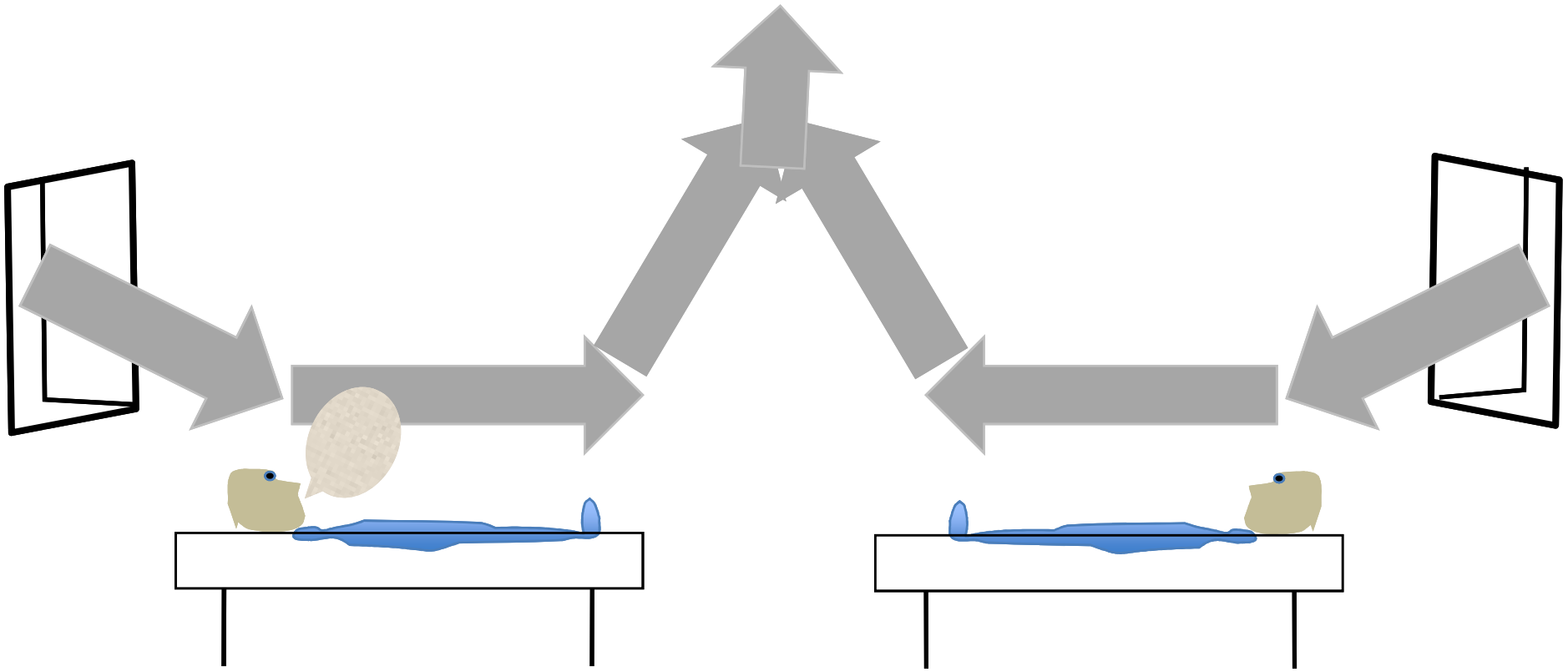


> 1 min

no kill



Negative pressure



regulation of inflow and outflow

→ **outflow > inflow**

most infectious patient in room with lowest pressure

An outbreak of multi-drug-resistant tuberculosis in a London teaching hospital

- **J Hosp Infect 1998; 39(2):111-7**
- **Breathnach AS *et al***

MDR TB outbreak in Hospital Ward

- **HIV –ve patient with drug susceptible TB**
  - **developed MDR-TB ? poor adherence to therapy**
  - **admitted to an isolation room in a ward with HIV-positive patients**
- **isolation room**
  - **at positive-pressure relative to the main ward**
- **MDR TB outbreak**
  - **7 HIV-positive contacts developed MDR-TB**
  - **MTB isolates were indistinguishable by molecular typing**

