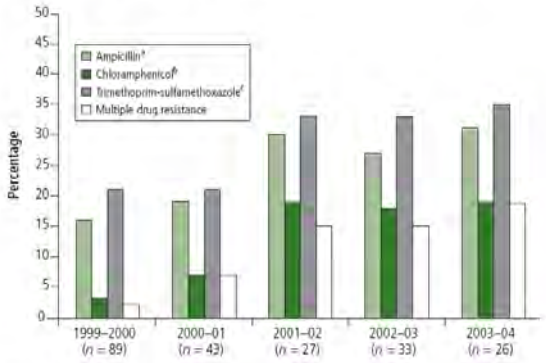
Global Antibiotic Resistance Partnership

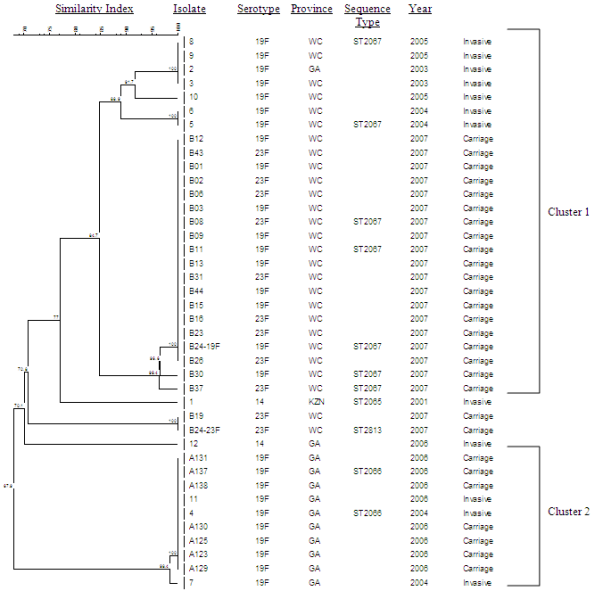
COUNTING GERMS IN SA

CDDEP THE CENTER FOR Disease Dynamics, Economics & Policy
WASHINGTON DC • NEW DELHI

Fig. 1. **Proportion of non-susceptible isolates causing *Haemophilus influenzae* serotype b disease in children below five years, by category for each of the 12-month periods, South Africa**



[a] χ^2 - test for trend, $P = 0.04$.
[b] $P = 0.001$.
[c] $P = 0.06$.



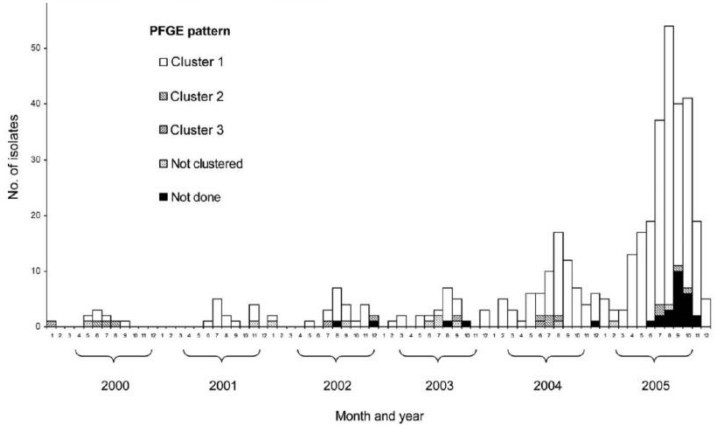


Figure 2. *Neisseria meningitidis* serogroup W135 isolates ($n = 406$) causing invasive meningococcal disease in South Africa, by PFGE pattern and year, 2000–2005.

gram indicating the clonality of the fluoroquinolone-resistant pneumococci
olates. "A" in the isolate number indicates carriage isolates from hospital A,
olates from hospital B. GA, Gauteng; WC, Western Cape; KZN, KwaZulu-

Dr Anne von Gottberg
GARP Meeting, 8-9 February 2010

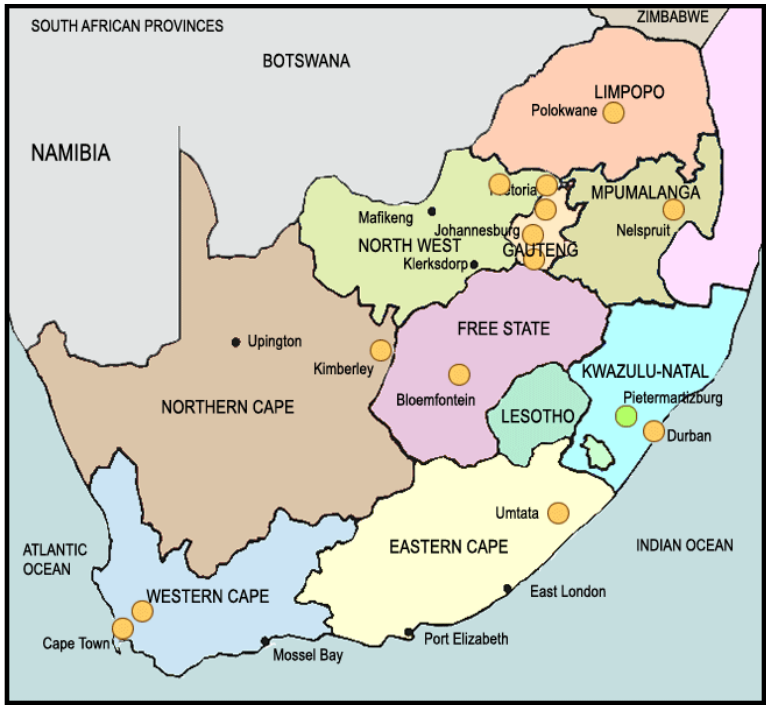
NATIONAL HEALTH LABORATORY SERVICE

Overview

- Describe GERMS-SA (Group for Enteric, Respiratory and Meningeal disease Surveillance in South Africa)
- Work related to bacterial meningitis pathogens
- Work related to fungal pathogens (Dr Nelesh Govender)
- Work related to bacterial enteric pathogens (Dr Karen Keddy)

Background

- GERMS-SA
  - surveillance for laboratory-confirmed cases
  - invasive disease
  - >270 clinical microbiology laboratories
  - enhanced surveillance at 25 hospital sites

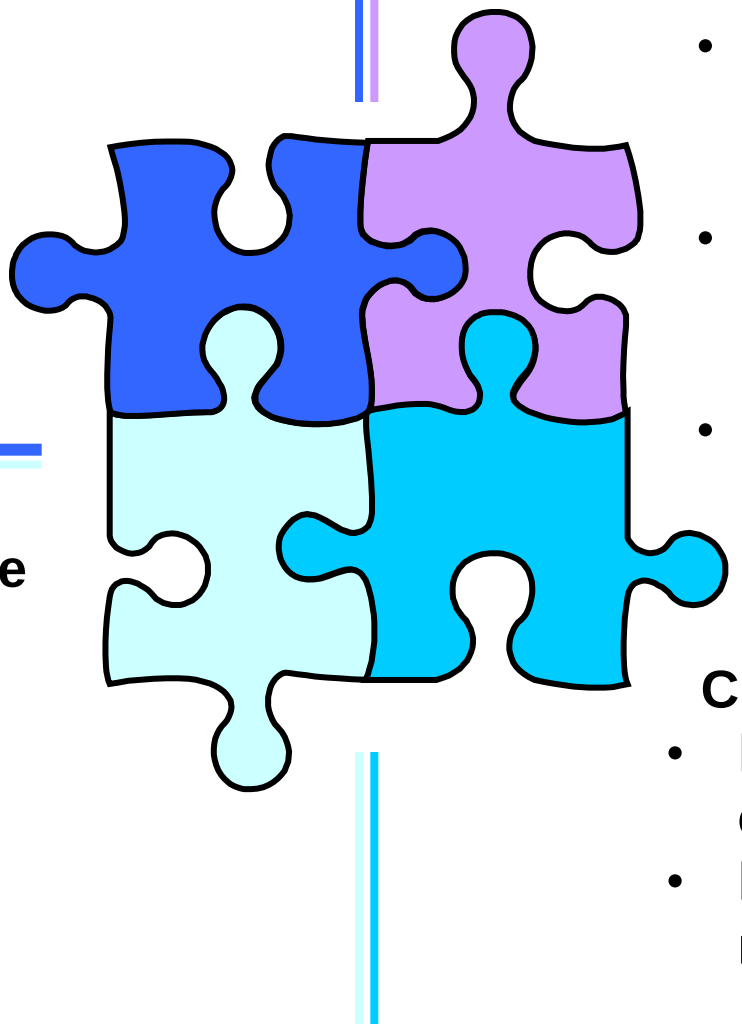


GERMS SOUTH AFRICA

DISEASES UNDER SURVEILLANCE

AIDS-related OIs

- Surrogate marker for burden of HIV/AIDS
- Impact of Comprehensive Plan for HIV/ AIDS
- Natural history of OIs in SA



Epidemic-prone diseases

- Supplement clinical disease notification system
- Monitor epidemiology over time
- Inform response to outbreaks

Vaccine-preventable diseases

- Estimate burden of disease
- Describe serotype distribution
- Assess impact of vaccine

Childhood diseases

- Estimate burden of disease
- Monitor antimicrobial resistance patterns

Organism	**Phenotypic characterisation**	**Genotypic characterisation (selected isolates only)**
Streptococcus pneumoniae*, *Haemophilus influenzae* and *Neisseria meningitidis	**Antimicrobial susceptibility testing***, serotyping (or serogrouping)	Molecular typing (PCR, PFGE, MLST), **molecular antimicrobial resistance determination**
Salmonella* spp. and *Shigella* spp., *Vibrio cholerae*, diarrhoeagenic *Escherichia coli	**Antimicrobial susceptibility testing***, serotyping	Molecular relatedness (PFGE), virulence gene determination (PCR)
***Cryptococcus* spp.**	Confirmation of genus/ species identification, **antimicrobial susceptibility testing*** (selected cases)	Molecular typing
Pneumocystis jirovecii	Semi-quantitative estimation of organism load (specimen)	**Molecular antimicrobial resistance determination**

The national, laboratory & hospital network

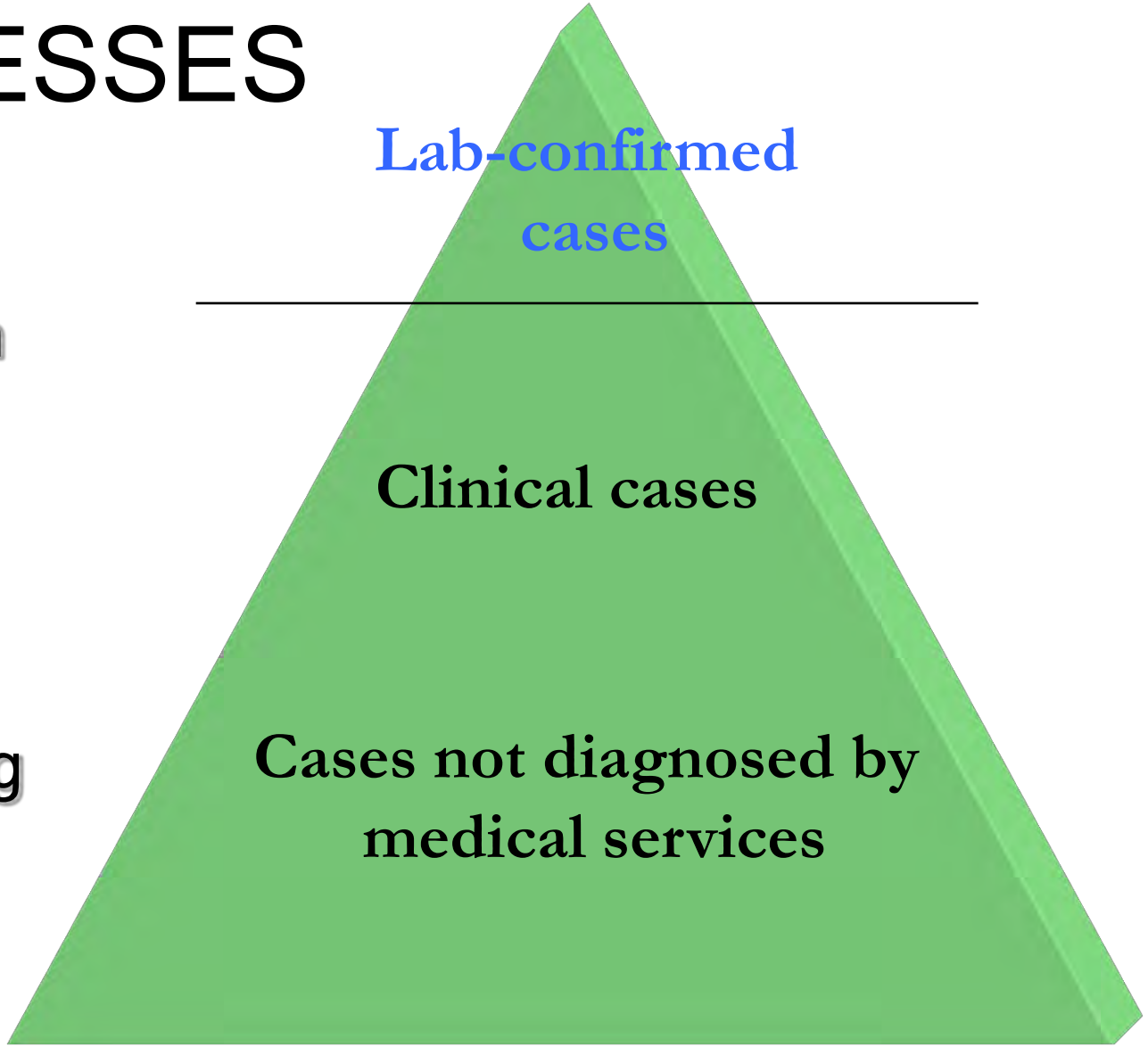
GERMS-SA SURVEILLANCE

- Strengths
  - Specificity of case definition
  - Isolates are available for future lab work
  - Includes diseases not part of the DoH notification system
  - In line with the International Health Regulations / WHO reporting requirements

GERMS SOUTH AFRICA

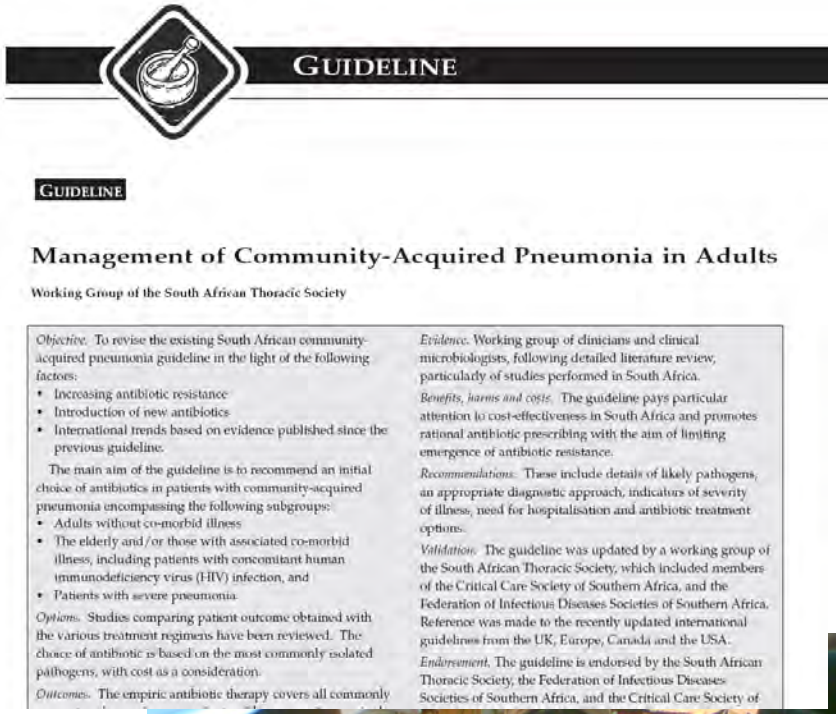
WEAKNESSES

- laboratory confirmation leads to a delay in reporting
- tip of iceberg



GERMS SOUTH AFRICA

Reasons for surveillance



GUIDELINE

GUIDELINE

Management of Community-Acquired Pneumonia in Adults

Working Group of the South African Thoracic Society

Objective. To revise the existing South African community-acquired pneumonia guideline in the light of the following factors:

- Increasing antibiotic resistance
- Introduction of new antibiotics
- International trends based on evidence published since the previous guideline.

