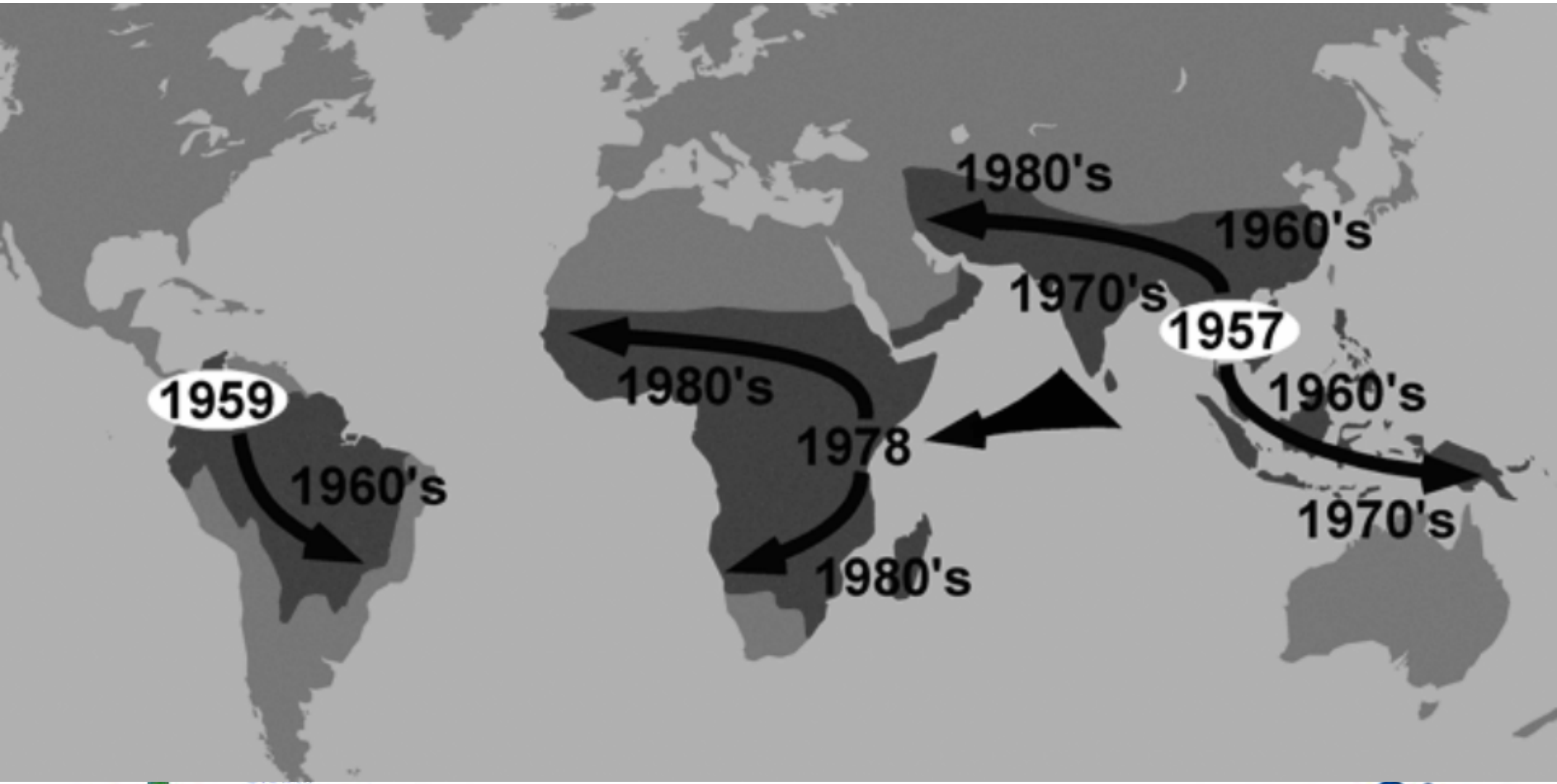
Leading Infectious Killers
Millions of deaths, worldwide, all ages,

