Infection Prevention and Control for Tuberculosis

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Loss of fitness, 1953

- **Middlebrook, G., and M. L. Cohn**
- **"Some observations on the pathogenicity of isoniazid-resistant variants of tubercle bacilli"**

  (Science, 1953, 118:297-299)

Regaining fitness

- Compensatory mutations
- ? Other mechanisms

→ highly successful resistant strains

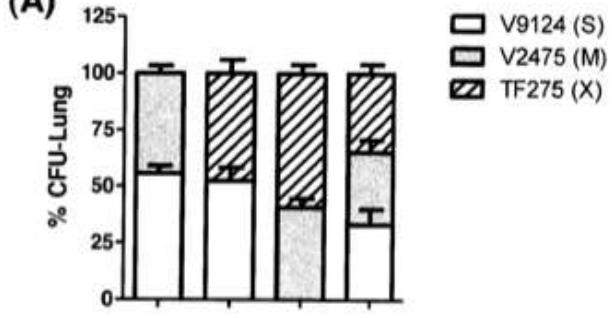
↓

- Beijing
- F28
- F16/LAM4/KZN

} ? over-compensation

Competition in mice: fitness test

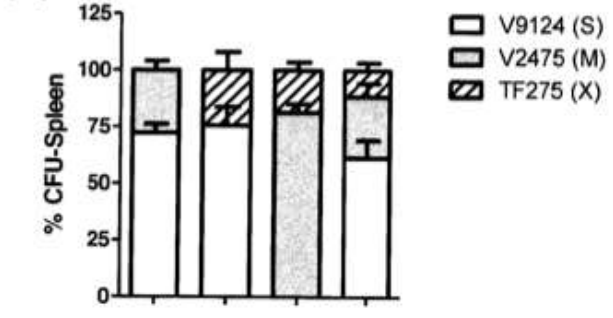
(A)



(B)

Wilcoxon Signed Rank Test for the two strains competition		
Group Comparison	**Organs**	**P-value**
Sens versus MDR	Lung	0.0996
Sens versus MDR	Spleen	0.0059
MDR versus XDR	Lung	0.0645
MDR versus XDR	Spleen	0.0020
Sens versus XDR	Lung	0.6758
Sens versus XDR	Spleen	0.0371

(C)