The main aim of the guideline is to recommend an initial choice of antibiotics in patients with community-acquired pneumonia encompassing the following subgroups:

- Adults without co-morbid illness
- The elderly and/or those with associated co-morbid illness, including patients with concomitant human immunodeficiency virus (HIV) infection, and
- Patients with severe pneumonia.

Options. Studies comparing patient outcome obtained with the various treatment regimens have been reviewed. The choice of antibiotic is based on the most commonly isolated pathogens, with cost as a consideration.

Outcomes. The empiric antibiotic therapy covers all commonly

Evidence. Working group of clinicians and clinical microbiologists, following detailed literature review, particularly of studies performed in South Africa.

Benefits, harms and costs. The guideline pays particular attention to cost-effectiveness in South Africa and promotes rational antibiotic prescribing with the aim of limiting emergence of antibiotic resistance.

Recommendations. These include details of likely pathogens, an appropriate diagnostic approach, indicators of severity of illness, need for hospitalisation and antibiotic treatment options.

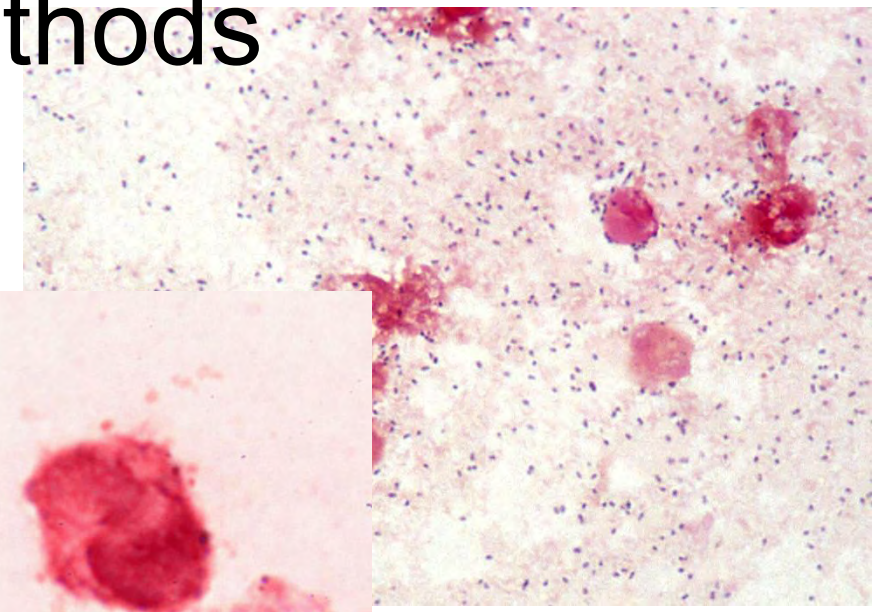
Validation. The guideline was updated by a working group of the South African Thoracic Society, which included members of the Critical Care Society of Southern Africa, and the Federation of Infectious Diseases Societies of Southern Africa. Reference was made to the recently updated international guidelines from the UK, Europe, Canada and the USA.

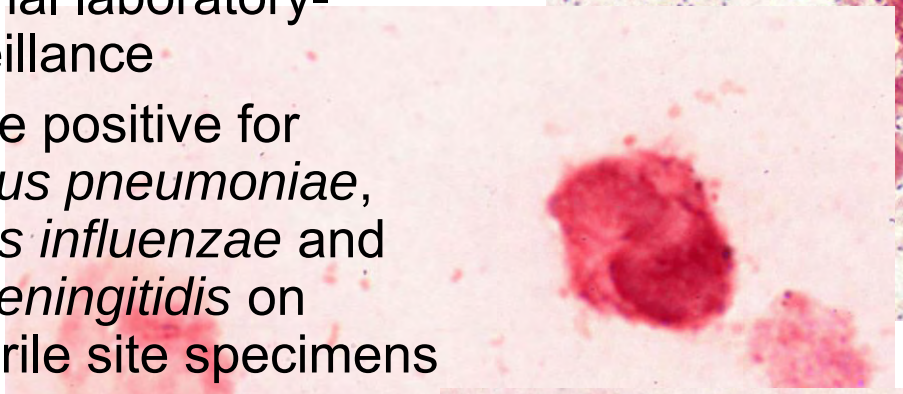
Endorsement. The guideline is endorsed by the South African Thoracic Society, the Federation of Infectious Diseases Societies of Southern Africa, and the Critical Care Society of

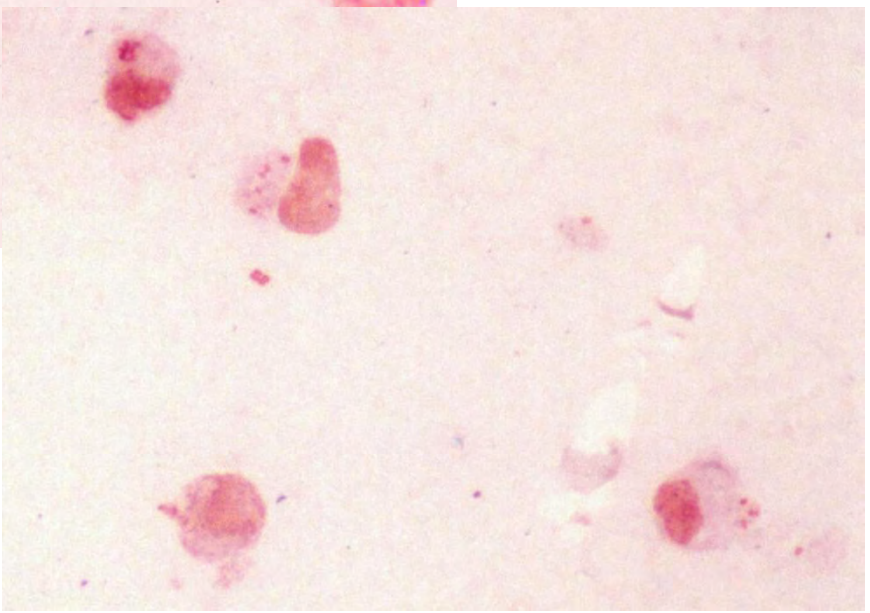
- *Streptococcus pneumoniae*
  - antimicrobial susceptibility
  - monitoring of serotypes prior to vaccine introduction
  - surveillance after vaccine introduction (2009)
- *Haemophilus influenzae*
  - surveillance after vaccine introduction
  - antimicrobial susceptibility
- *Neisseria meningitidis*
  - Epidemic prone
  - Monitoring serogroups and strains for vaccine development
  - antimicrobial susceptibility

Definitions and methods

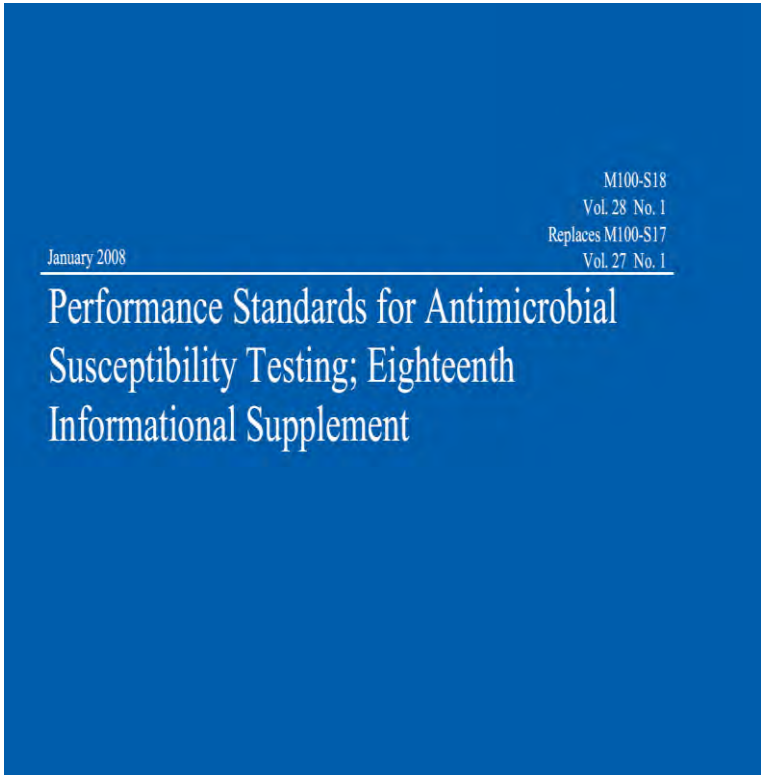
- Active national laboratory-based surveillance
- Case: culture positive for *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Neisseria meningitidis* on normally sterile site specimens
- Repeat isolates from the same patient are excluded; recurrent episodes were defined as repeated isolation >21 days
- Serotyping/serogrouping
- Antimicrobial susceptibility testing according to CLSI guidelines