P. falciparum – resistance to CQ, SP in most endemic countries. Emerging resistance to artemisinin

Global spread of chloroquine-resistant strains of *P. falciparum*



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Health Care Consequences

Higher Cost of Care

- Higher prescription cost of newer antibiotics
- Rising insurance premiums

Lower Quality of Care

- Increased risk of morbidity and mortality
- Each year 63,000 deaths attributed to drug resistance in hospital infections by CDC

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Difficulty in Measuring Burden of Resistance

- Resistance-related hospitalizations are not recorded
- Correlation between disease severity and colonization with resistant pathogen
- Not all antibiotic use is bad

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Why is resistance increasing?

Factors internal to the health care system

- Overuse and inappropriate use (for instance, to treat viral infections)
- Sicker patients and longer hospital stays
- Inadequate infection control in hospital settings
- Insufficient treatment compliance
- Widespread use of broad spectrum agents

Factors external to the health care system

- Use in poultry and cattle feed as growth promoters
- Spread of drug resistance from other countries

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What are the incentives to protect antibiotic effectiveness?

Those who use (or manufacture) antibiotics may not have sufficient incentives to consider the impact (cost) of this usage on the rest of society

- Incentives for patients
- Incentives for physicians
- Incentives for hospitals
- Incentives for pharmaceutical companies
- Government?

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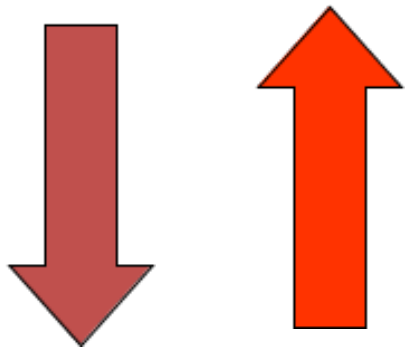
RESOURCES FOR THE FUTURE

Dealing with resistance

Make better use of existing drugs



Find new drugs

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Incentives for Physicians

- Satisfying patient expectations

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TABLE 5

Frequency of Antibiotic Prescribing by Factors Related to Patients' Expectations of Antibiotics (N = 482)

Factor	No.* (%)	Antibiotic Prescribed No. (%)	OR (95% CI)
Patient expects antibiotic			
Yes	290 (60)	213 (73)	2.6 (1.7-3.9)
No	150 (31)	78 (52)	reference
No answer	42 (9)	28 (67)	
Clinician believes patient expects an antibiotic			
Yes	298 (62)	236 (79)	4.7 (3.2-7.1)
No	182 (38)	81 (45)	reference
No answer	2 (<1)	2 (100)	
Antibiotic helped similar illness in the past			
Yes	284 (59)	212 (75)	4.5 (2.9-6.9)
No	170 (35)	88 (52)	reference
Don't know	19 (4)	12 (63)	
No answer	9 (2)	5 (56)	

NOTE: Because some questions were unanswered, the numbers may not add up to 482.
*In outpatients with nonspecific upper respiratory infections, acute bronchitis, or acute sinusitis.
OR denotes odds ratio; CI, confidence interval.

Dosh, J Fam Pr 1999

Incentives for Physicians

- Satisfying patient expectations
- Financial (reimbursement) incentives
  - Substitute for repeat visit
- Malpractice liability