Prevention of transmission in health care facilities

- patient management and staff practice
  - triage and separation
  - cough education
  - fast tracking care and diagnosis
- infrastructure
  - ventilation systems
  - negative pressure
  - size of OPD/wards vs patient volumes
- **personal protective equipment**
  - **N95 respirators**

Reasons for failing of the filter

- **Filter saturation**
- **Face-seal leaks**
- **Damage**
- **Manufacturing defects**

Prevented by restricted period of use

Detected by fit testing

Depends on the contamination level of the air you breath

Challenges with personal protection

- **adherence**
  - **unpleasant for user**
  - **unfriendly for patients**
- **confusing information**
  - **when to discard ?**
- **fit-testing**
  - **consistency in donning the mask**
  - **procurement system**

TB control = prevention of transmission

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- prophylaxis for the non-infected part of the population
  - vaccination
  - prophylactic medication

Infection prevention outside health care facilities

- community education
  - household education/counseling
  - targeted group education

  - How ???

Can social interventions prevent tuberculosis?: the Papworth experiment (1918-1943) revisited.

- **Am J Respir Crit Care Med 2012 Sep 1;186(5):442-9. doi: 10.1164/rccm.201201-0023OC. Epub 2012 Jul 5**

- **Bhargava A et al.**

- **rationale**
  - **consensus on the need to address social determinants of tuberculosis for TB control**
  - **evidence based on interventions is lacking**

- **objectives**
  - **reanalyzed data from the sociomedical experiment performed at the Papworth Village Settlement in England**
  - **impact of stable employment and adequate housing and nutrition on the incidence of TB infection and disease in children living with parents with active TB was documented during 1918-1943**

- **social interventions including adequate nutrition**
  - **did not reduce TB transmission**
  - **did reduce the incidence of TB disease in children living with parents with active TB**
  - **the susceptible host**

- **results relevant today**
  - **prevention of TB in children of patients with active TB in our high-burden setting**

Tuberculosis transmission to young children in a South African community: modelling household and community infection risks

- **Clin Infect Dis.2010 Aug 15;51(4):401-8**

- **Wood R et al**

Conclusions

- **annual risk in preschool children**
  - **greatest if infectious residents in the home**
  - **substantial proportion of transmissions may occur from non resident adults**

- **benefits of increased ventilation**
  - **maximized when the period of infectivity is reduced**
  - **(prompt treatment reservoir/infected case)**

Indoor Social Networks in a South African Township: Potential Contribution of Location to Tuberculosis Transmission

- **PLoS One 2012; 7(6): e39246**

- **Wood R *et al***

Conclusions

- **increasing numbers of social contacts occurred throughout**
  - **childhood, adolescence, and young adulthood**
  - **predominantly in school and public transport**
- **rapid increase in non-home socialization**
  - **parallels the increasing TB infection rates during childhood and young adulthood**
- **further studies of the environmental conditions**
  - **schools and public transport indicated**

TB control = prevention of transmission

- decreasing infectiousness of patients
- prevention of transmission
  - infection prevention in health care facilities
  - infection prevention in public transport and buildings
  - infection prevention at home
- **prophylaxis for the non-infected part of the population**
  - **vaccination (new vaccines – many years before 1st one could be available)**
  - **antimicrobial prophylaxis**

Back to basics

- A reservoir for the organism
- A susceptible host
- Transmission from one to the other

- each of these is a target where we can prevent infections from occurring

Back to basics

- **The current epidemic in KZN is the result of:**
  - **a high density of TB transmitters in the population (massive reservoir)**
  - **a high density of highly TB susceptible host individuals in the population (the HIV infected)**
  - **ongoing transmission**

Back to basics

- we need to address each of these
  - active, early case finding (reservoir)
    - before patients become infectious
    - before a productive cough develops
  - decreasing host susceptibility
    - early ARV treatment
    - socio economic factors – nutrition
    - ? prophylaxis
    - vaccines
  - transmission
    - effective barrier between infected and non-infected
    - difficult to achieve