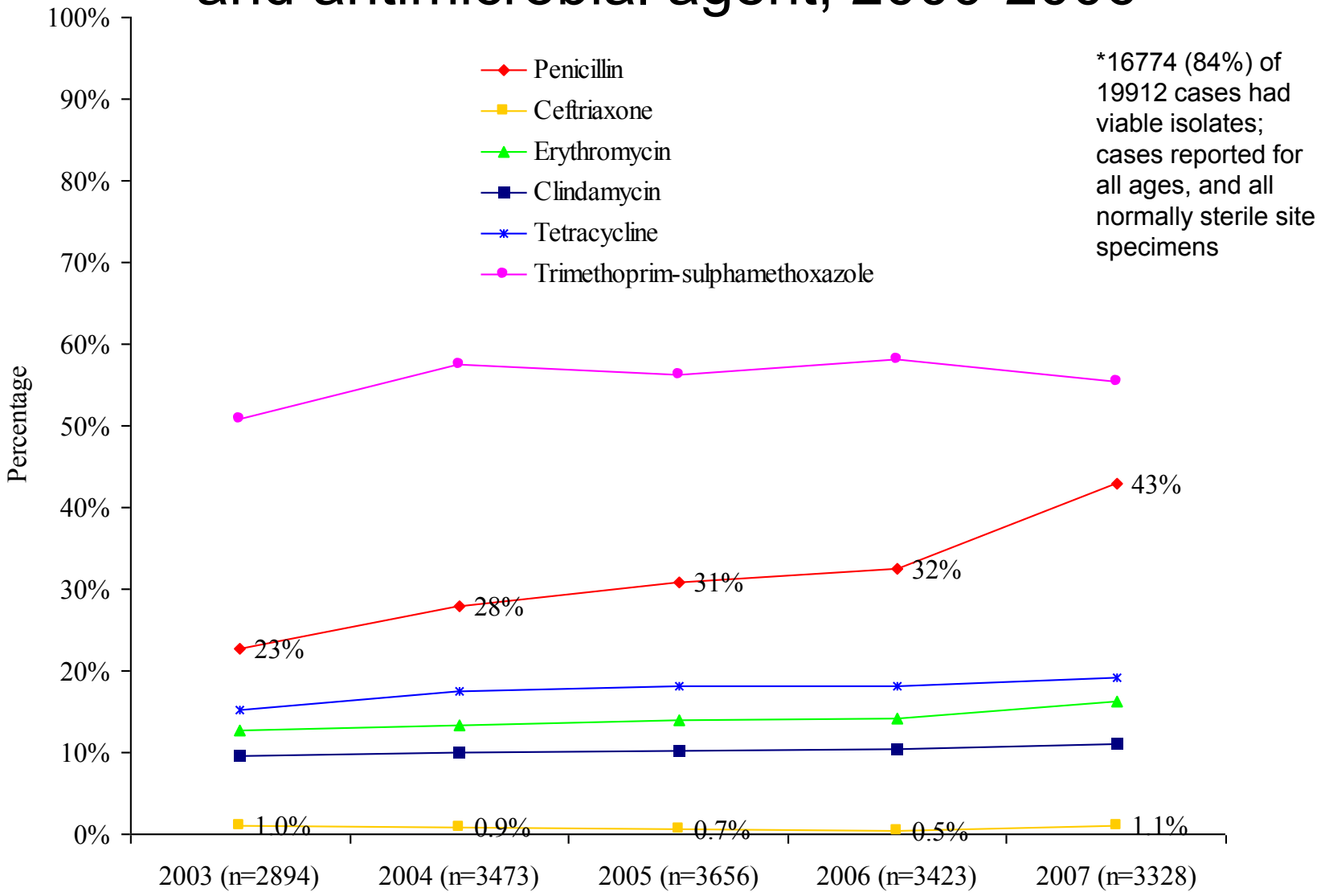




Methods of antimicrobial susceptibility testing

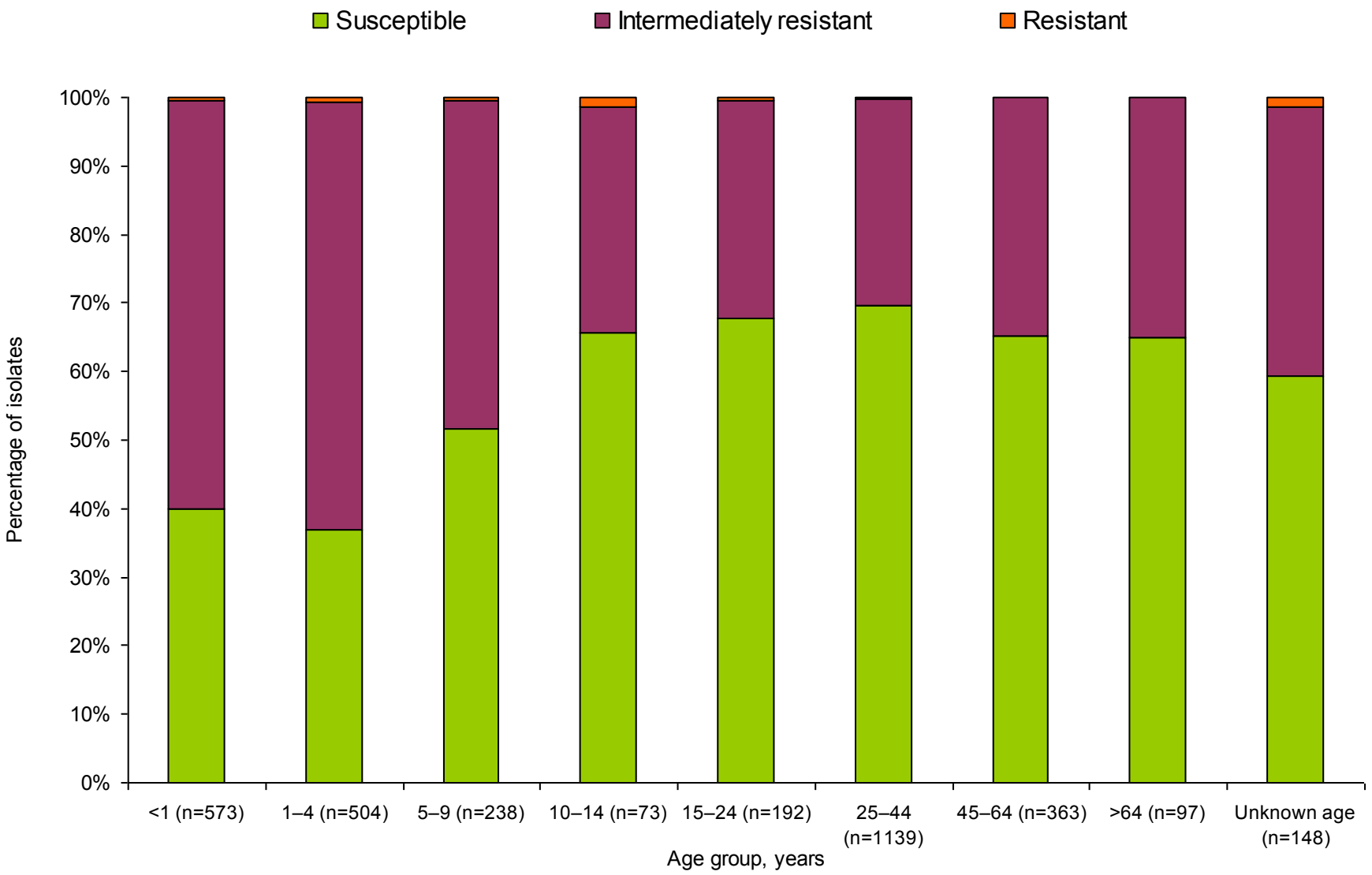


Percentage of non-susceptible pneumococcal isolates causing invasive disease* by year and antimicrobial agent, 2000-2006



*16774 (84%) of 19912 cases had viable isolates; cases reported for all ages, and all normally sterile site specimens

Percentage of cases of IPD reported to RMPRU in 2007 by age group and penicillin susceptibility (4733 cases reported, 3327 with viable isolates)

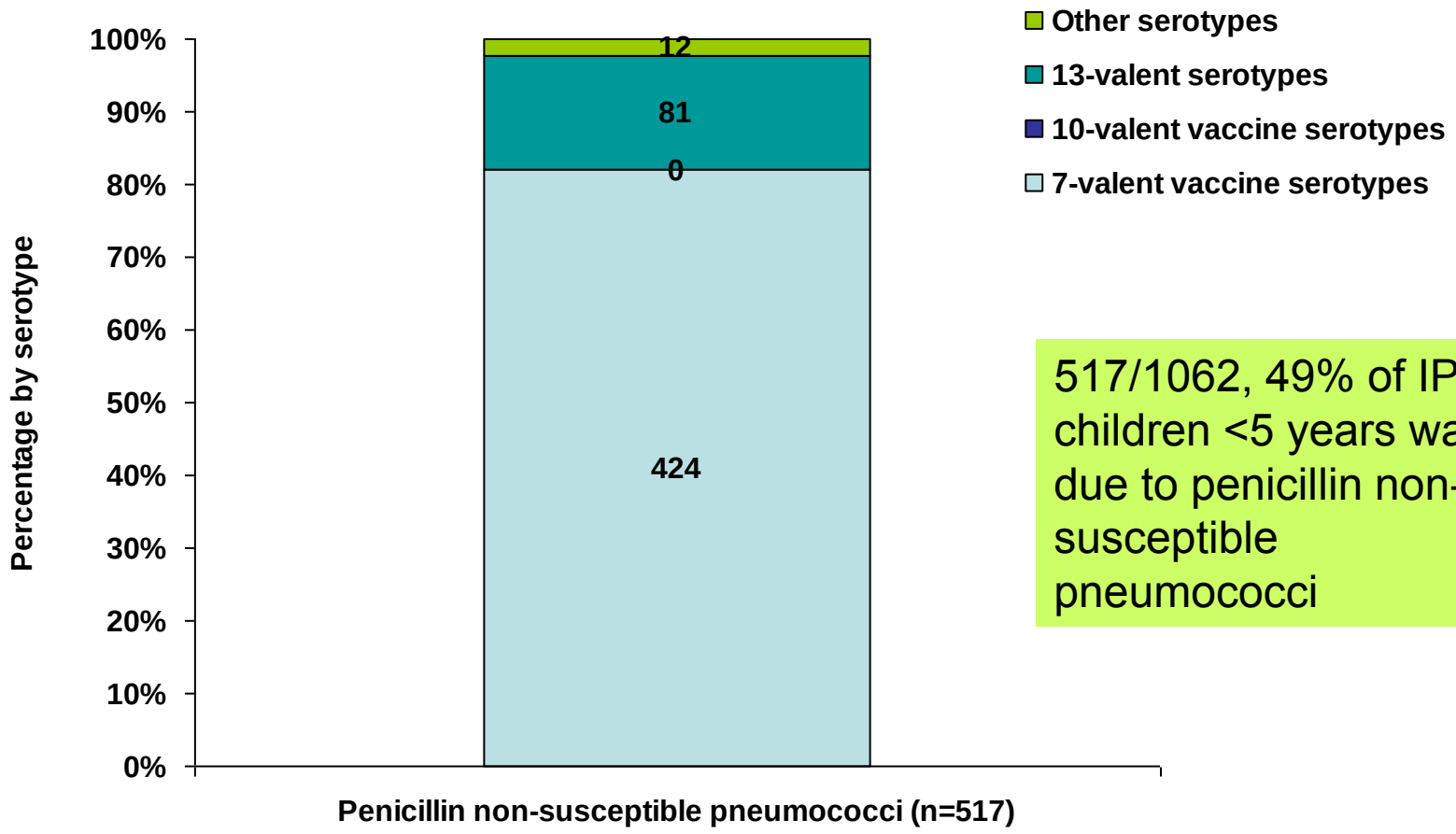


(non-susceptible MIC>0.06mg/L)

Major serotypes associated with drug resistance

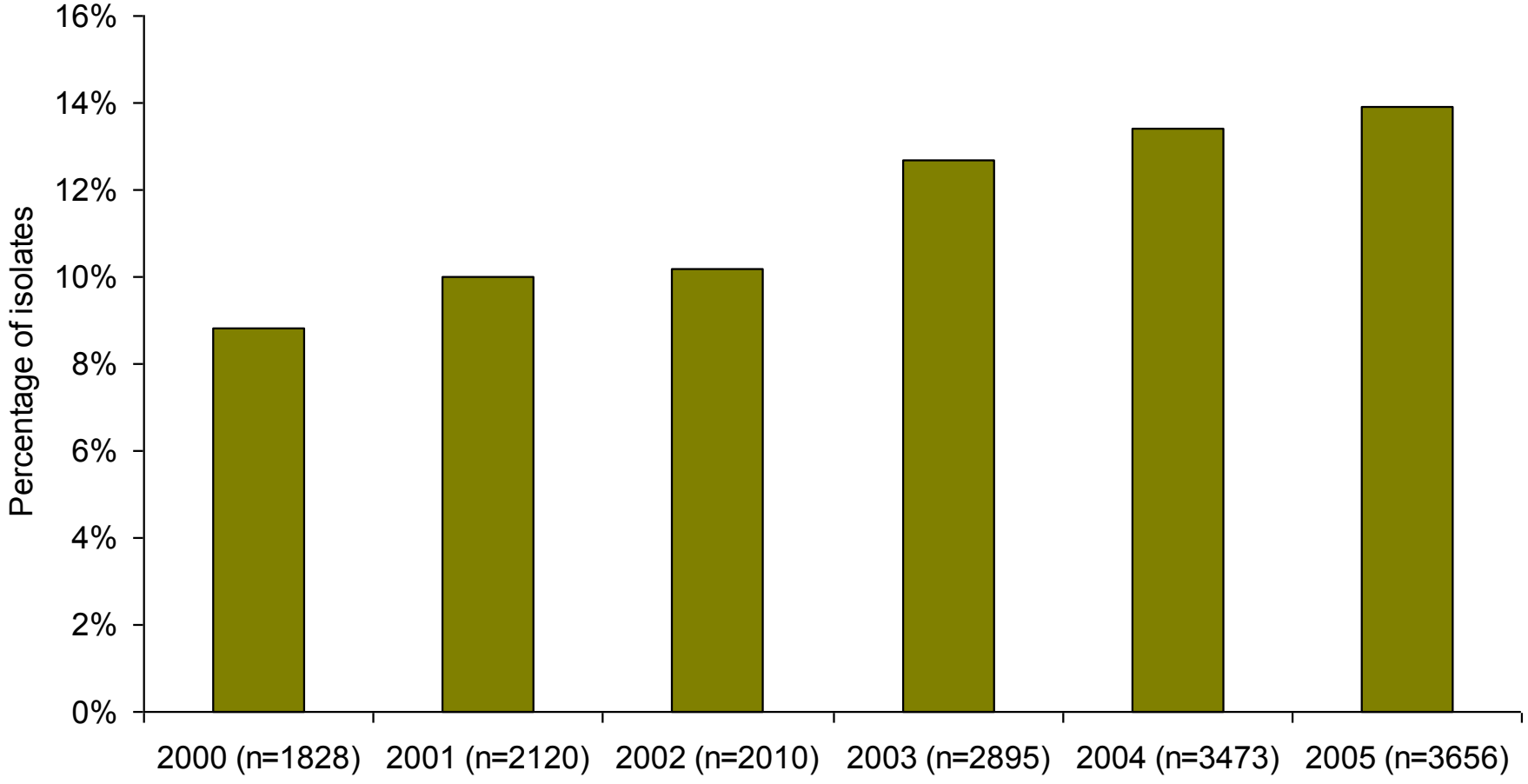
7-valent vaccine	10-valent vaccine	13-valent vaccine	Common serotypes associated with drug resistance
	1	1	
		3	
4	4	4	
	5	5	
		6A	6A
6B	6B	6B	6B
	7F	7F	
9V	9V	9V	9V/N
14	14	14	14
18C	18C	18C	
		19A	19A
19F	19F	19F	19F
23F	23F	23F	23F

Percentage of penicillin non-susceptible disease in children <5 years by vaccine serotypes, 2006, South Africa



517/1062, 49% of IPD in children <5 years was due to penicillin non-susceptible pneumococci

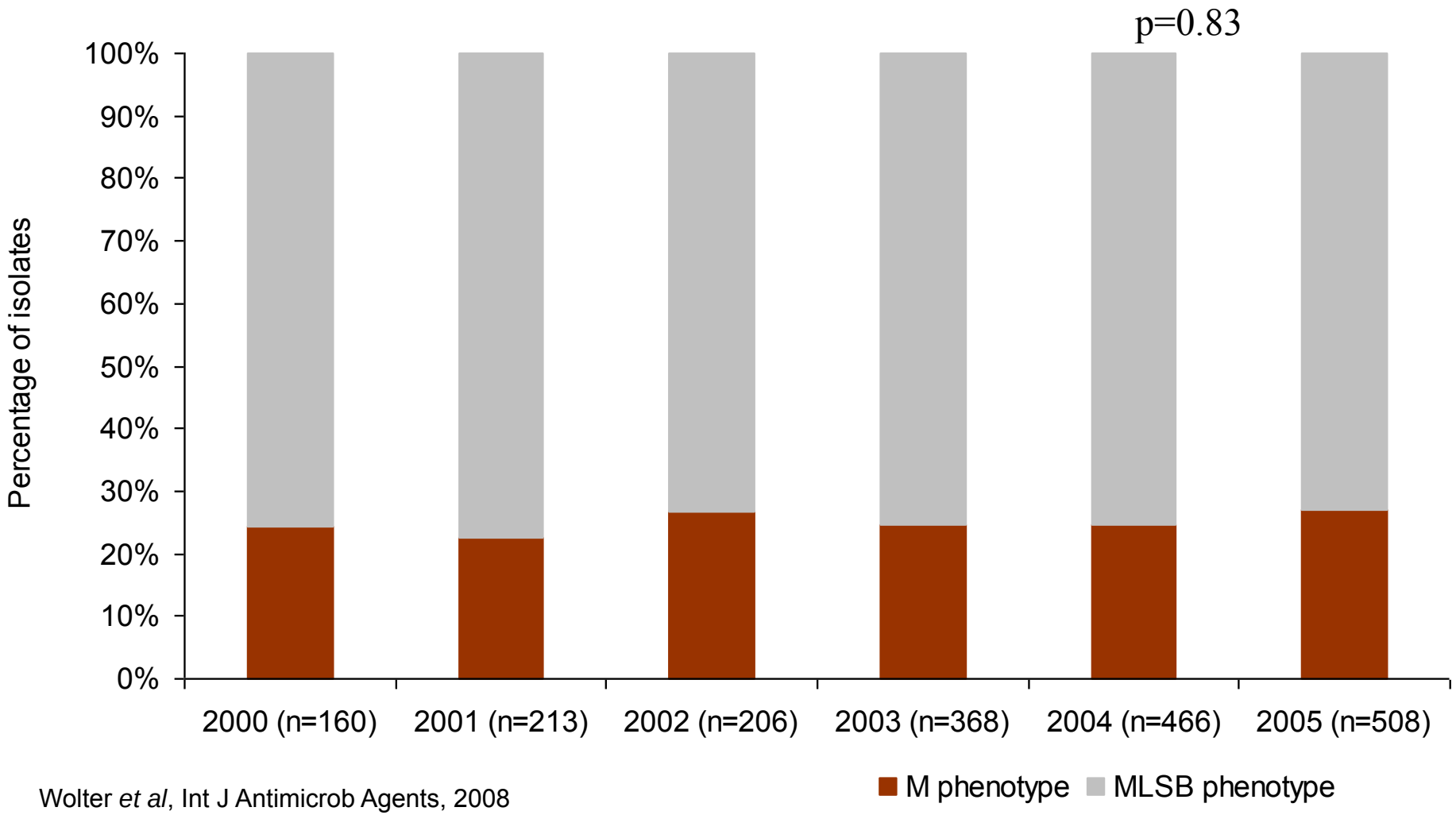
Percentage of macrolide-nonsusceptible pneumococcal isolates causing invasive disease by year, South Africa, 2000-2005