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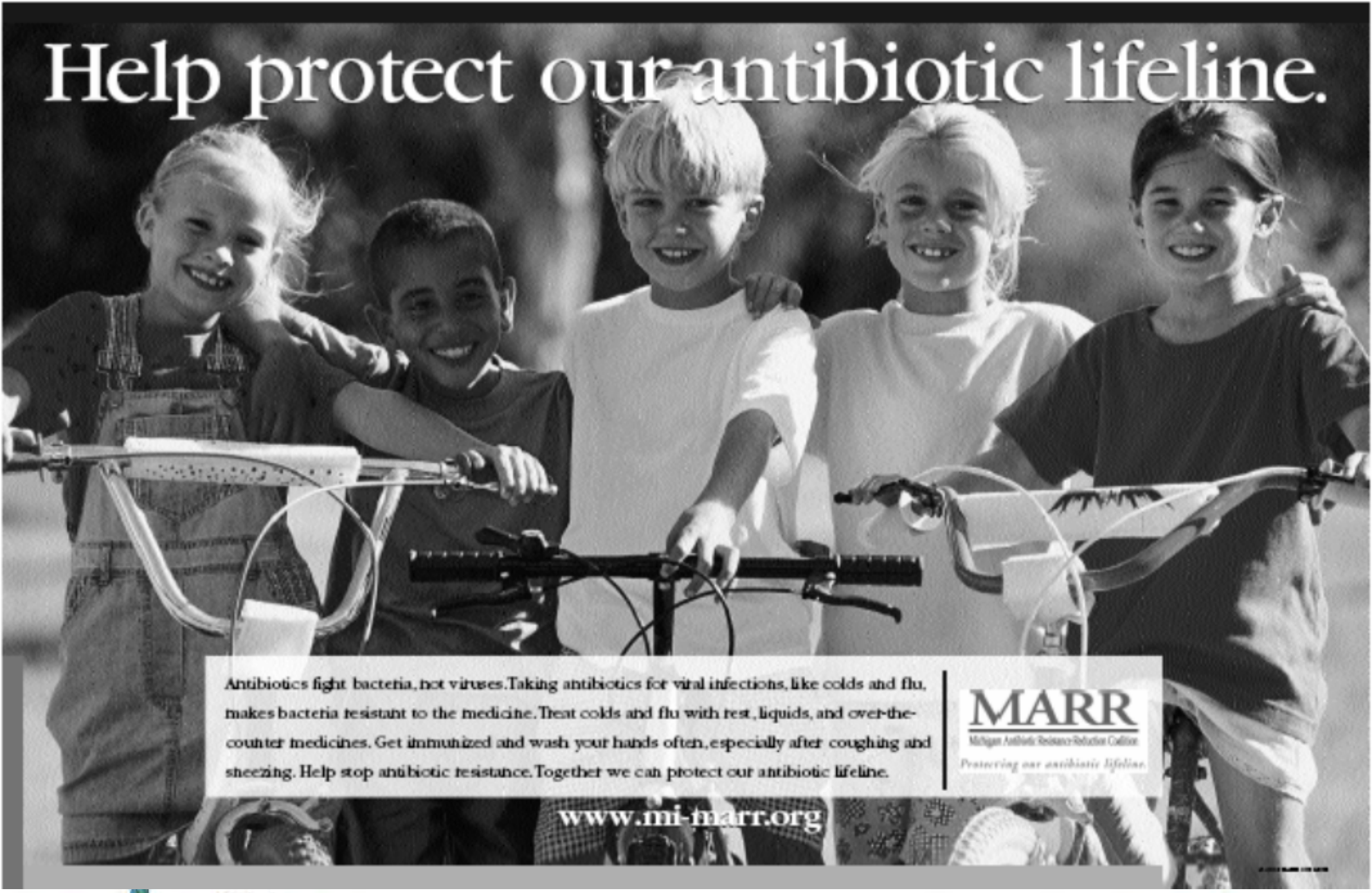

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Campaign to Prevent Antimicrobial Resistance

Centers for Disease Control and Prevention
National Center for Infectious Diseases
Division of Healthcare Quality Promotion

Clinicians hold the solution!

- *Link to: Campaign to Prevent Antimicrobial Resistance Online*
- *Link to: Federal Action Plan to Combat Antimicrobial Resistance*

CDC
Centers for Disease Control and Prevention

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Antibiotic resistance: What's that?

Bacteria often cause infections such as urinary tract or respiratory tract infections, e.g. pneumonia.

Fortunately, there are antibiotics which are usually able to fight these bacteria reliably.

However, bacteria know how to resist antibiotics. Especially when the dose of the antibiotic is too small or treatment is discontinued too soon, the bacteria have the chance to survive. The survivors use this immediately by developing different defence mechanisms against future antibiotic attacks.