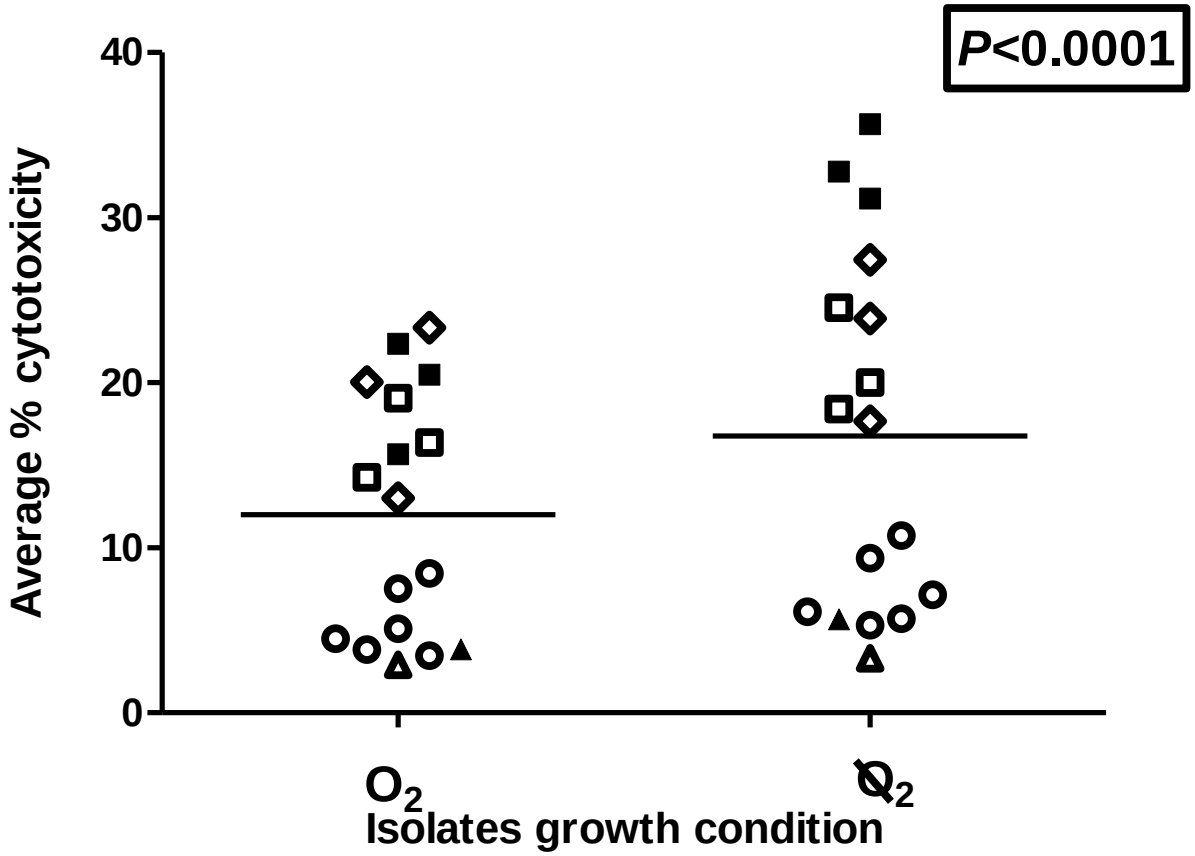


(D)

Wilcoxon Signed Rank Test for three strains competition		
Group Comparison	**Organs**	**P-value**
Sens versus MDR	Lung	0.9097
Sens versus MDR	Spleen	0.0269
MDR versusX DR	Lung	0.4697
MDR versus XDR	Spleen	0.0122
Sens versus XDR	Lung	1.0000
Sens versus XDR	Spleen	0.0068

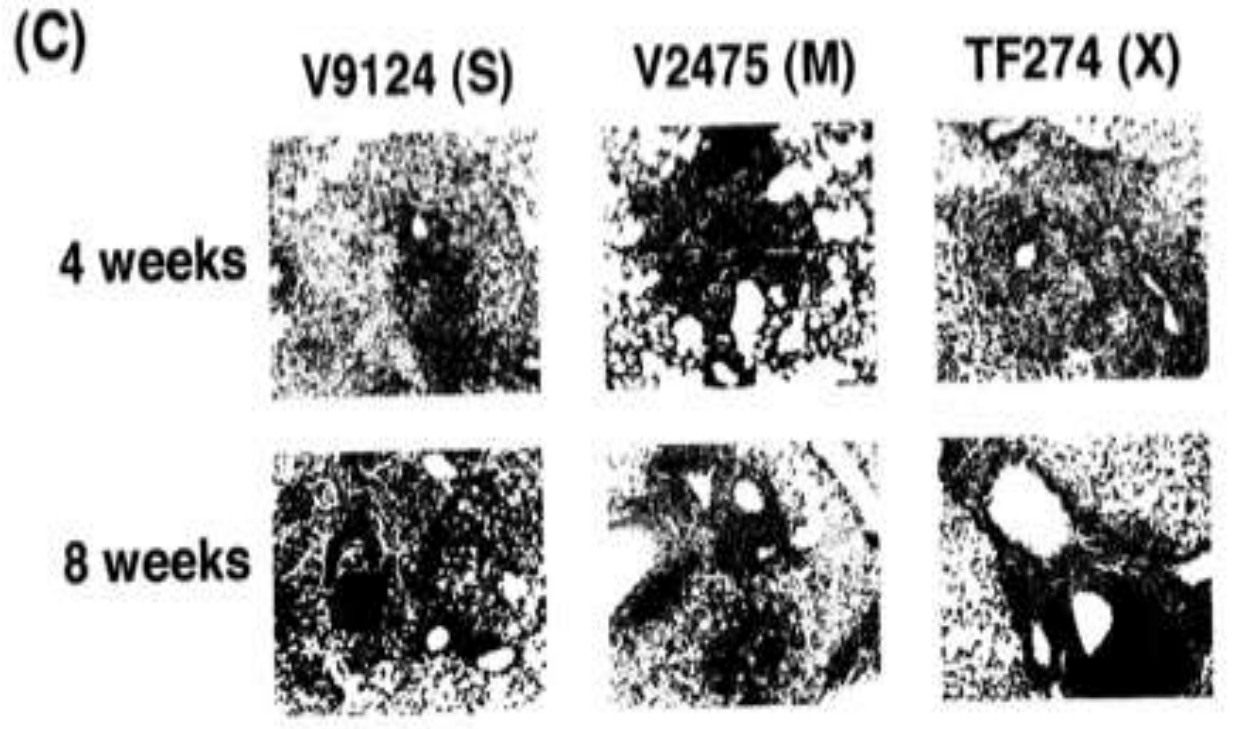
(collaborative project with Duke University, Sunhee Lee et all)