Wolter *et al*, Int J Antimicrob Agents, 2008

Chi square test for trend, $p<0.001$

Percentages of M (mef) and MLS_B (erm) phenotypes in macrolide-nonsusceptible pneumococcal isolates causing invasive disease by year, South Africa, 2000-2005

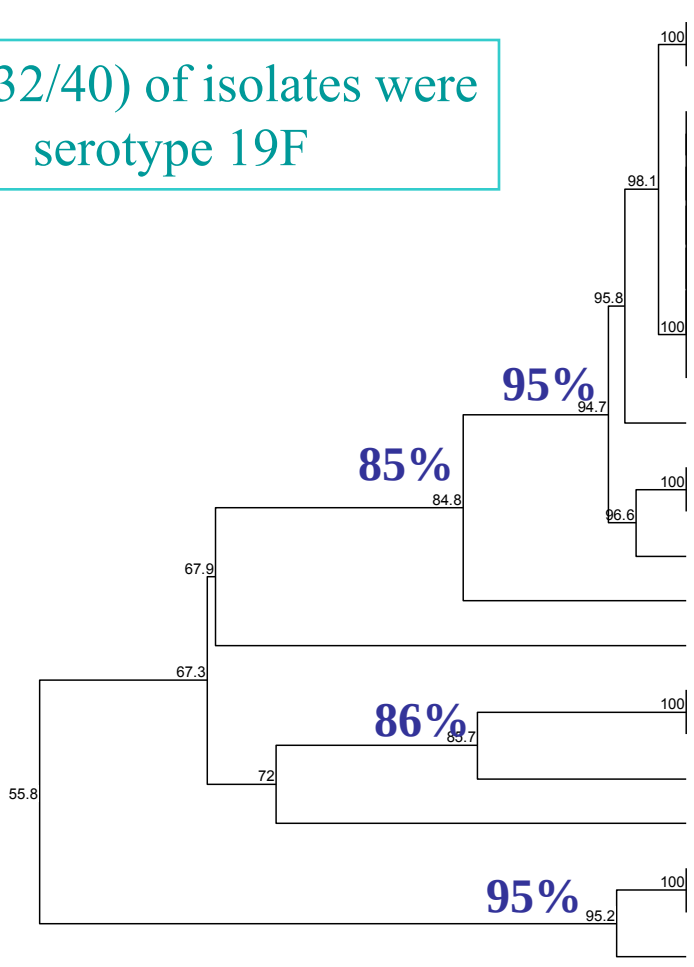


Wolter *et al*, Int J Antimicrob Agents, 2008

PFGE dendrogram showing the genetic relationship between South African erythromycin-nonsusceptible strains containing *erm*(B) and *mef*(A), South Africa, 2005

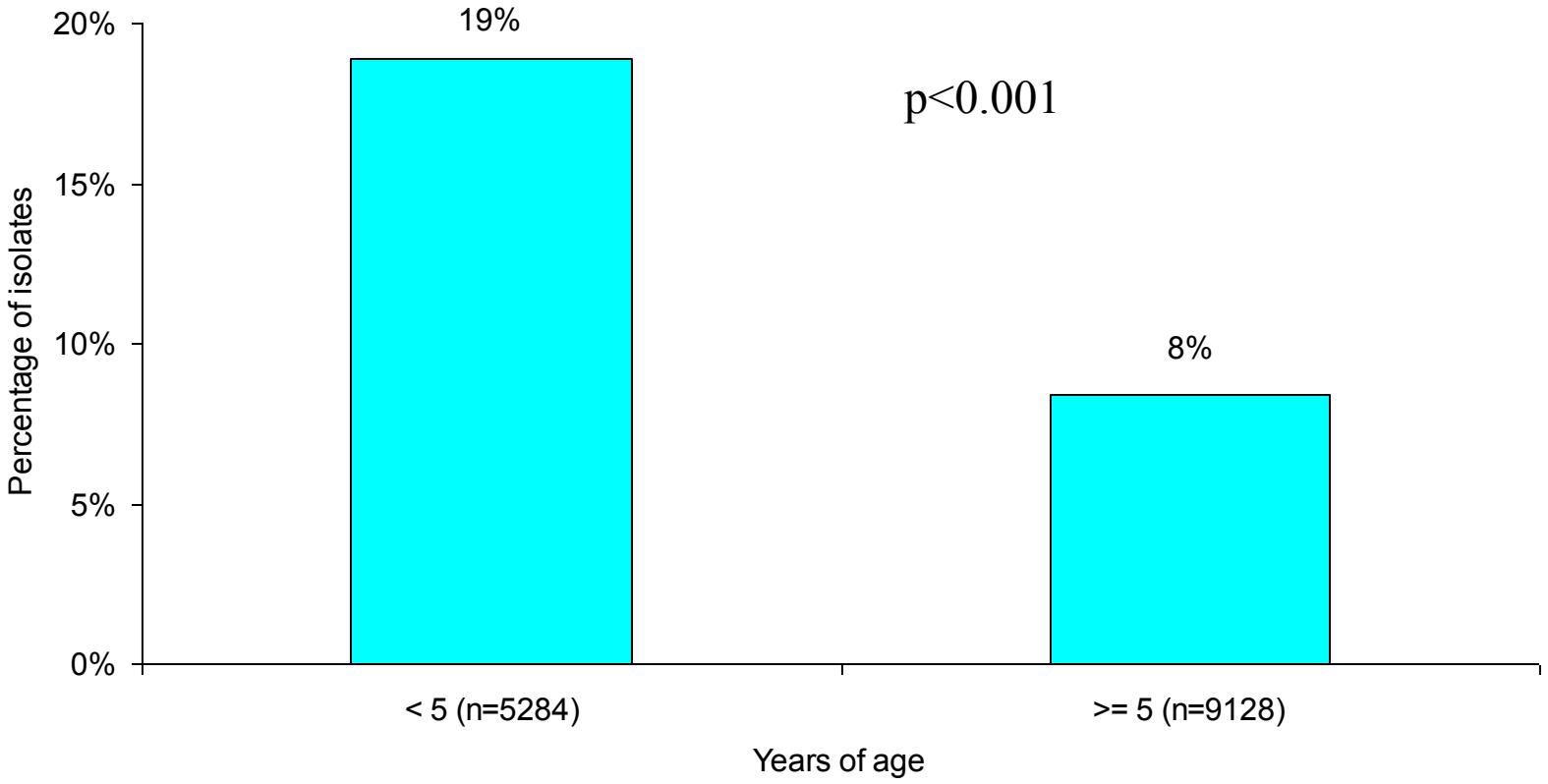
Wolter *et al*, Int J Antimicrob Agents, 2008

80% (32/40) of isolates were serotype 19F



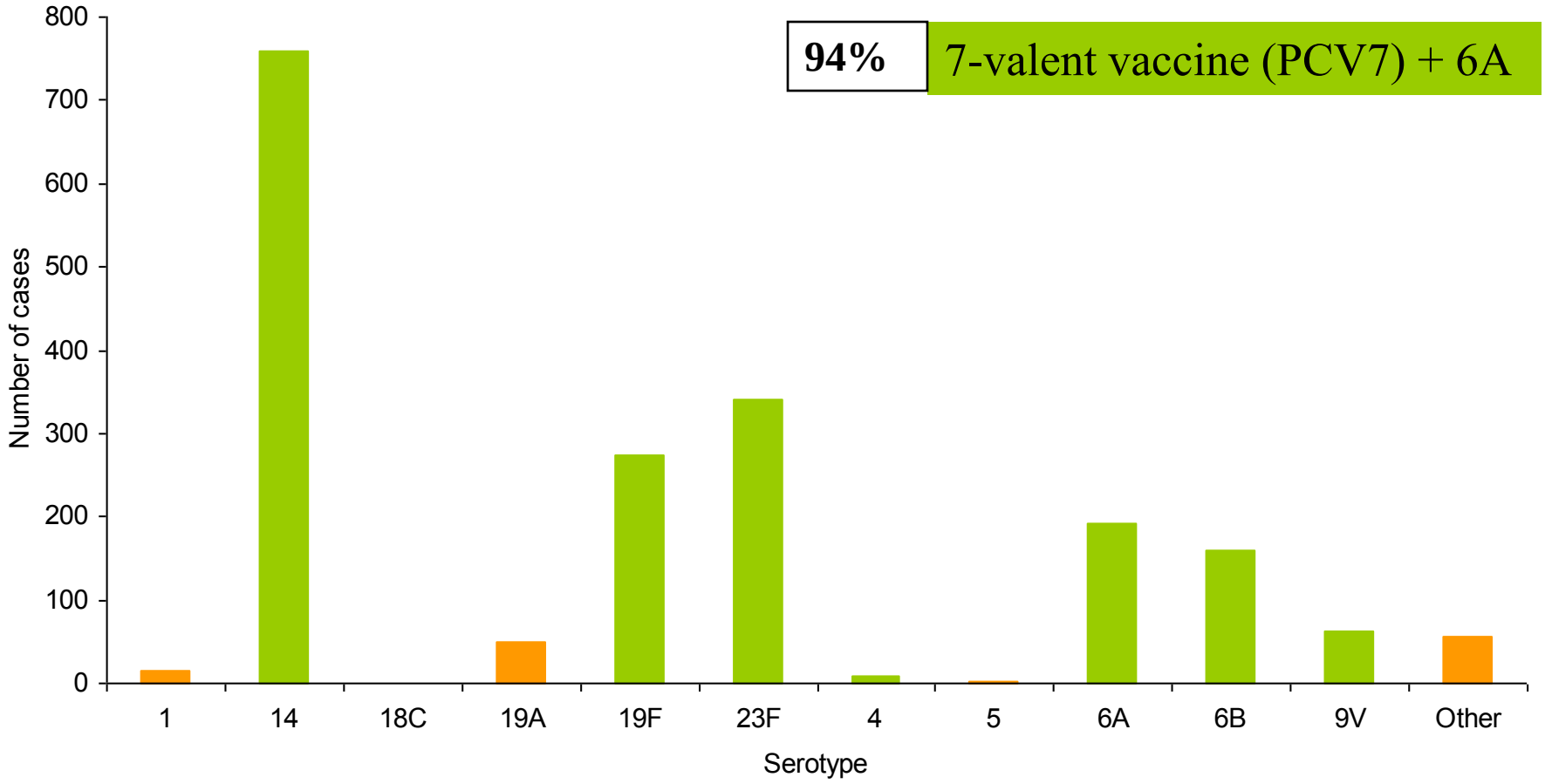
Strain	Serotype	Sequence Type	Antibiogram
2316	19F		
4433	19F		
517	19F		
919	19F		
1754	19F		
2255	19F	ST1412	PEN, TET, ERY, CLI, SXT
2691	19F		
2801	19F		
3241	19F		
171	19F		
368	19F	ST271	PEN, TET, ERY, CLI, SXT
2181	19F		
3136	19F		
Taiwan19F-14	19F	ST236	
4881	25	ST2650	PEN, TET, ERY, CLI, SXT
1951	14		
5234	14	ST2652	PEN, TET, ERY, CLI, SXT
England14-9	14	ST9	
549	23F	ST2651	PEN, TET, ERY, CLI, SXT
2994	23F		
3600	23F	ST1444	PEN, TET, ERY, CLI, SXT
787	23F		

Percentage of macrolide-nonsusceptible pneumococcal isolates causing invasive disease by age, South Africa, 2000-2005



Wolter *et al*, Int J Antimicrob Agents, 2008

Macrolide-nonsusceptible pneumococcal isolates (n=1921) causing invasive disease by serotype, South Africa, 2000-2005



Wolter *et al*, Int J Antimicrob Agents, 2008

Prevalence of FQ-resistant pneumococci causing IPD in South Africa

- January 2000 to December 2006:
  - 21 521 cases of invasive pneumococcal disease (IPD)
  - 44% (8692/19572) in children <15 years old
  - 8052 (93%) had isolates available for analysis
- FQ resistance
  - 7-year period, 22 (0.1%) of 19,404 isolates were nonsusceptible to ofloxacin
  - 12 were levofloxacin-non-susceptible
  - All 12 from children <15 years old
  - 3 of the 9 provinces in South Africa

von Gottberg et al, Lancet 2008

Reported cases of invasive pneumococcal disease by levofloxacin susceptibility, South Africa, 2000-2006

Levofloxacin MIC*	Year of surveillance						
	2000	2001	2002	2003	2004	2005	2006
≥4mg/L	0	1	0	2	4	3	2
<4mg/L	1828	2119	2010	2892	3469	3653	3421
Isolate not tested	175	110	127	333	311	451	610
Total cases reported	2003	2230	2137	3227	3784	4107	4033

*MIC, minimum inhibitory concentration

von Gottberg et al, Lancet 2008

Univariate comparison of pneumococcal infections that were susceptible or not susceptible to levofloxacin, isolated from children under 15 years of age, South Africa, 2000-2006
National surveillance

Characteristics	Levofloxacin-non-susceptible	Levofloxacin-susceptible	P value	Relative risk (95% confidence intervals)
Age (years)*	1 (0-13)	1 (0-15)	0.81	Not available
Male	7/12 (58)	4265/7855 (54)	0.78	1.18 (0.37-3.71)
Isolation from CSF	3/12 (33)	2371/8040 (29)	0.73	0.80 (0.22-2.94)
Penicillin non-susceptible	5/12 (42)	2955/8040 (37)	0.72	1.23 (0.39-3.87)
Rifampin non-susceptible	12/12 (100)	355/8040 (4)	<0.001	Undefined

Data are median (range) or n/n (%)
*Age available for 12 levofloxacin-non-susceptible cases, and 8040 levofloxacin-susceptible cases

Univariate comparison of pneumococcal infections that were susceptible or not susceptible to levofloxacin, isolated from children under 15 years of age, South Africa, 2003-2006
Enhanced sentinel surveillance

2000-2006: 5 of 10 children with antibiotic history were exposed to fluoroquinolones

Characteristics	Levofloxacin-non-susceptible	Levofloxacin-susceptible	P value	Relative risk (95% confidence intervals)
HIV	9/9 (100)	1376/1745 (79)	0.12	Undefined
Nosocomial infection	8/10 (80)	109/2709 (4)	<0.001	88.96 (19.10-414.29)
History of tuberculosis treatment	8/9 (89)	396/2202 (18)	<0.001	35.78 (4.49-285.30)
Case fatality rate	4/10 (40)	622/2695 (23)	0.20	2.21 (0.63-7.82)

Data are n/n (%)
Data for HIV serological status, nosocomial infection, history of tuberculosis treatment, and outcome were only available during enhanced surveillance (2003 onwards) and not available for all cases. Denominators change slightly reflecting those cases with available data.