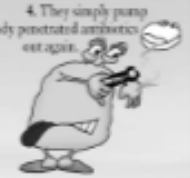
Bacteria are tiny, but firmly set on survival.
They can develop four different ways to protect themselves against the deadly effect of antibiotics:

1. They change their vulnerable target, so that antibiotics are unable to find points of attack.

2. They produce enzymes which make certain antibiotics ineffective.

3. They change their outer shell, so that antibiotics cannot penetrate any longer.

4. They simply pump already penetrated antibiotics out again.



If bacteria can repel the attack of an antibiotic by these mechanisms, then they have become resistant to this antibiotic. Unfortunately, resistant bacteria multiply just as quickly as do all other bacteria.

Resistant bacteria can be dangerous. Since certain antibiotics can no longer do them any harm, a simple infection can quickly turn into an illness that is difficult to treat. For this reason it is so important to prevent the emergence of resistance.

What can we do against resistance?

Patients can make an important contribution, by:
- not unnecessarily demanding antibiotics from their physician, e.g. to treat a common cold
- taking the antibiotic dose precisely as prescribed by the physician
- taking the prescribed dose regularly and completely - even if they quickly feel better again

Physicians can prevent the emergence of resistance, by:
- avoiding unnecessary prescription of antibiotics, e.g. for viral infections
- resisting unjustified demands by patients or parents for antibiotics
- prescribing suitable antibiotics which will work the fastest and best

Bayer AG supports physicians and patients through:
- supply of modern, efficient antibiotics
- the LIBRA initiative, which promotes the responsible use of antibiotics and which supports the fight against resistance development
- a broad information offer on this topic under www.librainitiative.com
- providing current data on resistance development - so-called Surveillance data - under www.librainitiative.com

LIBRA

Bayer

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SOURCES THE FUTURE

Hospital Incentives

- Antibiotics may be a substitute for infection control

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RESOURCES FOR THE FUTURE

Hospital Incentives

- Hospitals are "sources" for colonization with resistant pathogens
- Health facilities often "share" patients
- Positive external benefits of active surveillance and infection control

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Implications for policy

- Dutch experience: frequency of MRSA infections is < 0.5% after an intensive "search-and-destroy" campaign, compared with 50% in some areas
- In Siouxland (Iowa, Nebraska, S. Dakota), an epidemic of VRE was reversed
- Regionally coordinated response to epidemic

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Who pays for hospital-acquired infections?

- Medicare/Medicaid bear greatest burden of additional cost
- 76% of 11,668 HAIs in 2004 billed to federal Medicare ($1 billion cost)
- Rest to Medicaid ($372 million cost)
- $20 billion burden on Medicare nationwide

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Incentives for Pharma

- Example of Baytril
- Increasing patent scope for antibiotics
  - open access problem of drug effectiveness
  - welfare costs of monopoly power

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The Antibiotics Pipeline

Antibiotics are not a priority for pharmaceutical companies

- Less profitable than drugs for chronic diseases or lifestyle illnesses
- Focus on broad spectrum agents