Cytotoxicity of F15/LAM4/KZN isolates on alveolar epithelium



(Sturm laboratories, KZN)

Bacterial burden of F15/LAM4/KZN in lung and spleen and lung pathology



(collaborative project with Duke University, Sunhee Lee et all)

Virulent (fit), resistant *M. tuberculosis* strains are a reality !

How do we deal with that ?

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**
  - **vaccination**
  - **prophylactic medication**

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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

Different epidemics per geographical region

- **Western Cape province**
  - **MDR transmitted**
  - **XDR not transmitted**

- **KwaZulu-Natal**
  - **MDR transmitted (Beijing, F28 and F15/LAM4/KZN)**
  - **XDR transmitted: F15/LAM4/KZN only**

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Prevention of transmission in health care facilities

- **Administrative control**
  - **triage**
- **Environmental control**
  - **ventilation**
  - **airflow control**
- **Personal protection**
  - **masks/respirators**

Where is the problem ?

Risk assessment in specialised TB facilities in KZN

IPC unit

KZN Department of Health

Challenges with triage

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

immediate attendence

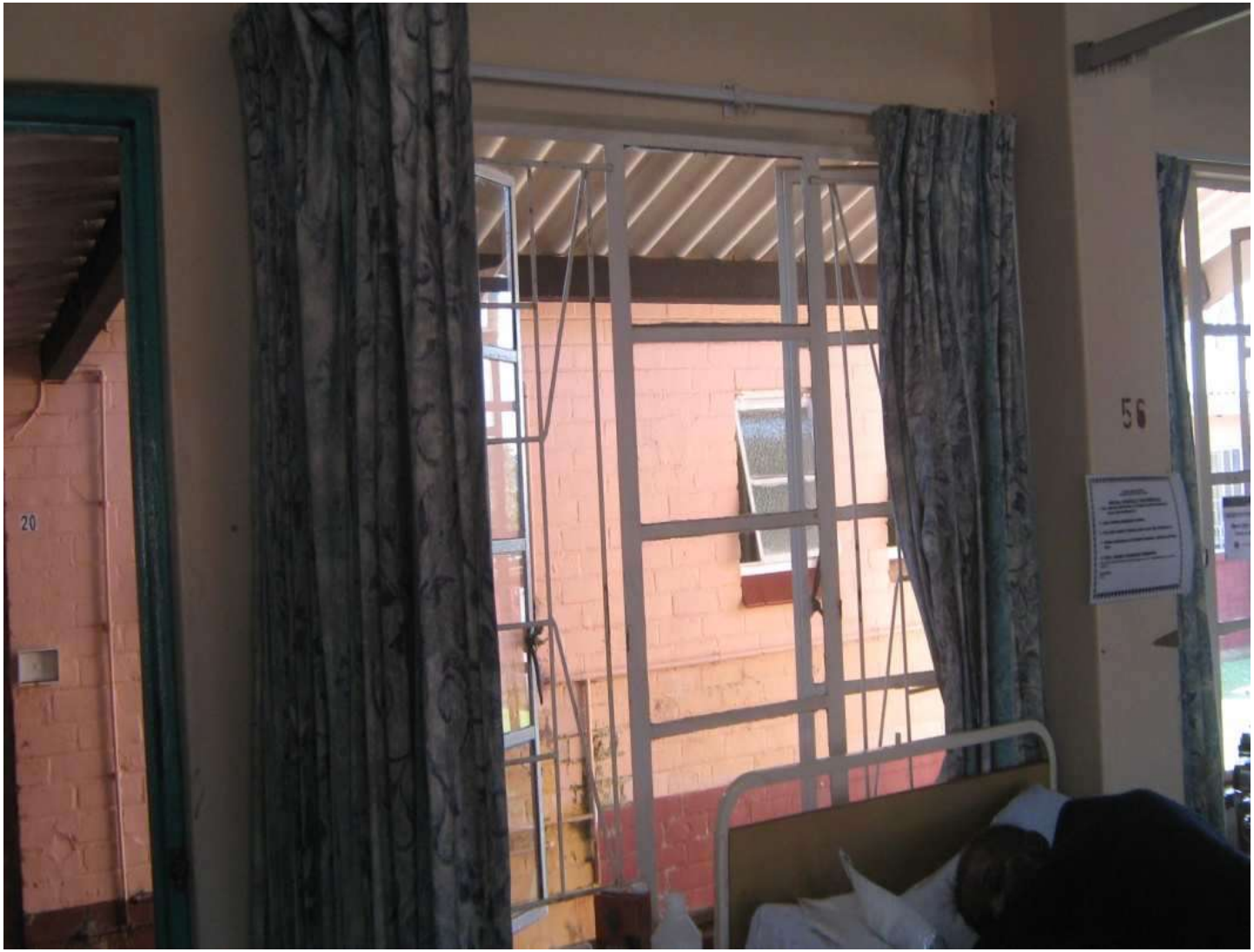
separate waiting area

where?

over-crowding in OPD

Challenges with environmental control

- **Building structure**
  - **ventilation systems**
  - **ceiling height**
  - **isolation wards**