Carriage study

- Objectives
  - Determine prevalence and risk factors for nasopharyngeal carriage of levofloxacin-non-susceptible pneumococci
- Study design
  - Cross-sectional survey
- Study population
  - Patients hospitalized at 2 TB hospitals (Gauteng and Western Cape)
  - No healthcare workers were swabbed

von Gottberg et al, Lancet 2008

Results-carriage study

- Hospital A (TB hospital, Gauteng)
  - Adults (August 2006)
    - 116 (83%) of 139 eligible adults swabbed
    - Prevalence of carriage 0/116
  - Children (August 2006)
    - 19 of 19 eligible children swabbed
    - Prevalence of carriage 9/19, 47%
    - All resistant to levofloxacin (MIC>32mg/L)
- Hospital B (TB hospital, Western Cape)
  - Children (May 2007)
    - 46 (98%) of 47 eligible children swabbed
    - Prevalence of carriage 26/46, 57%
    - 22/26, 85% resistant to levofloxacin (MIC>32mg/L) (23 isolates – one patient carried two resistant strains)

Comparison of children (<15 years of age) from tuberculosis hospitals carrying levofloxacin-non-susceptible pneumococcus (LNSSP) and not carrying LNSSP

	LNSSP carriers (n=31)	Not carrying LNSSP (n=34)	P value
Age (in years)	3 (0-11)	7 (0-14)	0.082
% Male	17 (55)	18 (53)	0.88
Days in hospital	107 (13-614)	107 (2-425)	0.39
HIV seropositive*	17/30 (57)	12/31 (39)	0.16
Median CD4	228 (5-1969)	425 (37-1069)	0.76
Current MDR TB therapy including FQ¶	24 (77)	20 (59)	0.11
Duration of FQ for TB treatment	94 (43-601)	112 (1-443)	0.45
Place of residence (last 3 months)			
TB Hospital	28 (90)	26 (76)	0.173
Other chronic care	2 (7)	2 (6)	
Community	1 (3)	6 (18)	

Data are median (range) or n (%)
#Four cases carrying fluoroquinolone-susceptible isolate were excluded
*HIV-status unavailable for 1 patient carrying a FQRP
¶43 receiving ofloxacin, 1 receiving ciprofloxacin (neonate exposed to MDR from mother)
TB=tuberculosis; FQ=fluoroquinolone; MDR TB = multidrug-resistant tuberculosis; NA=not applicable

JOURNAL OF CLINICAL MICROBIOLOGY, Apr. 2007, p. 1225–1233 Vol. 45, No. 4
0095-1137/07/$08.00+0 doi:10.1128/JCM.02193-06

Discovery of a New Capsular Serotype (6C) within Serogroup 6 of *Streptococcus pneumoniae*[▽]

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Genetic Basis for the New Pneumococcal Serotype, 6C[▽]

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Received 9 April 2007/Returned for modification 13 May 2007/Accepted 10 June 2007

Serotype 6C (91st serotype)

- Described in 2007 and discovered „by accident'
- Phenotypically indistinguishable from 6A using Quellung reaction (imposter?)
- How? polysaccharides are almost identical

6A →2) – Galactose - (1→3) – Glucose – (1→3) – Rhamnose – **(1→3)** – Ribitol – (5→P

6B →2) – Galactose - (1→3) – Glucose – (1→3) – Rhamnose – **(1→4)** – Ribitol – (5→P

6C →2) – **Glucose** - (1→3) – Glucose – (1→3) – Rhamnose – **(1→3)** – Ribitol – (5→P

Characteristics of cases infected with serotypes 6A and 6C causing invasive pneumococcal disease in South Africa, 2005-2006

Characteristic	No. of isolates (%)		P-value
	6A n=578	6C n=30	
Age <15 years	311/550 (57%)	6/30 (20%)	**<0.001**
Male gender	264/560 (47%)	18/30 (60%)	0.2
CSF specimen culture positive	167/578 (29%)	15/30 (50%)	**0.01**
Blood specimen culture positive	342/578 (59%)	13/30 (43%)	0.09
CSF + Blood specimens culture positive	46/578 (8%)	2/30 (7%)	1
Other normally sterile sites	23/578 (4%)	0/30	0.6
HIV-seropositive [a]	139/163 (85%)	7/8 (88%)	1
Case-fatality rate (Number of deaths/Number of cases)[a]	56/237 (24%)	4/13 (31%)	0.5
Penicillin nonsusceptible	128/578 (22%)	0/30	**0.004**
Trimethoprim-sulfamethoxazole nonsusceptible	452/578 (78%)	15/30 (50%)	**<0.001**

[a] Data only available at enhanced surveillance sites

Du Plessis *et al*, Int J Antimicrob Agents, 2008

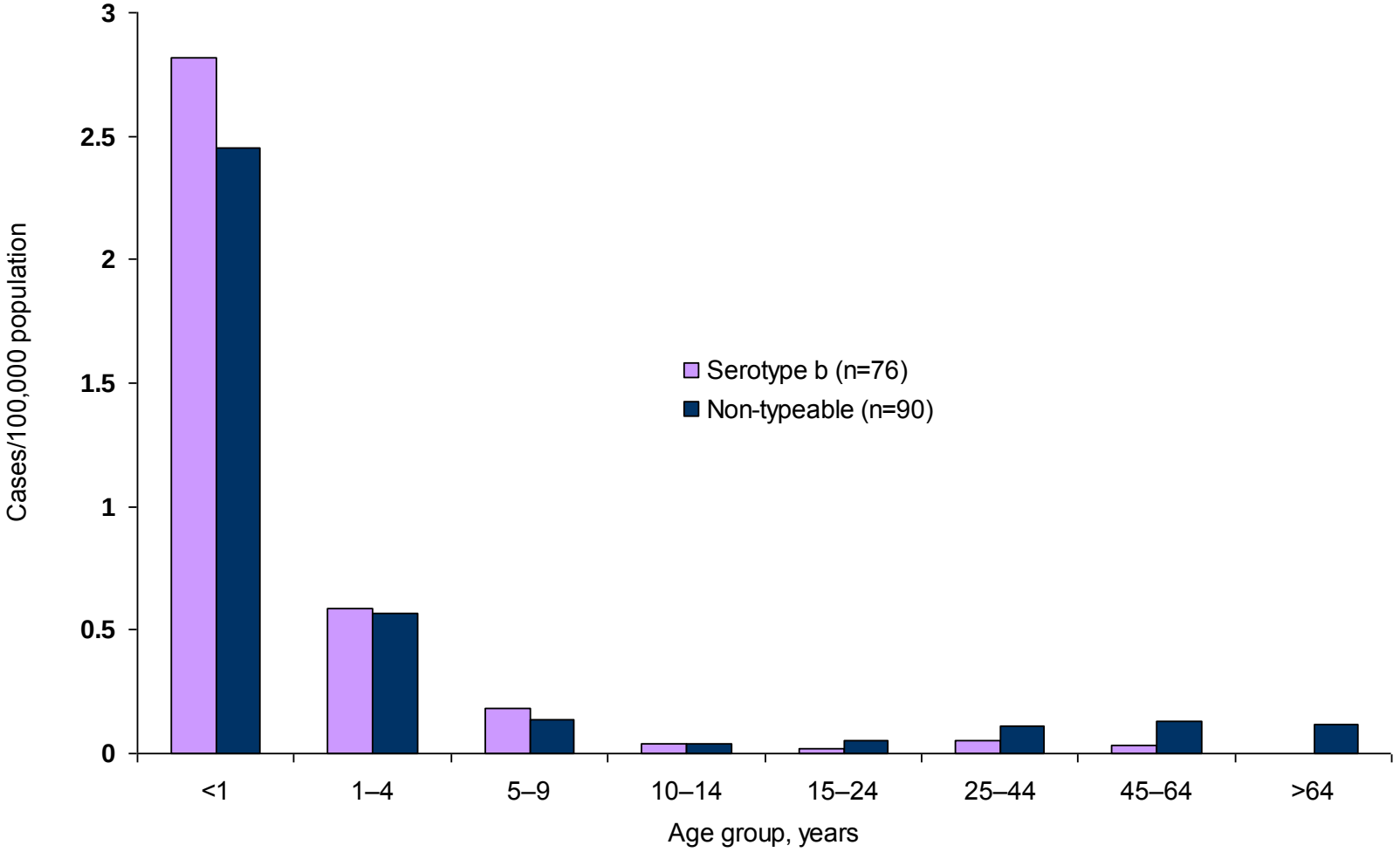
Table 1. **Reported cases of invasive disease caused by *Haemophilus influenzae* and *Streptococcus pneumoniae* in South African children less than five years old, by 12-month period**

Disease	Years of surveillance					
	1999–2000	2000–01	2001–02	2002–03	2003–04	% change[a]
	n (%)					
Haemophilus influenzae						
Type b	89 (65)	43 (46)	27 (30)	33 (31)	26 (17)	–71
Other typable[b]	8 (6)	6 (6)	11 (12)	13 (12)	25 (16)	213
Nontypable	18 (13)	19 (20)	32 (35)	35 (33)	58 (37)	217
No isolate available	22 (16)	26 (28)	21 (23)	25 (24)	46 (30)	Not applicable
All	137	94	91	106	155	12
Streptococcus pneumoniae (all serotypes)	453	691	788	733	1218	169

[a] Comparing 1999–2000 with 2003–04.
[b] Includes serotypes a ($n = 10$), c ($n = 6$), d ($n = 5$), e ($n = 3$) and f ($n = 39$).

von Gottberg *et al*, Bull of the WHO, October 2006

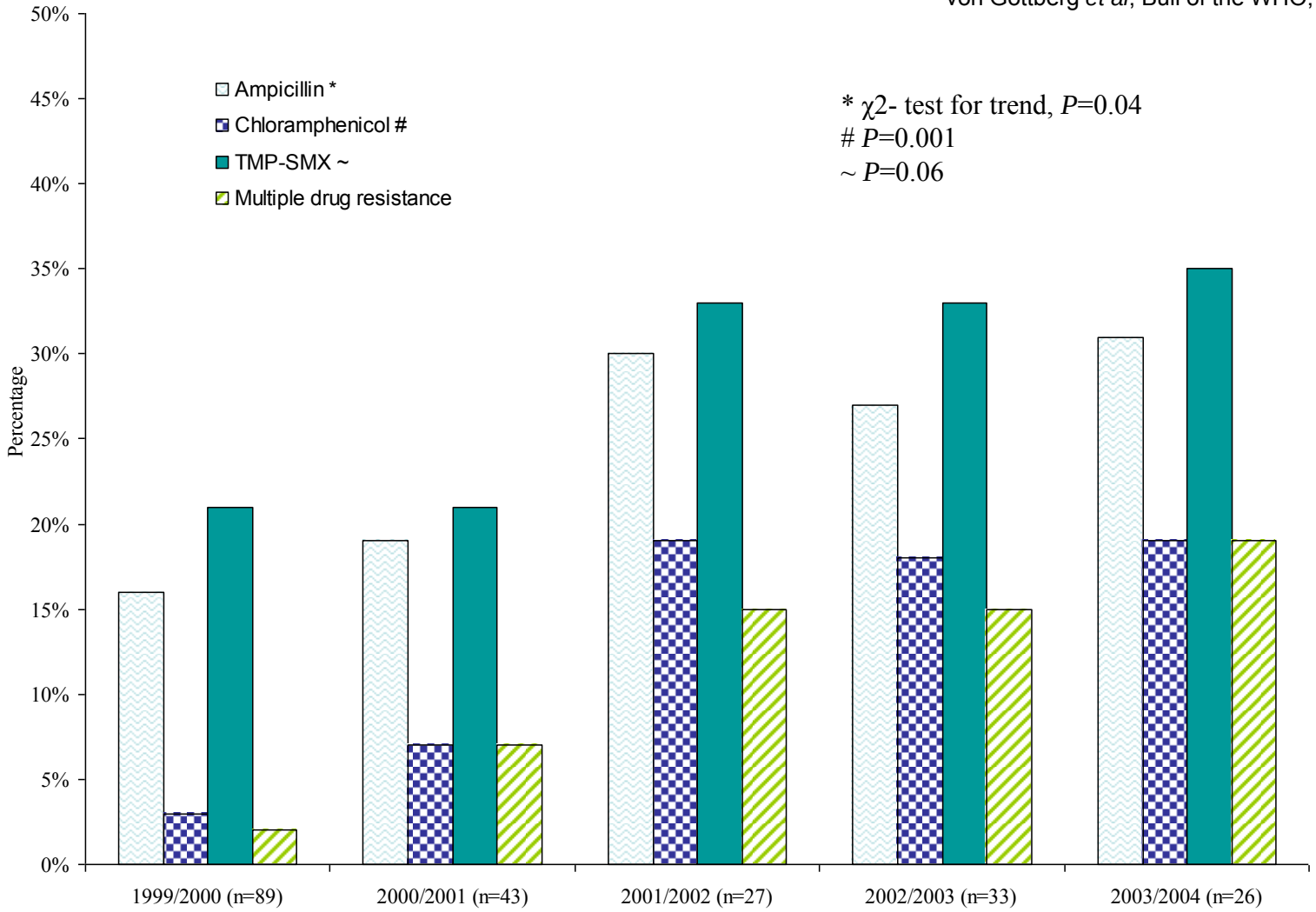
Reported age-specific incidence rates of serotype b and non-typeable *Haemophilus influenzae* disease, South Africa, 2007*



*Of 420 cases reported, 401 had known age, and 215 had viable isolates available for serotyping

