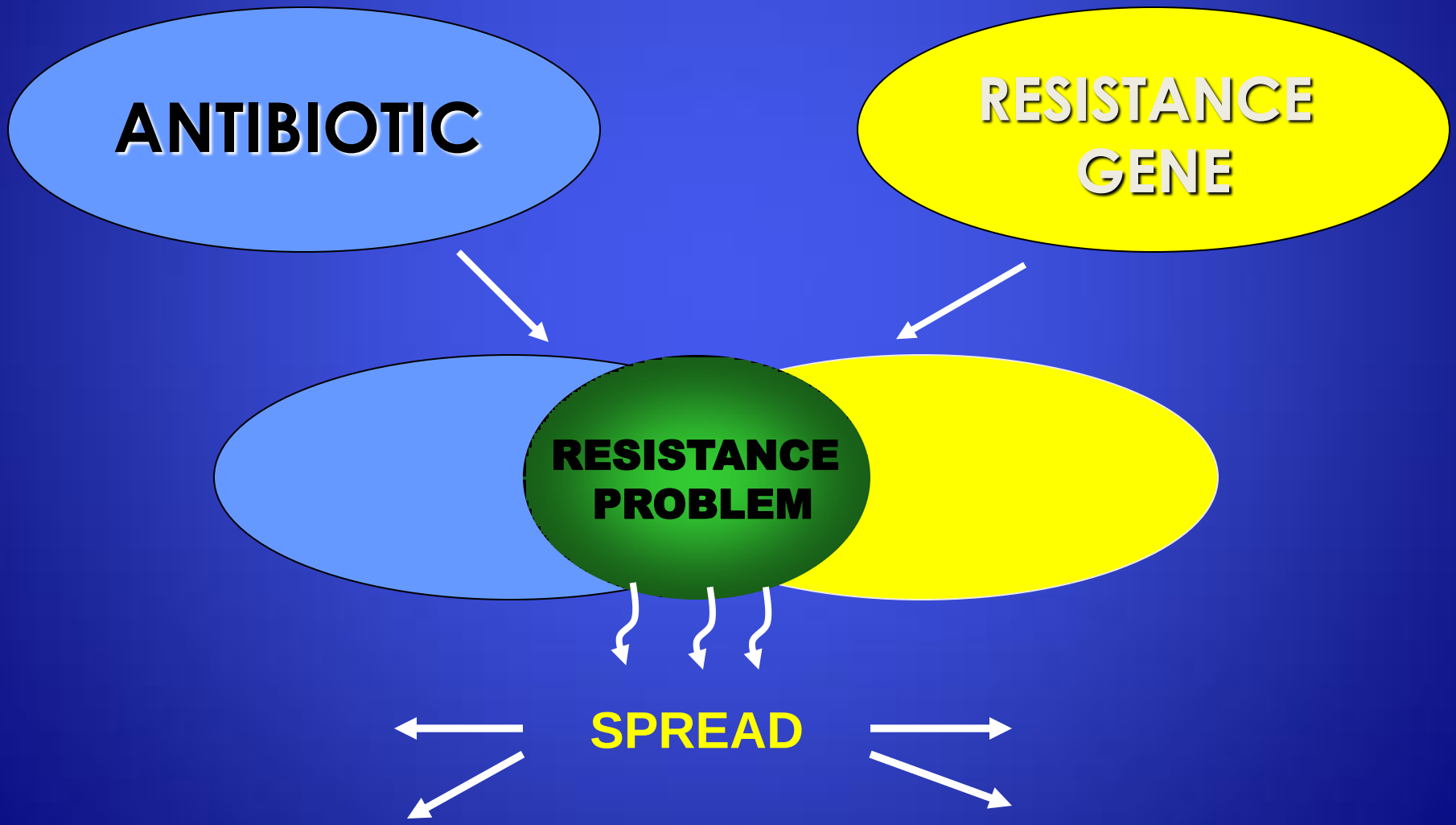
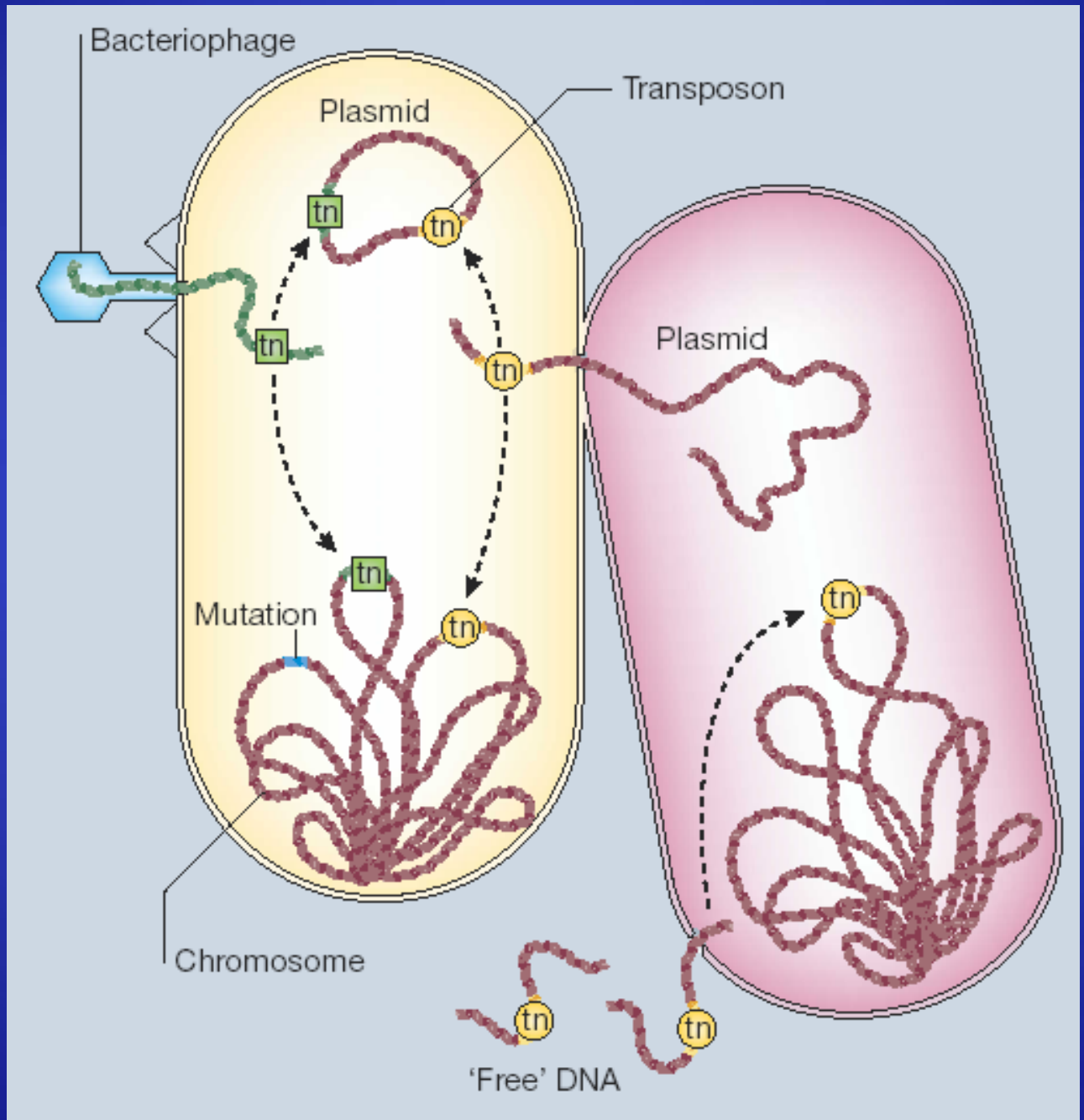
Antibiotic Resistance: A Global Call to Action