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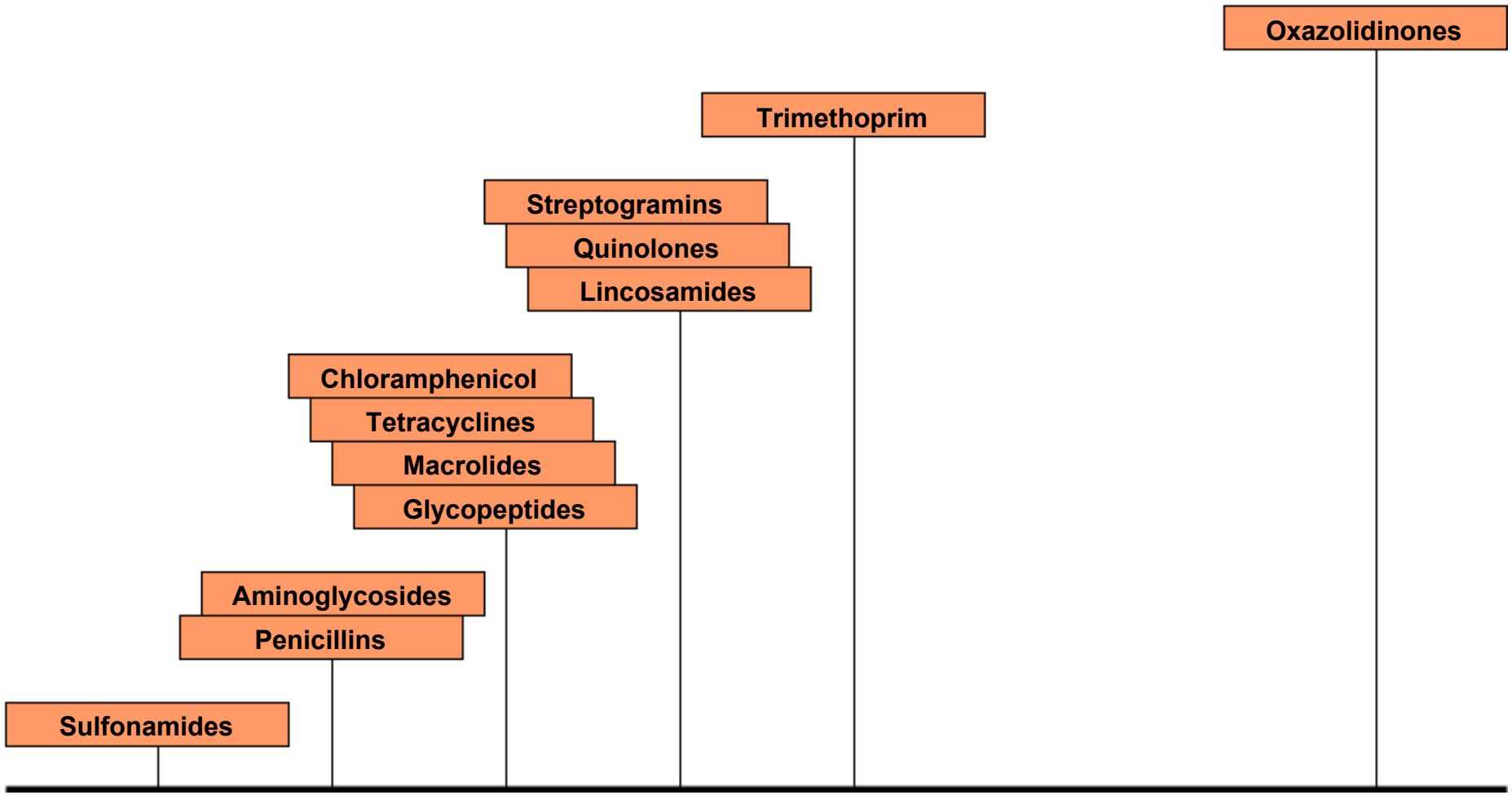
Discovery of new classes of antibiotics



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RESOURCES FOR THE FUTURE

Role for Government: Vaccinations

- Pnemococcal vaccinations
- Invest in R & D for a MRSA vaccine

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Role for Government: Infection Control

- Require hospital reporting of infections and resistance
- Medicare reimbursement for HAIs
- Regional cooperation in infection control

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Role for Government: Infection Control

- Invest in national surveillance
- Exercise regulatory oversight

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Challenges in developing countries