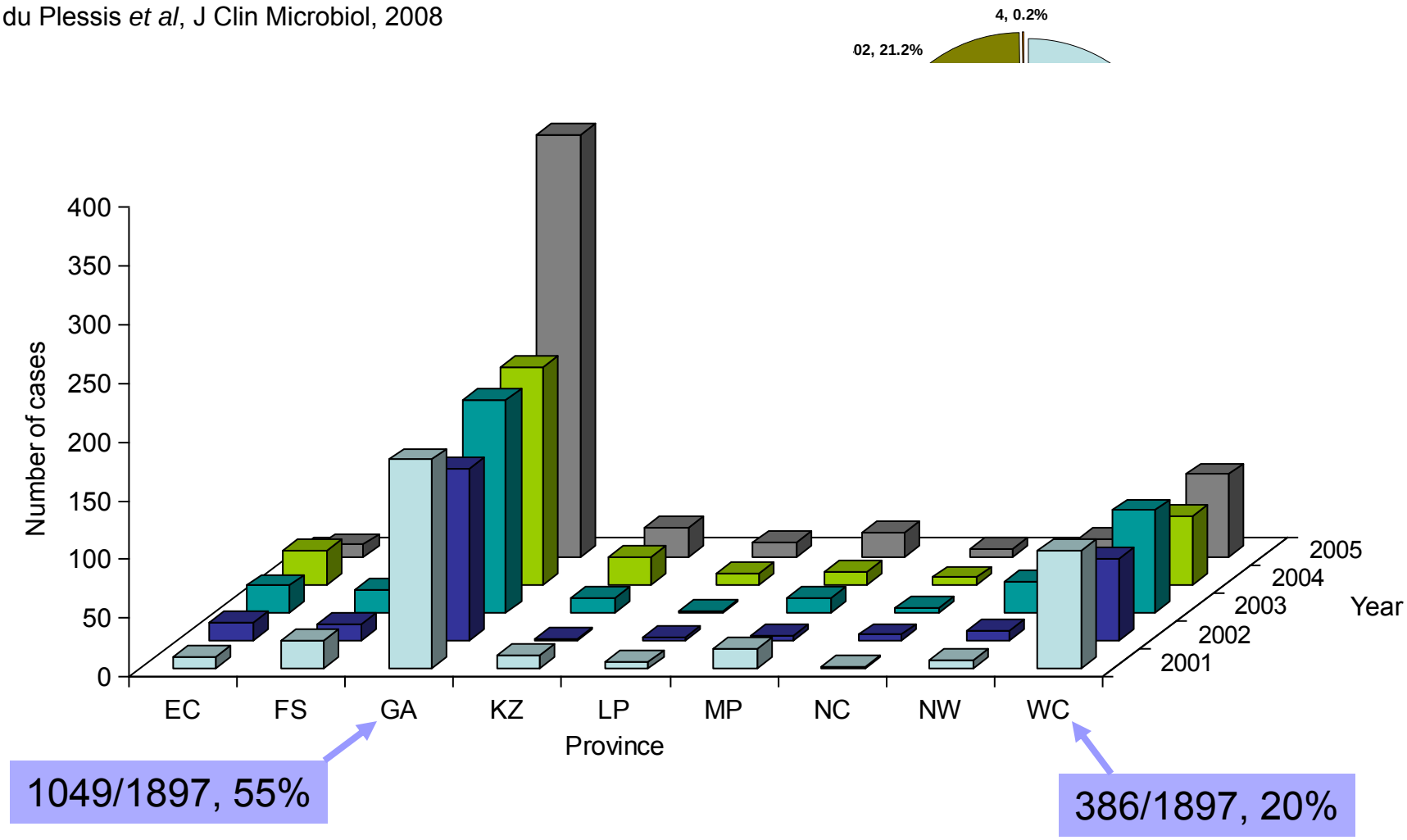
Percentage of isolates causing *Haemophilus influenzae* serotype b non-susceptible disease in children below five years, by category for each of the 12-month periods, South Africa, 1999-2004

von Gottberg *et al*, Bull of the WHO, October 2006



Laboratory-confirmed meningococcal disease by province and year, South Africa, 2001-2005

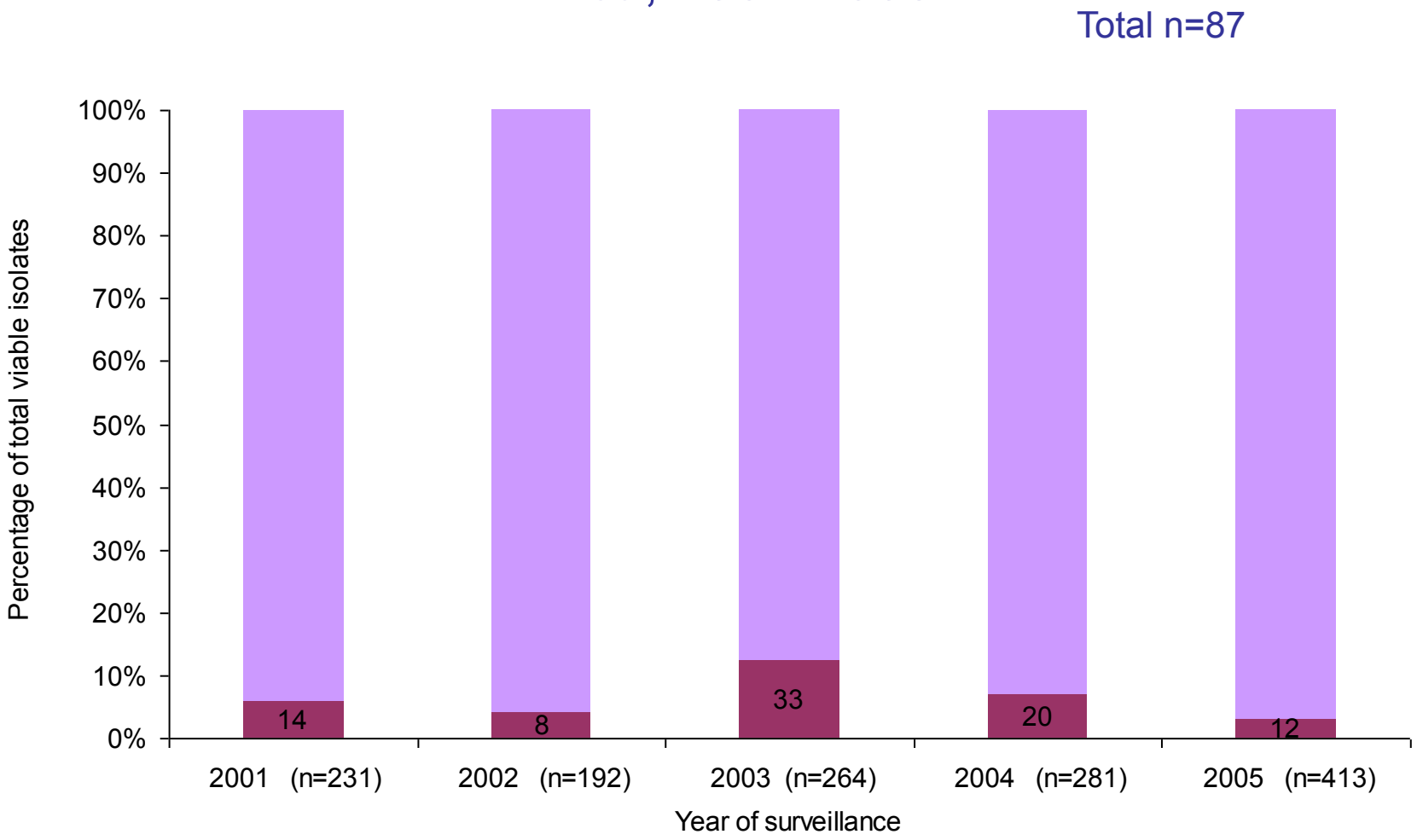
du Plessis *et al*, J Clin Microbiol, 2008



Laboratory-confirmed meningococcal disease in South Africa 2001-2005

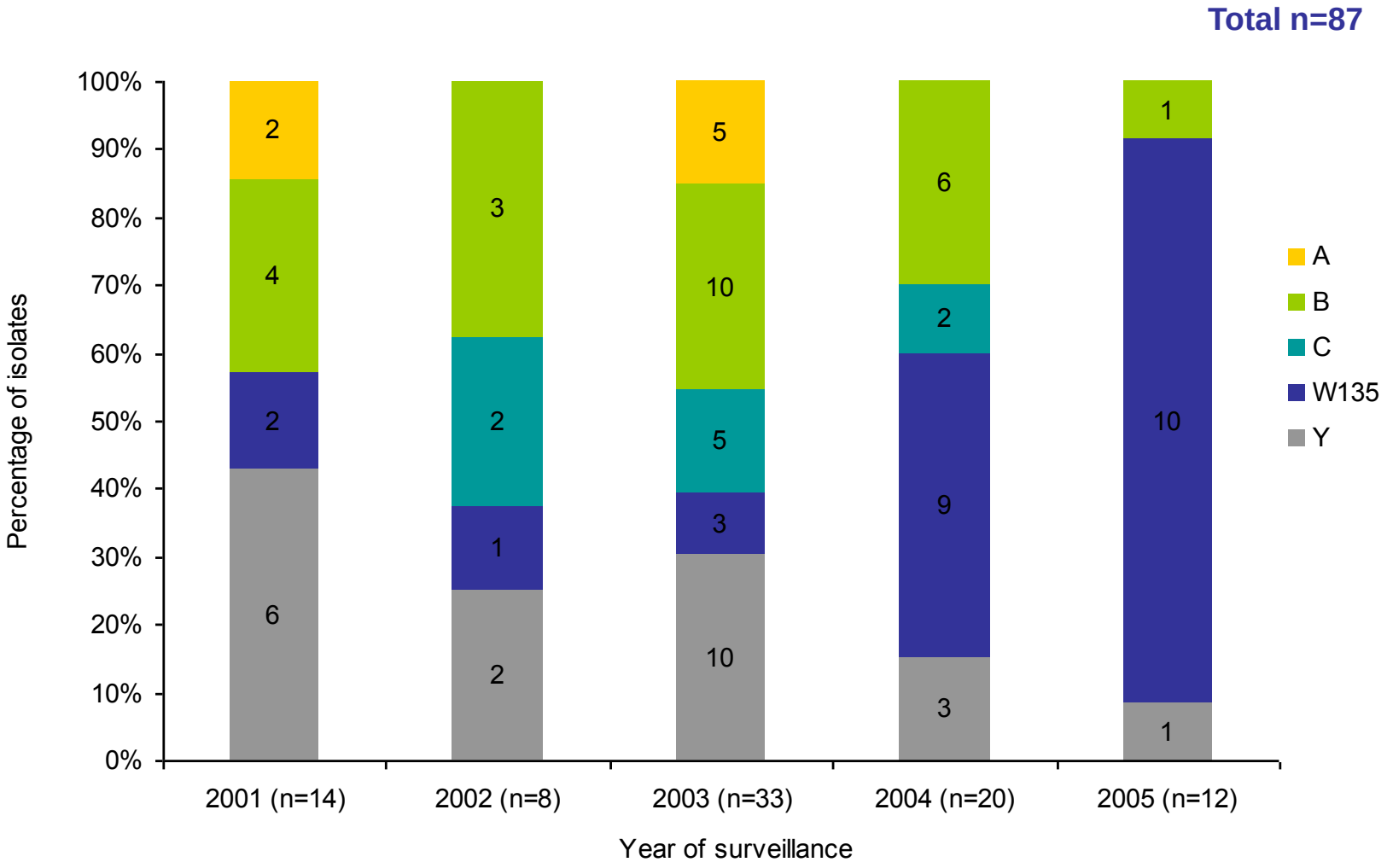
- Case definition:
  - positive on culture or
  - latex positive + either microscopy or PCR
  - from a normally sterile site specimens (*e.g.* blood or CSF)
- 1897 cases of invasive disease reported through national laboratory-based surveillance network (GERMS-SA)
- Average annual incidence:
  - 0.83/100,000 population (range 0.59 to 1.16/100,000)
- 1381 viable isolates (73%) available for further testing
- Age known in 1750/1897 (92%)

Percentage of penicillin intermediately resistant invasive meningococcal isolates by year (all serogroups), South Africa, 2001-2005



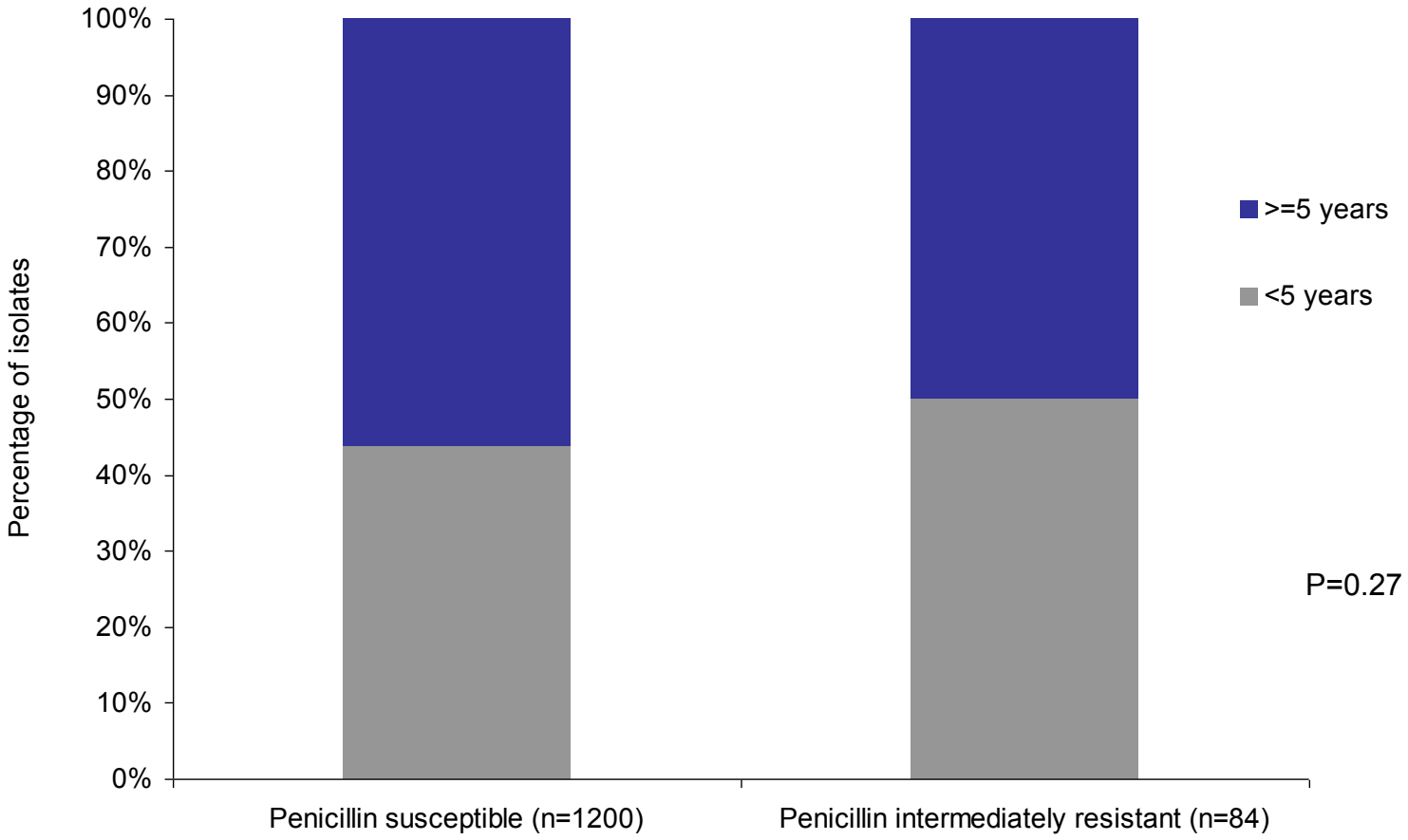
du Plessis *et al*, J Clin Microbiol, 2008

