

Antibiotic Pressure and Resistance in Bacteria

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Antibiotic Pressure and Resistance in Bacteria

- What is it and why is it important?
- How extensive is it?
- How does it happen?
- What factors promote the spread of resistant bacteria ?
- How does it pertain to the development of CA-MRSA infections?
- What can HCW do to curb this trend?

Antibiotic Pressure and Resistance in Bacteria

What is it ?

- **”Selection pressure of antibiotics has led to the emergence of antibiotic-resistant bacteria.”**
 - **Antibiotics can effect bacteria unrelated to the targeted infectious agent; these may be “normal” flora, leading to the emergence of resistant mutants inhabiting the same environment.**

Antibiotic Pressure and Resistance in Bacteria

Why is it important?

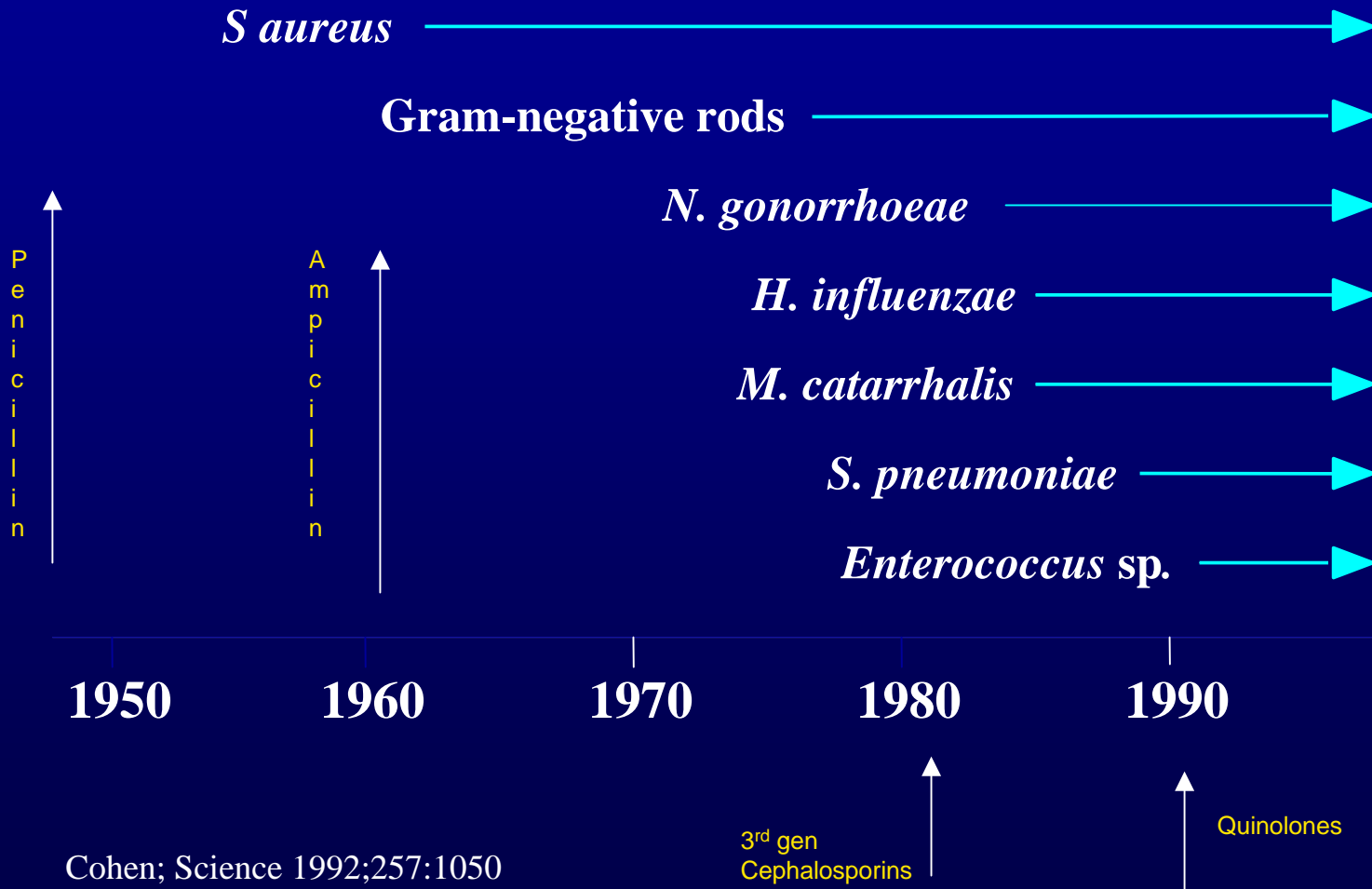
- Antibiotic resistance has developed in almost all classes of bacteria of pathogenic potential.
- Resistance in organisms of low virulence can emerge as important pathogens.
- The development of resistant bacteria has driven pharmaceutical research to develop more potent, broad-spectrum antibiotics.
- Use of these in turn, has fueled the appearance of bacteria with newer modes of resistance.