- Rising incomes – greater access to antibiotics

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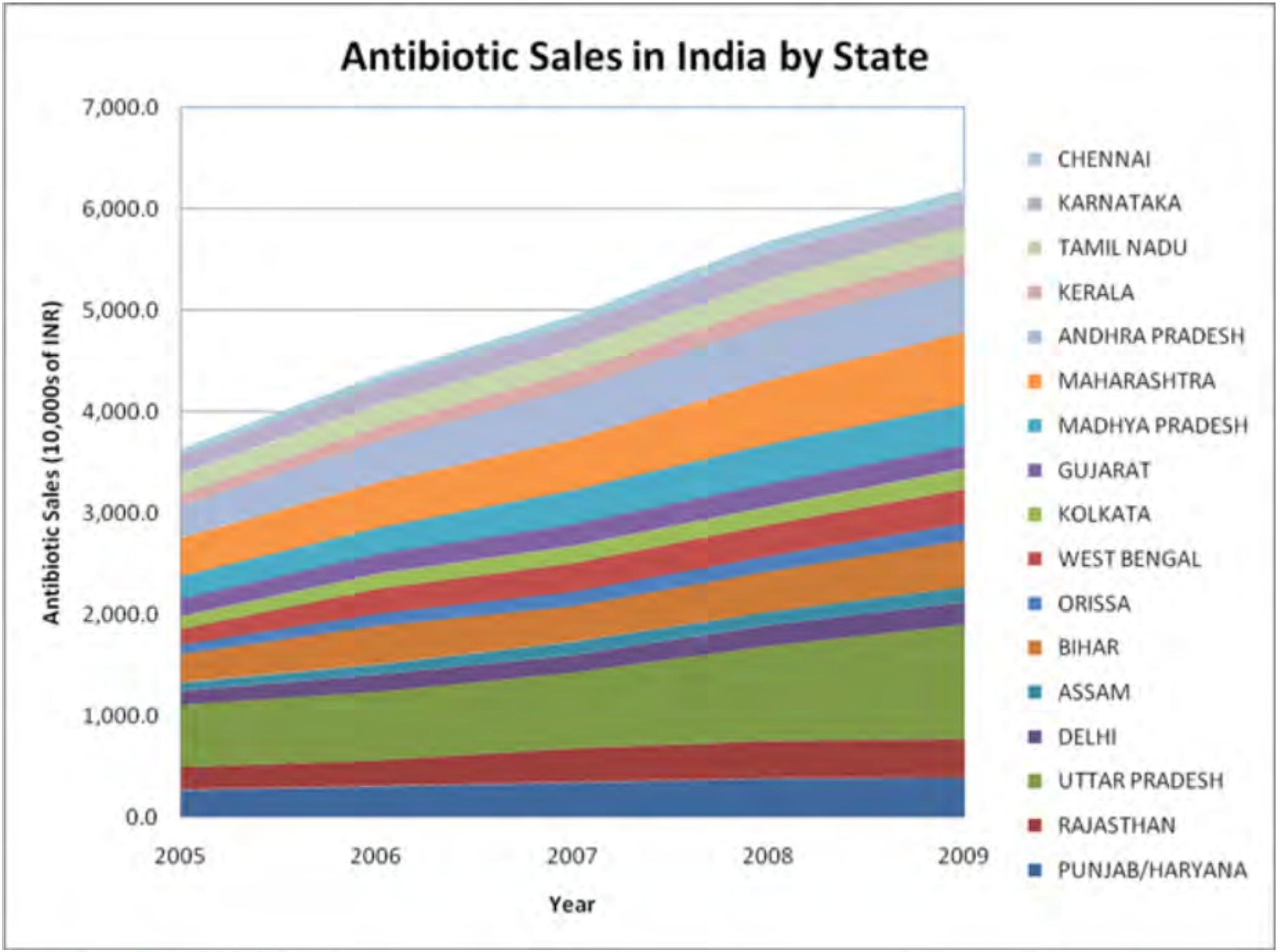
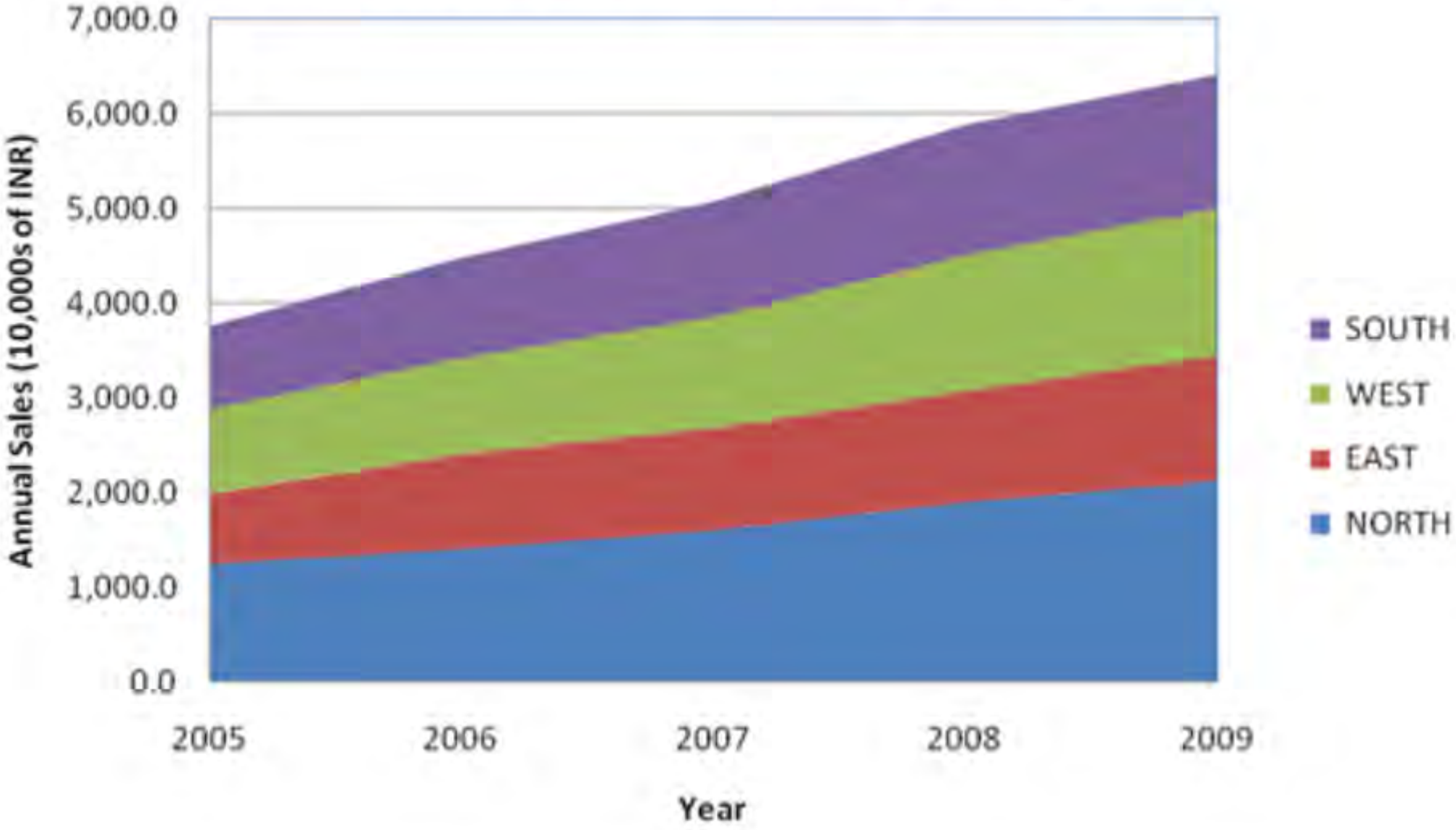