Percentage of penicillin intermediately-resistant meningococci by year and serogroup, South Africa, 2001-2005



du Plessis *et al*, J Clin Microbiol, 2008

Percentage of penicillin intermediately-resistant meningococci by age category, South Africa, 2001-2005



du Plessis *et al*, J Clin Microbiol, 2008

Summary

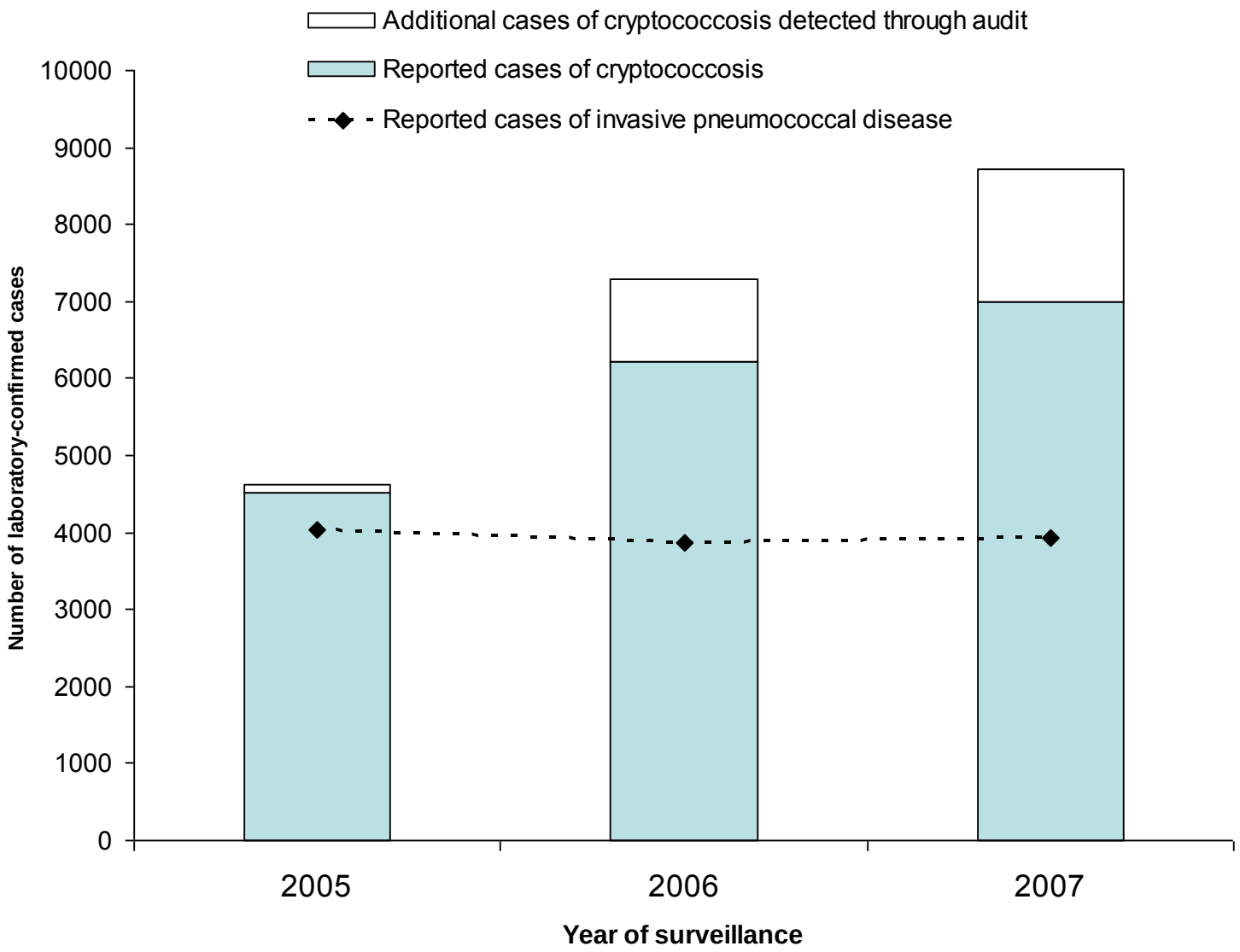
- Standardised methodologies
- Choice of antibiotics
  - Antibiotics used for treatment
  - New antibiotics $\rightarrow$ monitoring for emergence
- Molecular characterisation
- Regular analysis, review and feedback
- Future
  - Pneumococcal and Hib changes with routine vaccination
  - Meningococcal resistance for fluoroquinolones (MMWR, 2008)

Trends in antifungal drug susceptibility of *Cryptococcus* species, obtained through population-based surveillance, South Africa, 2002-2008

Nelesh Govender
Mycology Reference Unit,
National Institute for Communicable Diseases, a branch of the National Health Laboratory Service

NATIONAL HEALTH LABORATORY SERVICE

Annual number of cases of cryptococcosis (n=17,741), compared with number of reported cases of invasive pneumococcal disease (n=11,837), South Africa, 2005-2007



Questions

1. Has there been a change in susceptibility to “first-line” antifungal drugs, amongst South African incident-episode isolates, over time?

2. What is the susceptibility pattern for newer or infrequently-used drugs?

Incident-episode isolates

- Inclusion criteria:
  - Diagnosed at any one of four academic hospitals in Gauteng with first episode of cryptococcosis
  - Viable isolate available for testing from incident episode

- Isolates were selected, using a random number generator, from unique case patients identified during 2 surveillance periods:
  - March 2002 through February 2003
  - March 2007 through February 2008

Susceptibility to “first-line” drugs

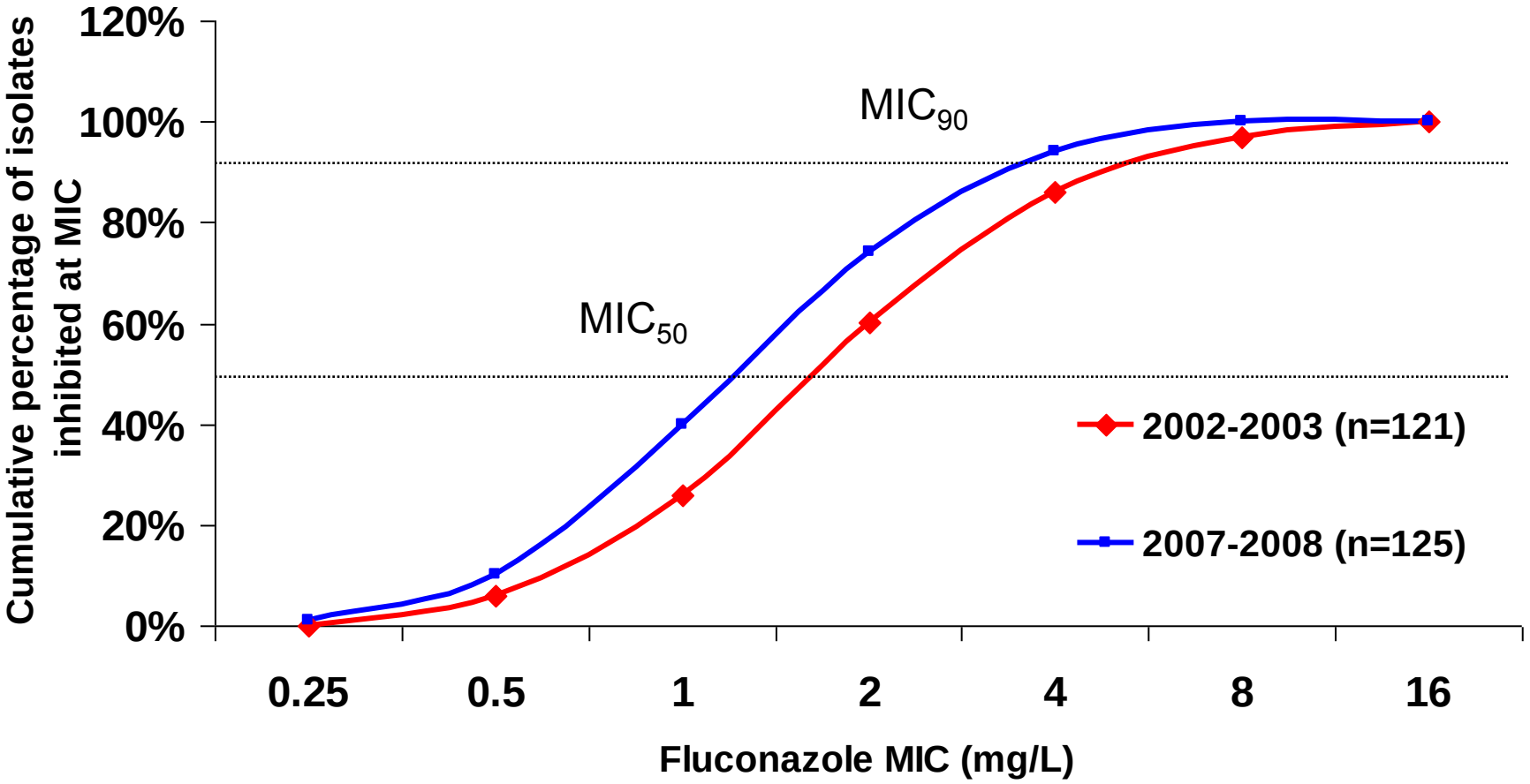
Antifungal drug	MIC (mg/L) for:					
	Isolates from 2002-2003 (n=121)			Isolates from 2007-2008 (n=125)		
	Range	*MIC_{50}	*MIC_{90}	Range	*MIC_{50}	*MIC_{90}
Amphotericin B	0.012-0.38	0.102	0.191	0.008-0.94	0.105	0.198
Fluconazole**	0.25-16	1.429	4.085	0.25-8	1.338	2.543

*Geometric mean titres for MIC_{50} and MIC_{90}

**Fluconazole MICs were determined for 183 additional, randomly-selected isolates: 66 in 2002-2003 (n=187) and 117 in 2007-2008 (n=242)

Susceptibility to fluconazole

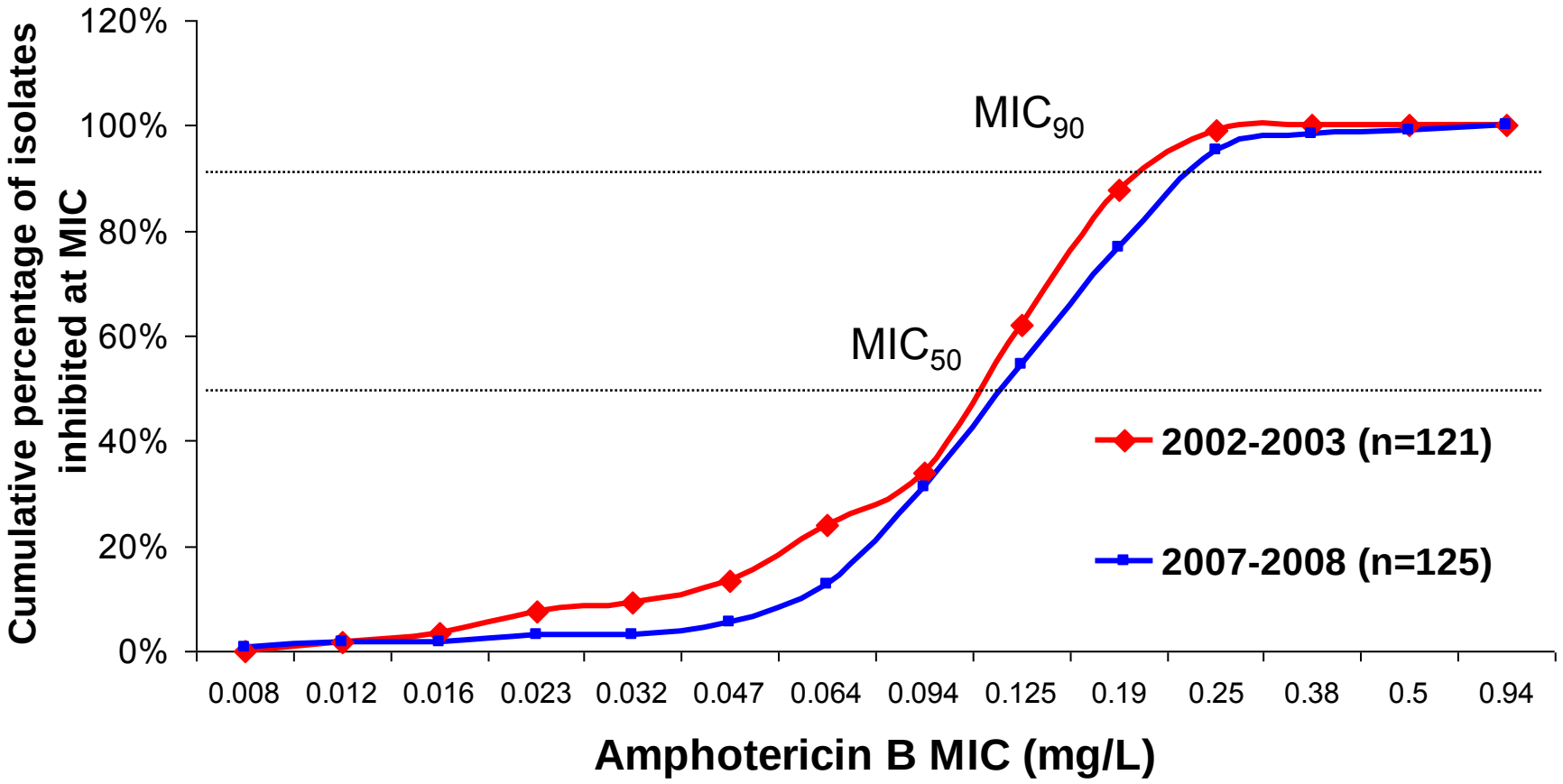
No isolates with MIC >16



*Fluconazole MICs were determined for 183 additional, randomly-selected isolates: 66 in 2002-2003 (n=187), and 117 in 2007-2008 (n=142)

Susceptibility to amphotericin B

No isolates with MIC >2



Susceptibility to other drugs

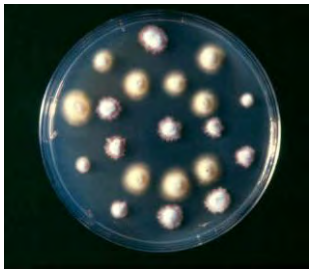
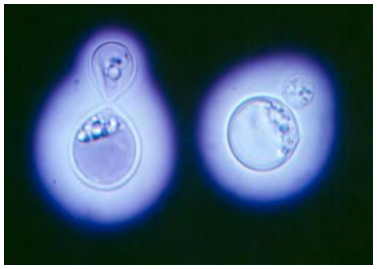
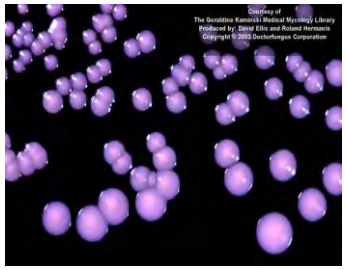
Antifungal drug	MIC (mg/mL) for:					
	Isolates from 2002-2003 (n=121)			Isolates from 2007-2008 (n=125)		
	Range	MIC_{50}	MIC_{90}	Range	MIC_{50}	MIC_{90}
Flucytosine	0.25-16	1	4	0.05-8	1	2
Itraconazole	0.03-1	0.12	0.25	0.015-0.5	0.06	0.12
Voriconazole	0.008-0.25	0.015	0.06	0.008-0.25	0.015	0.03
Posaconazole	0.03-0.5	0.12	0.25	0.03-1	0.06	0.12