Antibiotic Pressure and Resistance in Bacteria

Why is it important?

- Infections with resistant bacteria occur in health care settings **AND** the community.
- Examples of hospital setting: MDR Gram neg, *MRSA*, *VRE*
- Examples of community : *MRSA*, *PRSP*, Pcn R Quin R *N. gonorrhoea*, antibiotic resistant *Salmonella* and *Shigella*

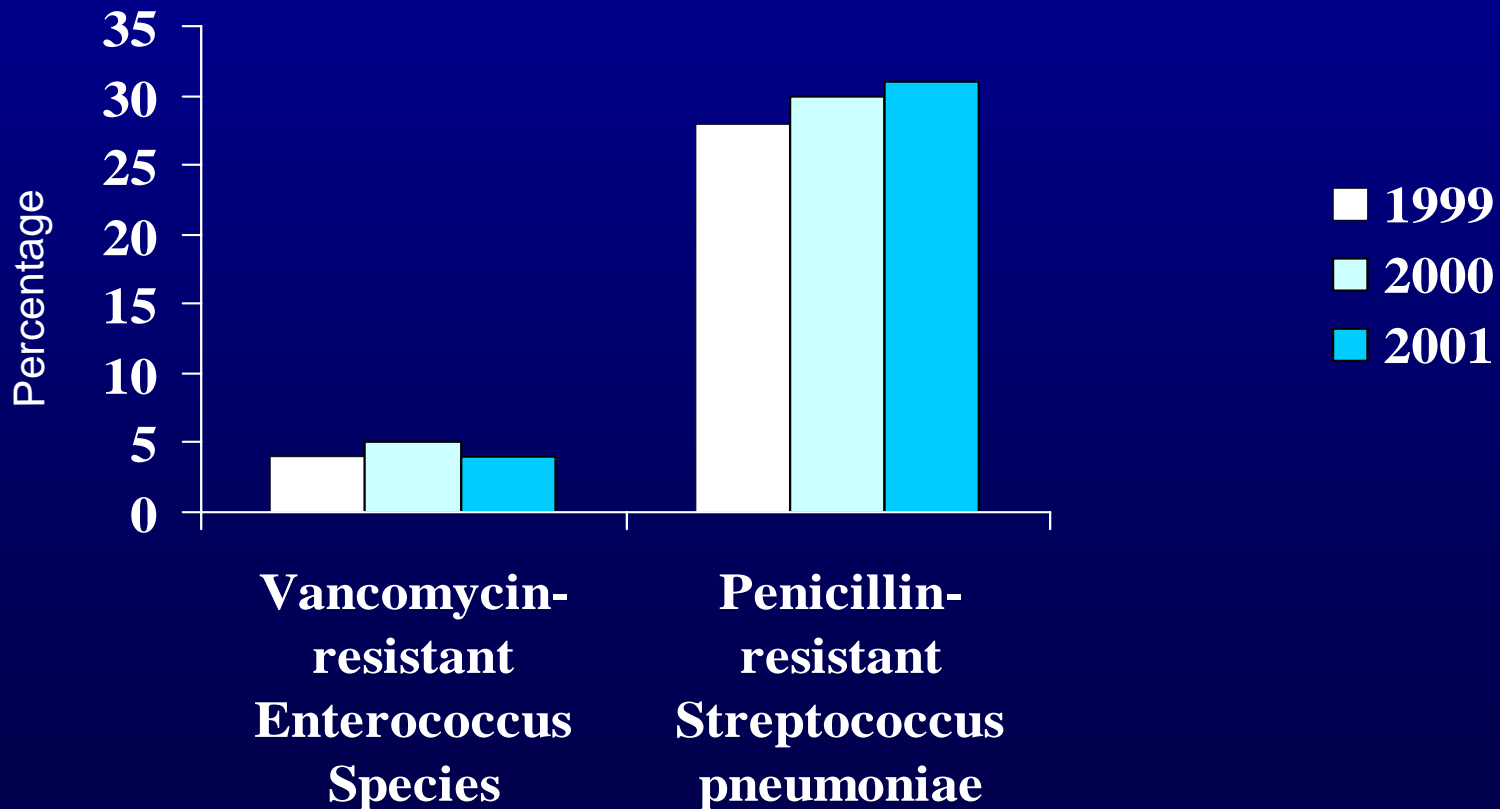
Emergence of Antibiotic-Resistant Bacteria