Antibiotic Sales in India by State
7,000.0
6,000.0
5,000.0
4,000.0
3,000.0
2,000.0
1,000.0
0.0
Antibiotic Sales (10,000s of INR)
2005
2006
2007
2008
2009
Year
CHENNAI
KARNATAKA
TAMIL NADU
KERALA
ANDHRA PRADESH
MAHARASHTRA
MADHYA PRADESH
GUJARAT
KOLKATA
WEST BENGAL
ORISSA
BIHAR
ASSAM
DELHI
UTTAR PRADESH
RAJASTHAN
PUNJAB/HARYANA

Antibiotic Sales in India by Region



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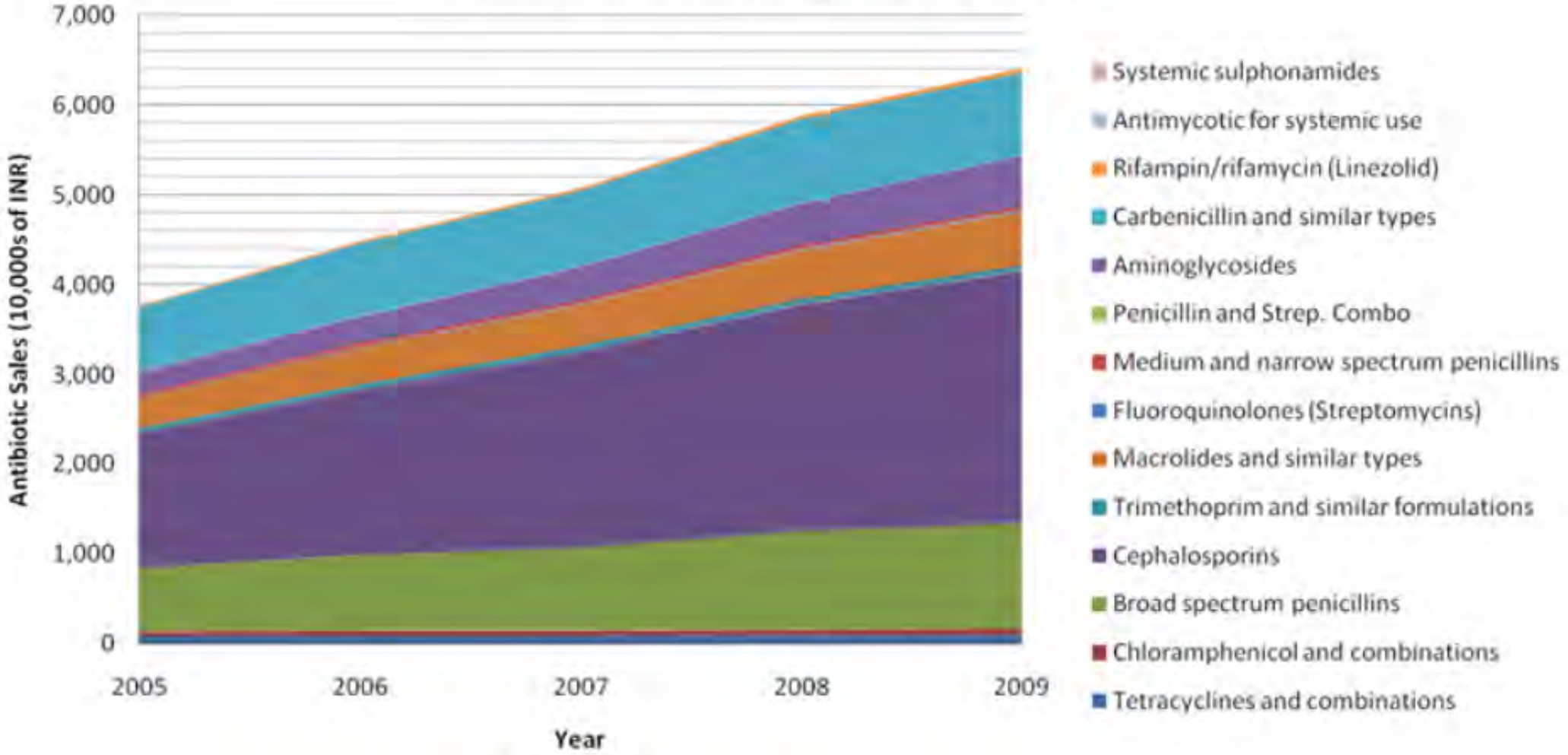
Antibiotic Sales in India by Type



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Challenges in developing countries

- Rising incomes – greater access to antibiotics
- Yet many patients do not have access to effective antibiotics
- Counterfeit or expired antibiotics
- Second line drugs may be unaffordable to many low-income families
- Burden of infectious disease including pneumococcal disease

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Objectives for this meeting

- How serious a problem is antibiotic resistance in Vietnam?
- What are the primary drivers of resistance?
- What policies could both help reduce the
  - Suboptimal use of antibiotics
  - Need for antibiotics
  - Emergence and spread of resistance

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