Incident-episode isolates **Summary**

- No upward shift in “first-line” drug MICs between 2002-2003 and 2007-2008, despite widespread use and availability of fluconazole

- Uniformly low MICs for flucytosine and itraconazole, which are infrequently-used drugs for treatment of cryptococcosis in South Africa, with little change over time

- Potent, in-vitro activity demonstrated for newer, antifungal drugs – voriconazole and posaconazole

TRAC-SOUTH AFRICA

Tracking **R**esistance to **A**ntifungal drugs for *C**andida*** species in South Africa

TRAC-South Africa
Objectives

- **Primary**
  - Describe the species distribution and susceptibility to 9 antifungal drugs for fungaemic *Candida* isolates from 20 sentinel, laboratory sites (in the public- and private-health sector) in South Africa, 2009-2010
- **Secondary**
  - Determine the rank importance of candidaemia, compared with other causes of bloodstream infection at sentinel sites
  - Calculate incidence rates for candidaemia at sentinel sites in the public-health sector

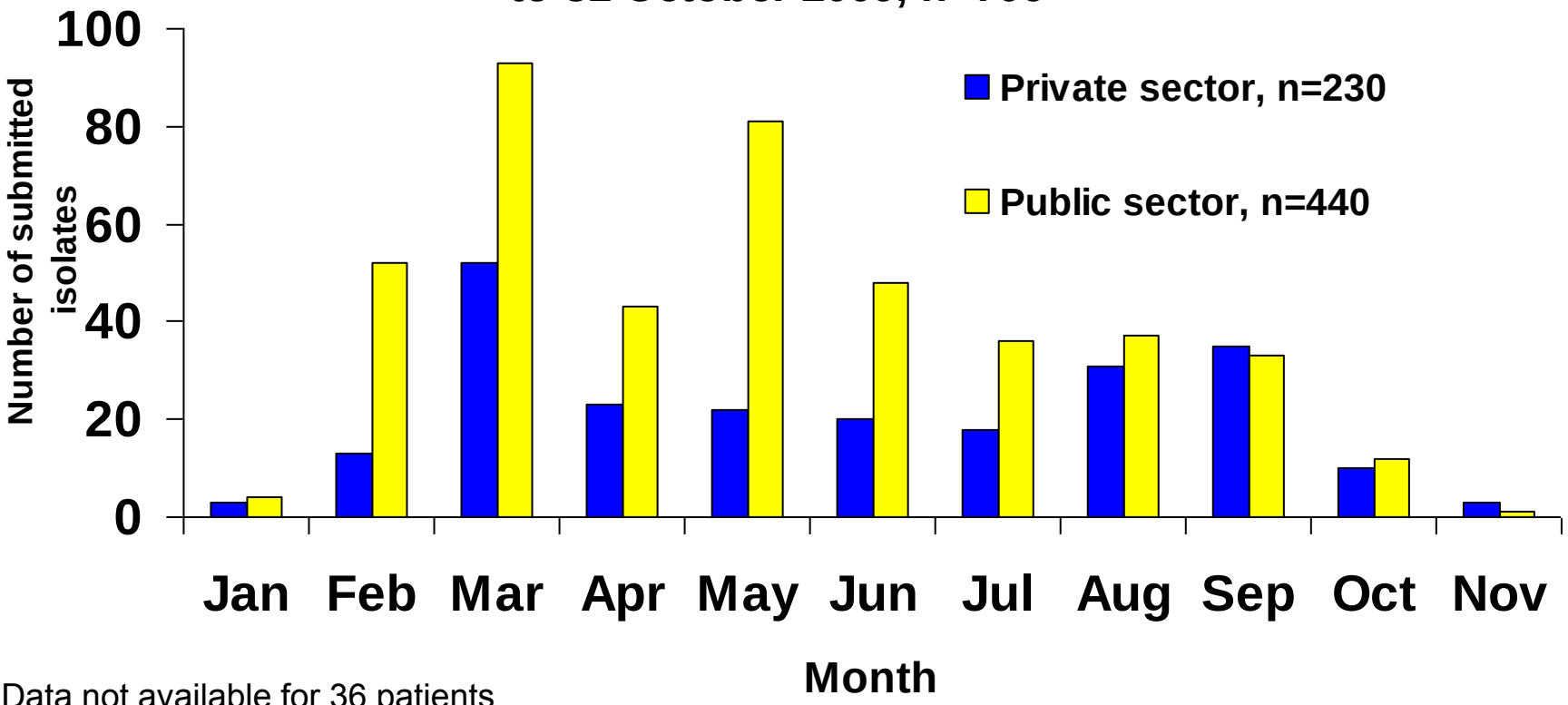
TRAC-South Africa
Methods

- **Case definition**: All patients with an incident episode of candidaemia who are admitted to any hospital, linked to a sentinel laboratory, during 2009 and 2010

- **Isolates** are submitted to the Mycology Reference Unit at NICD for:
  - Species identification
  - Susceptibility testing for 9 antifungal drugs: caspofungin, anidulafungin, micafungin, fluconazole, voriconazole, itraconazole, posaconazole, flucytosine, amphotericin B

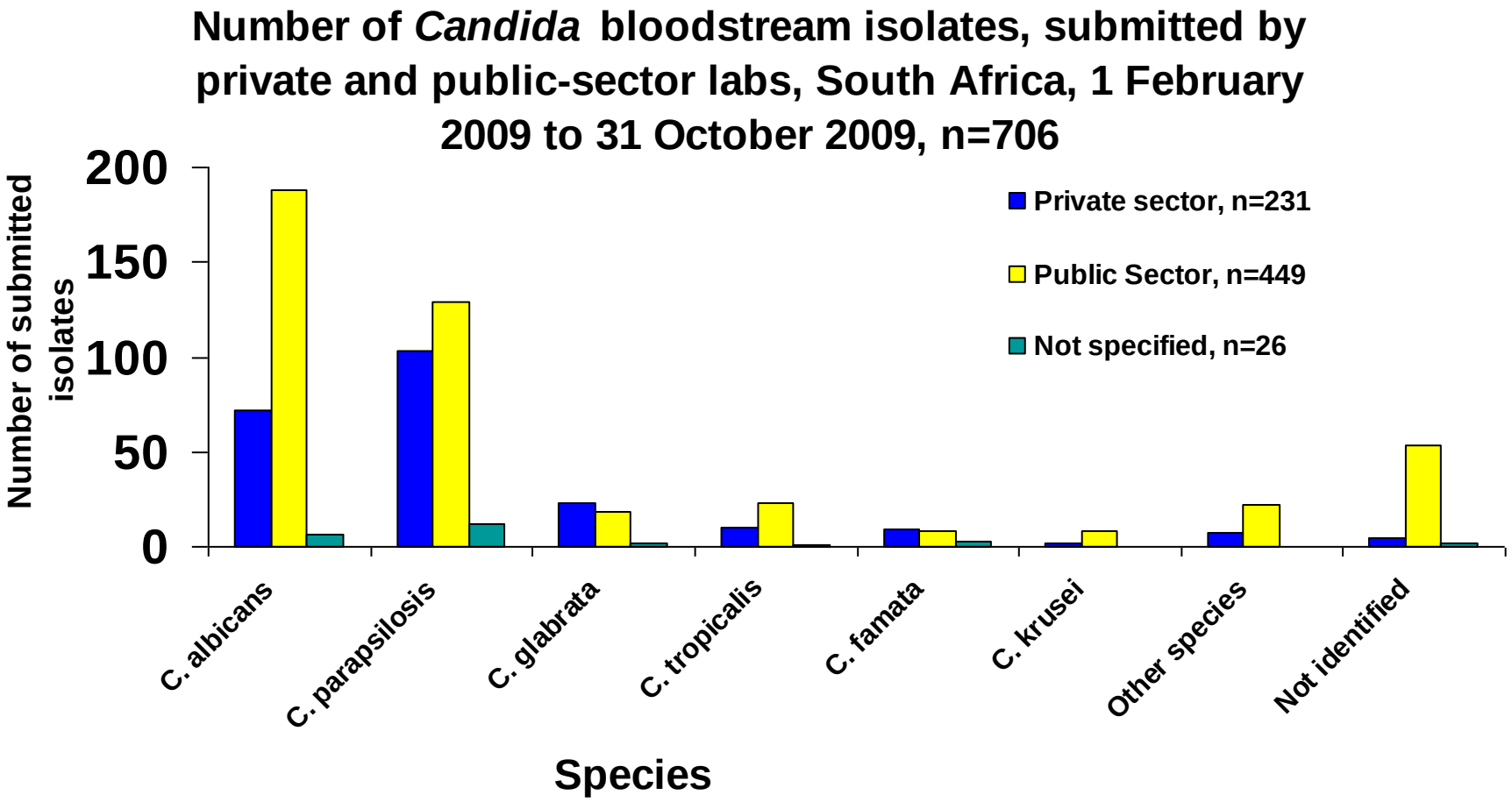
TRAC-SOUTH AFRICA
Isolates

Number of *Candida* bloodstream isolates, submitted by private and public-sector labs, South Africa, 1 January 2009 to 31 October 2009, n=706



*Data not available for 36 patients

TRAC-SOUTH AFRICA
Isolates



*Based on species ID provided by sending lab

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- TRAC-SA co-investigators, including public- and private-sector, and international collaborators

- The Mycology Reference Unit team

- The laboratories which submit isolates and case data to NICD

GERMS SOUTH AFRICA

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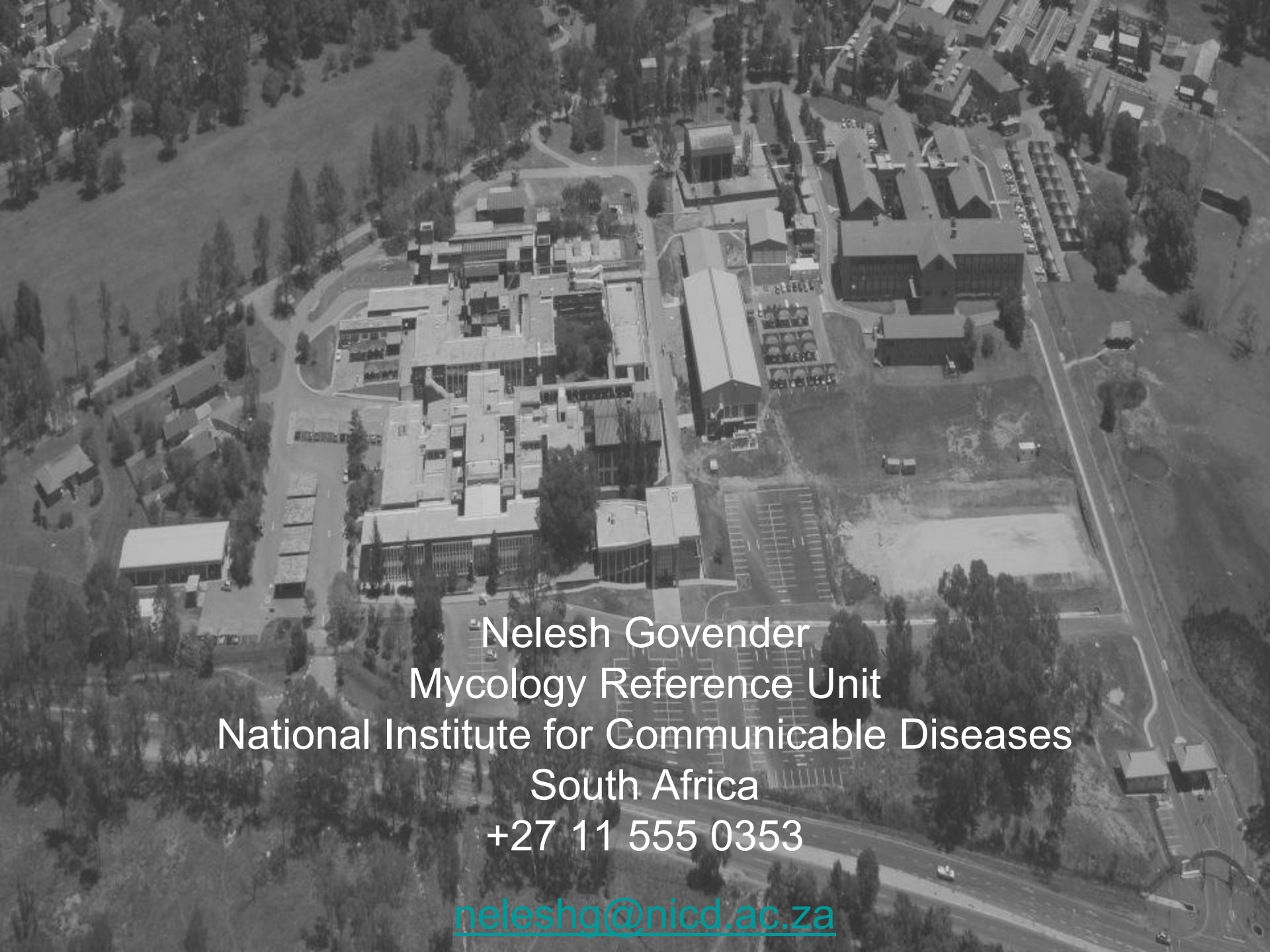

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GERMS-SA Case Definitions

Pathogen	Specimen	Lab tests
Streptococcus pneumoniae *Haemophilus* spp. *Neisseria meningitidis*	All normally sterile site specimens, e.g. CSF, blood, pleural fluid, peritoneal fluid, pericardial fluid, joint fluid, tissue, *etc.*	Culture positive **OR** Consistent Gram stain and positive antigen test **OR** PCR
Salmonella spp. (including *Salmonella* Typhi) *Shigella* spp.	All normally sterile site specimens, e.g. CSF, blood, pleural fluid, peritoneal fluid, pericardial fluid, joint fluid, tissue, etc. **OR** Gastrointestinal specimens, e.g. stools, rectal swabs, etc.	Positive Culture
Diarrhoeagenic *E. coli* *Vibrio cholerae*	Gastrointestinal specimens, e.g. stools, rectal swabs, etc.	Positive Culture
Cryptococcus spp.	Any specimen	Positive Culture **OR** Positive Antigen **OR** Positive India ink
Pneumocystis jirovecii	Respiratory tract specimens, e.g. sputum, bronchoalveolar lavage fluid, etc.	IFA positive