Cohen; Science 1992;257:1050

How extensive is the problem ?

Percentage of Laboratory Isolates Resistant to Antibiotics, Texas

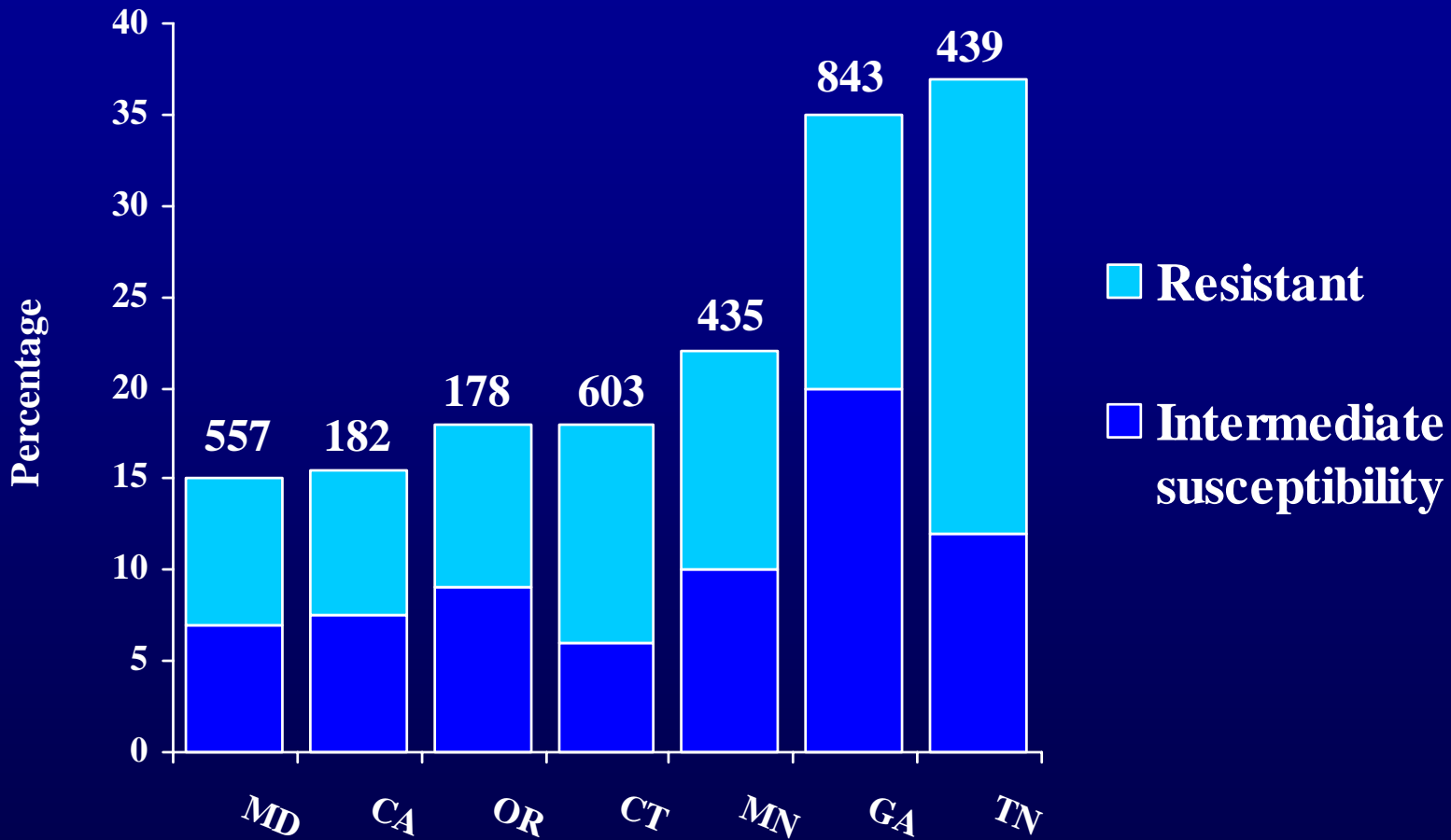


Scope of Problem:

S. pneumoniae

- Most common cause of bacteremia, bacterial pneumonia, meningitis, OM, sinusitis in childhood.
- Highest rates of invasive pneumococcal disease occur among young children, especially those aged <2 years