- **Overcrowding**
  - **ward**
  - **OPD**
- **Cough areas/booths**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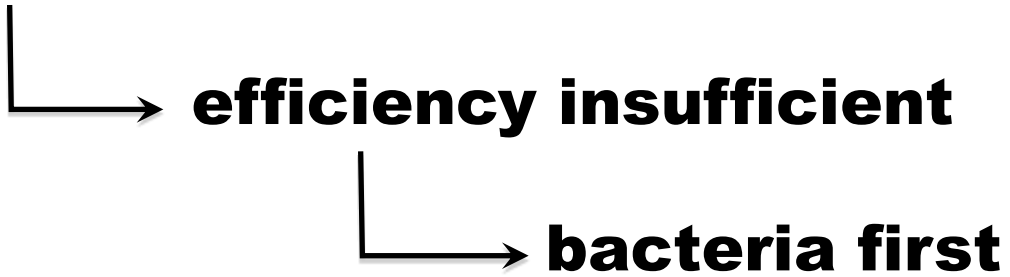
Challenges with personal protection

- **Adherence**
  - **unpleasant for user**
  - **unfriendly for patients**
- **Confusing information**
  - **when to discard ?**

Filter efficiency

- **Particle capture efficiency of electret (charged) filters decreases with filter load**
- **Maximum filter load for N series masks ≥ 200 mg**



Challenges with personal protection

- **Adherence**
  - **unpleasant for user**
  - **unfriendly for patients**
- **Confusing information**
  - **when to discard ?**
- **Fit-testing**
  - **consistancy in donning the mask**
  - **procurement system**

Risk assessment in specialised TB facilities in KZN

- **All 8 facilities had major challenges in all areas**

- **Need for structural changes in OPDs/clinics and wards**
  - **no short term solutions**
  - **maximise ventilation systems**
- **Need for optimisation of personal protection**

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Infection prevention outside health care facilities

- **Community education**
  - **household education/counseling**
  - **targeted group education**

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INH resistance in culture confirmed cases in KZN

1 Jan 2006 – 30 June 2007

n=25537

	No. of patients	%
All	6543	25.6
Single INH resistant	807	3.2
MDR	5377	21
pre-XDR	9	
XDR	610	2.4
others	1785	7