- US data: the seven most common serotypes isolated from the blood or CSF of children age <6 years account for 80% of disease
- Antimicrobial resistance is detected most frequently among these same serotypes.
- 1998 surveillance data from eight states: these serotypes accounted for **80%** of *penicillin-nonsusceptible isolates*.

Percentage of Invasive Pneumococcal Isolates Nonsusceptible to Penicillin, Selected States, 1997



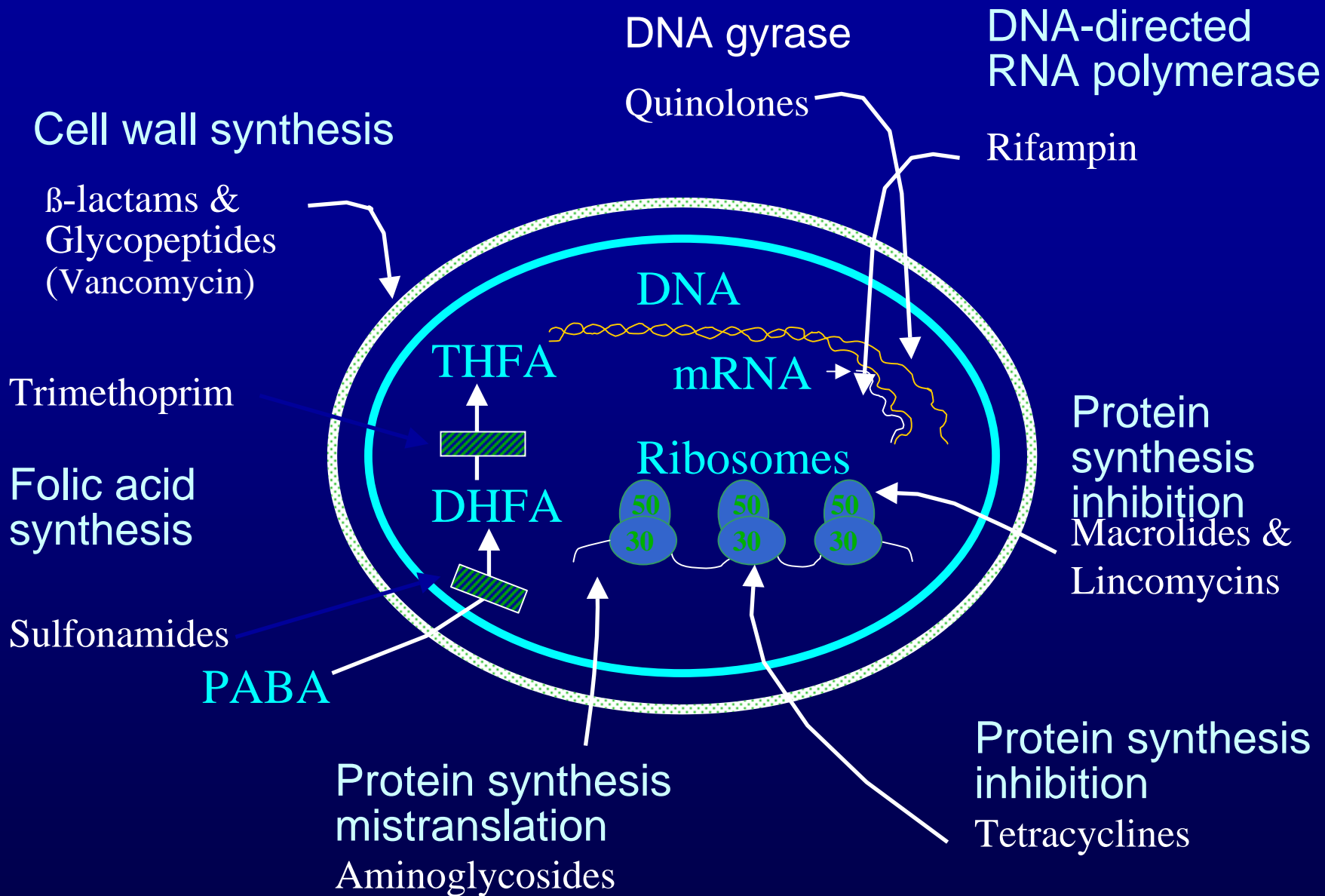
Mechanisms of Bacterial Resistance : how DO they do it ??



Antibiotic Pressure and Resistance in Bacteria

How does it occur?

- All antibiotics do NOT kill bacteria in the same way.
- Various classes of antibiotics work on different aspects of bacterial replication.



Antibiotic Pressure and Resistance in Bacteria

How does it happen ?

- Bacteria can become resistant as a result of genetic mutations; these can be transferred between bacteria and groups of bacteria.
- Under selective pressure of antibiotic exposure, these strains then proliferate.

Antibiotic Pressure and Resistance in Bacteria

What happened to S. aureus ?

- Can become Resistant to the B-lactam drugs (PCNs, Cephalosporins) by making a B-lactamase.
- In response to development of a drug that is stable to this mechanism (methicillin/oxacillin), *S. aureus* alters its binding site (PBP): Methicillin Resistant *S. aureus* (*MRSA*)
- In response to use of other types of antibx to combat *MRSA*: few strains now with decr. sens to vancomycin, clindamycin.

Antibiotic Pressure and Resistance in Bacteria

What happened to S. aureus ?

- Reports of increasing use of third gen cephalosporins and quinolones related to emergence of MRSA.
- Some data suggest that quinolones enhance expression of methicillin resistance in SA *in vitro*
- *Outbreaks of MRSA have been reduced by curbing antibiotic use: esp cephalosporins*

Antibiotic Pressure and Resistance in Bacteria

What factors promote their development and spread ?



Alteration of normal flora



Practices contributing to misuse of antibiotics



Settings that foster drug resistance



Failure to follow infection control principles

Practices Contributing to Misuse of Antibiotics



Inappropriate specimen selection and collection



Inappropriate clinical tests



Failure to use stains/smears



Failure to use cultures and susceptibility tests

Practices Contributing to Misuse of Antibiotics



Inappropriate specimen selection and collection



Inappropriate clinical tests



Failure to use stains/smears



Failure to use cultures and susceptibility tests

Inappropriate Antibiotic Use



Use of antibiotics with no clinical indication (eg, for viral infections)



Use of broad spectrum antibiotics when not indicated



Inappropriate choice of empiric antibiotics

Inappropriate Drug Regimen



Inappropriate dose - ineffective concentration of antibiotics at site of infection



Inappropriate route - ineffective concentration of antibiotics at site of infection