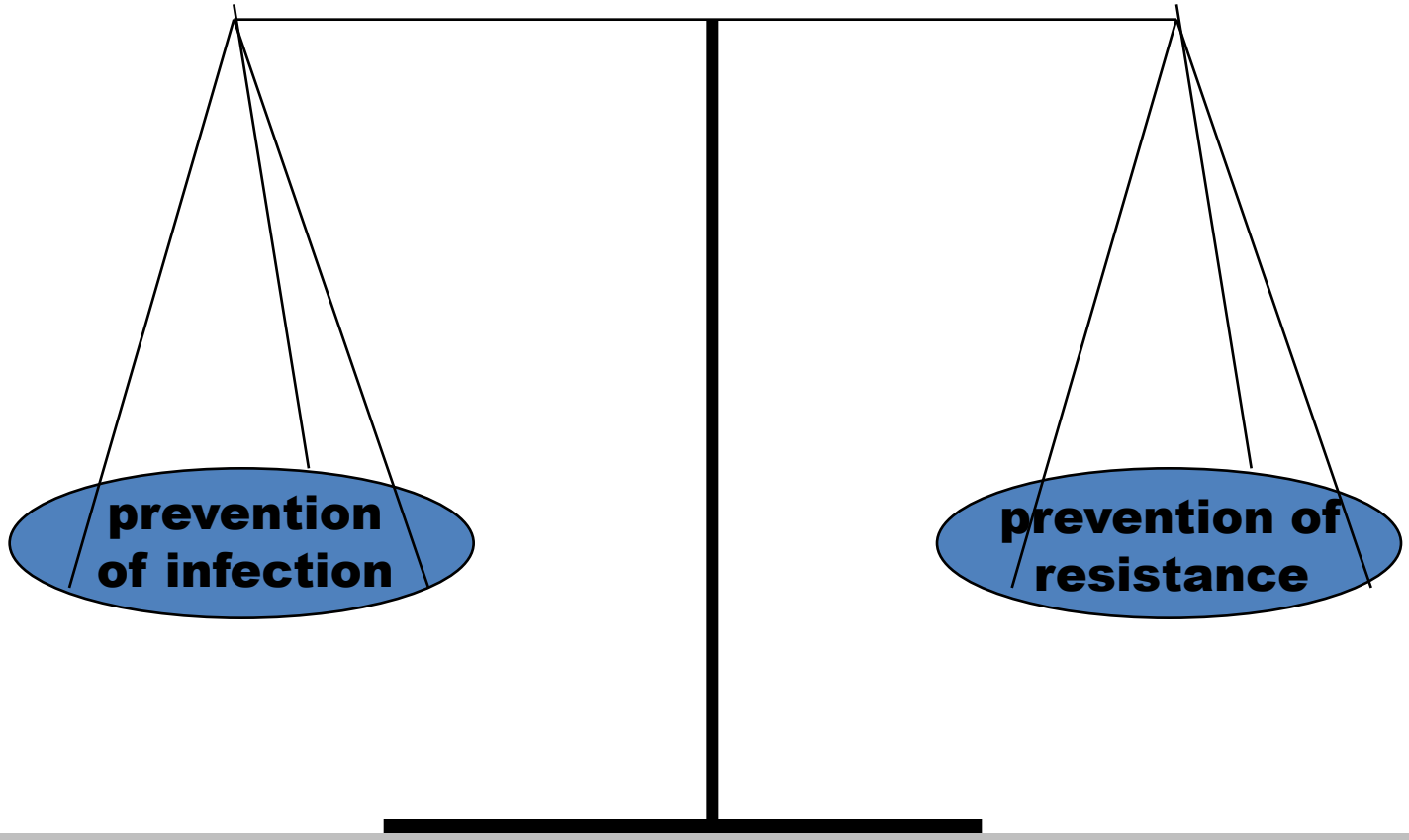
Botswana IPT trial

- **INH resistance in those receiving 36 mths IPT: 14%**
- **Background INH resistance: 9 %**
- **Increase: 5 % (55% in 3 years)**

Extrapolation of Botswana results to KZN

	Background resistance	Resistance after 3 years IPT
Botswana	**9 %**	**14 %**
KZN	**26 %**	**40.3%**

Public health responsibility



Should we introduce IPT everywhere or allow for differential approach ?

Back to basics

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

Back to basics

- **We need to decrease both these groups of individuals !**
- **How?**
  - **Active, early case finding**
    - **before patients become infectious**
    - **before a productive cough develops**
  - **Early ARV treatment**
    - **before the CD4 count starts dropping**
    - **immediately on diagnosis (active case finding)**

Acknowledgements

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Thank you