Inappropriate duration

Settings that Foster Drug Resistance

Community



Day-care centers



Long term care facilities



Homeless shelters



Jails

Settings that Foster Drug Resistance

 Intensive care units

 Oncology units

 Dialysis units

 Rehab units

 Transplant units

 Burn units

Physicians Can Impact

Patients



Optimize patient evaluation
Adopt judicious antibiotic
prescribing practices
Immunize patients

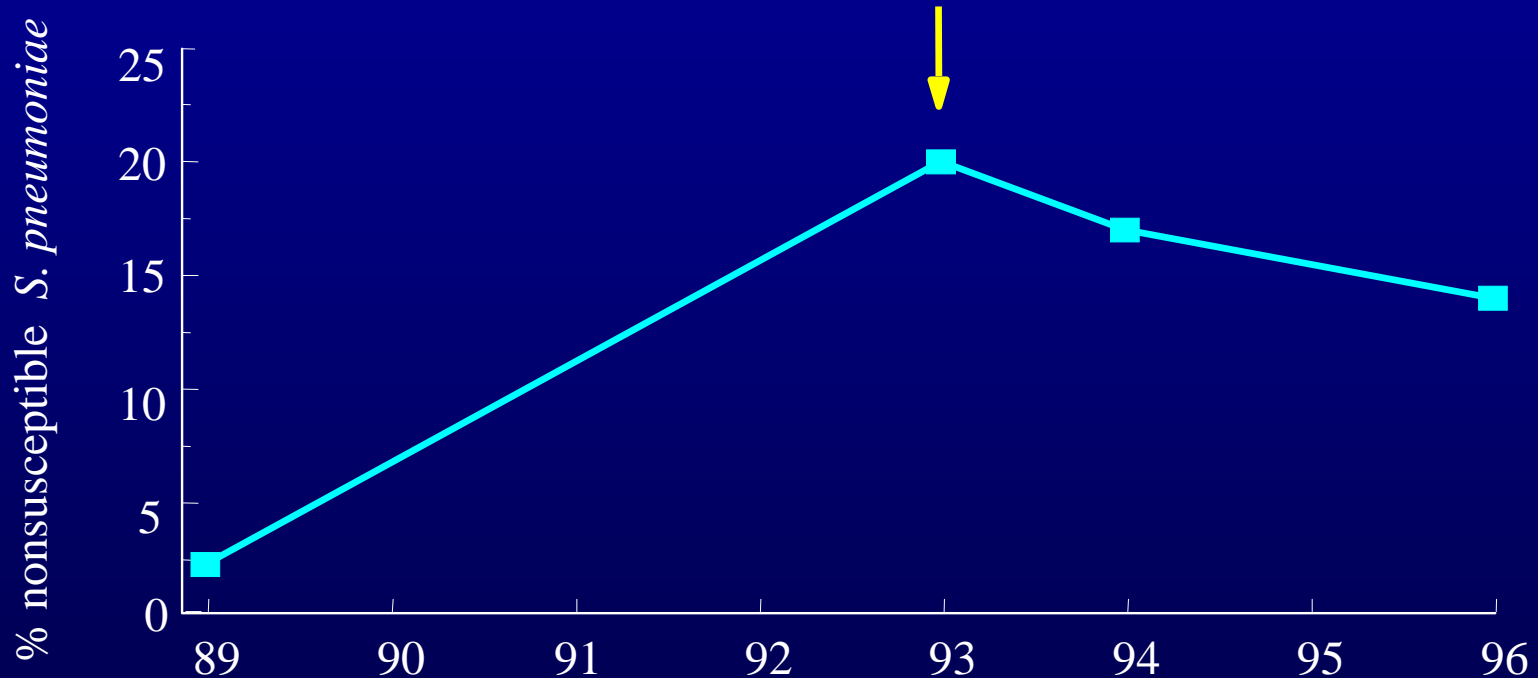
Other clinicians



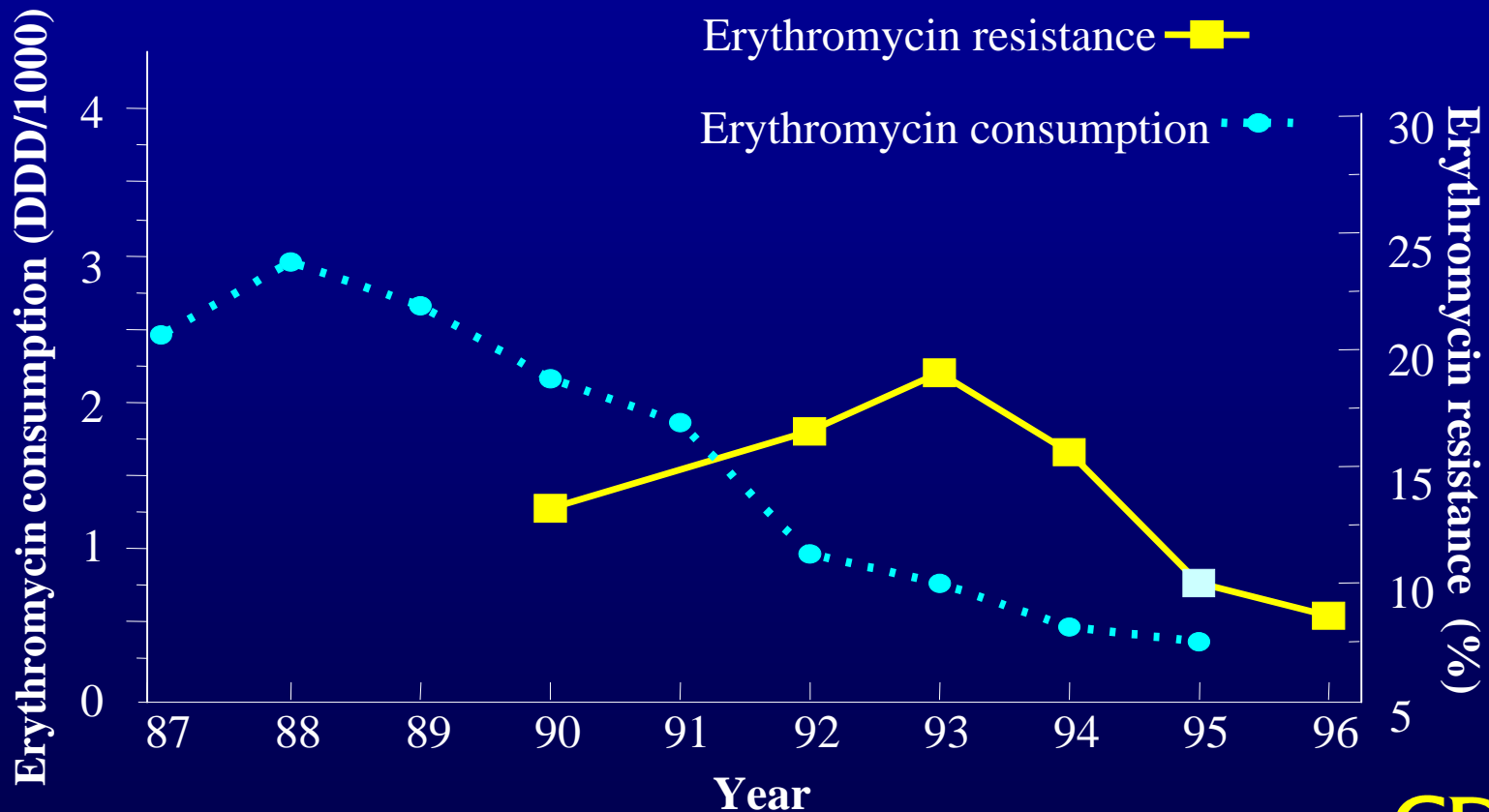
Optimize consultations with
other clinicians
Use infection control measures
Educate others about judicious
use of antibiotics

Controlling Pneumococcal Resistance- Iceland

Public campaign, physician education, and
increased antibiotic cost



Controlling Erythromycin Resistance in Group A Streptococci - Finland



Antibiotic Pressure and Resistance in Bacteria: *Conclusions*

- Bacteria evolve resistance to antibiotics in response to environmental pressure exerted by the use of antibiotics.
- Many of these bacteria are significant pathogens.
- Our responsibility to our community is to use antibiotics prudently, for appropriate indications.