Stuart B. Levy MD
Tufts University School of Medicine
Alliance for the Prudent Use of Antibiotics

Drug Resistance Equation



Gene Transfer Mechanisms



Problems of Multidrug-Resistant Bacteria

Hospital

Gram-negative

- *Acinetobacter sp.*
- *Citrobacter sp.*
- *Enterobacter sp.*
- *Klebsiella sp*.
- *Pseudomonas aeruginosa*

Gram-positive

- *Clostridium difficile*
- *Enterococcus sp.*: VRE
- Coagulase-negative *Staphylococcus*
- *Staphylococcus aureus*: MRSA/VRSA

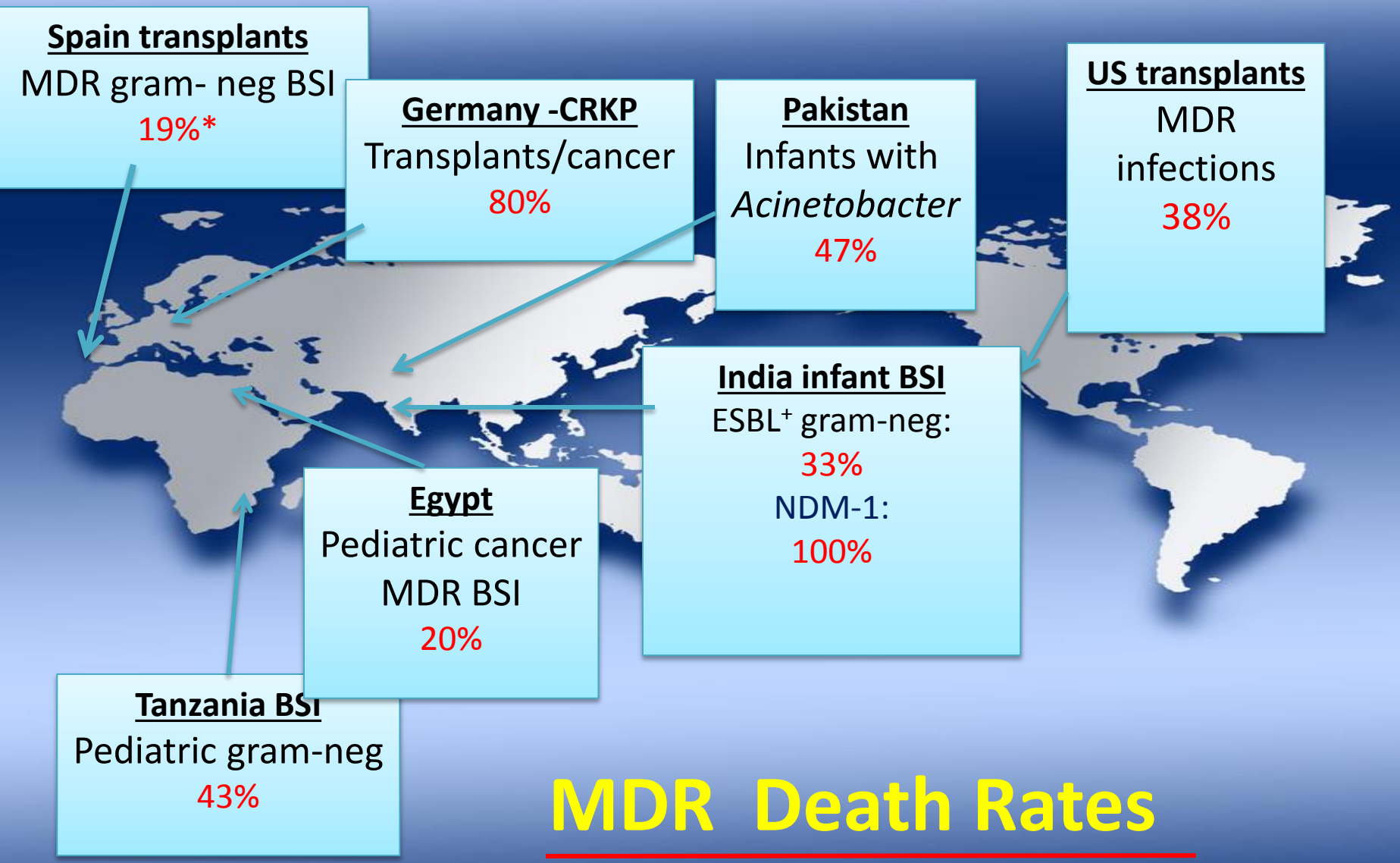
Community

Gram-negative

- *Escherichia coli*
- *Neisseria gonorrhoeae*
- *Salmonella typhi*
- *Salmonella typhimurium*

Gram-positive

- *Enterococcus sp.*: VRE
- *Mycobacterium tuberculosis*
- *Staphylococcus aureus*: MRSA
- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*



MDR Death Rates

Source: ReAct facts, May 2012

The NEW ENGLAND JOURNAL of MEDICINE

Perspective

The Emerging Threat of Untreatable Gonococcal Infection

Gail A. Bolan, M.D., P. Frederick Sparling, M.D., and Judith N. Wasserheit, M.D., M.P.H.

N Engl J Med 2012; 366:485-487 | February 9, 2012 | DOI: 10.1056/NEJMp1112456

"Nightmare Bacteria"

2013

CRE
Neisseria gonorrheae
C. diff
Acinetobacter

- 2 million people/yr. acquire serious resistant bacterial infections
- 23,000 people die as a direct result

Source: CDC

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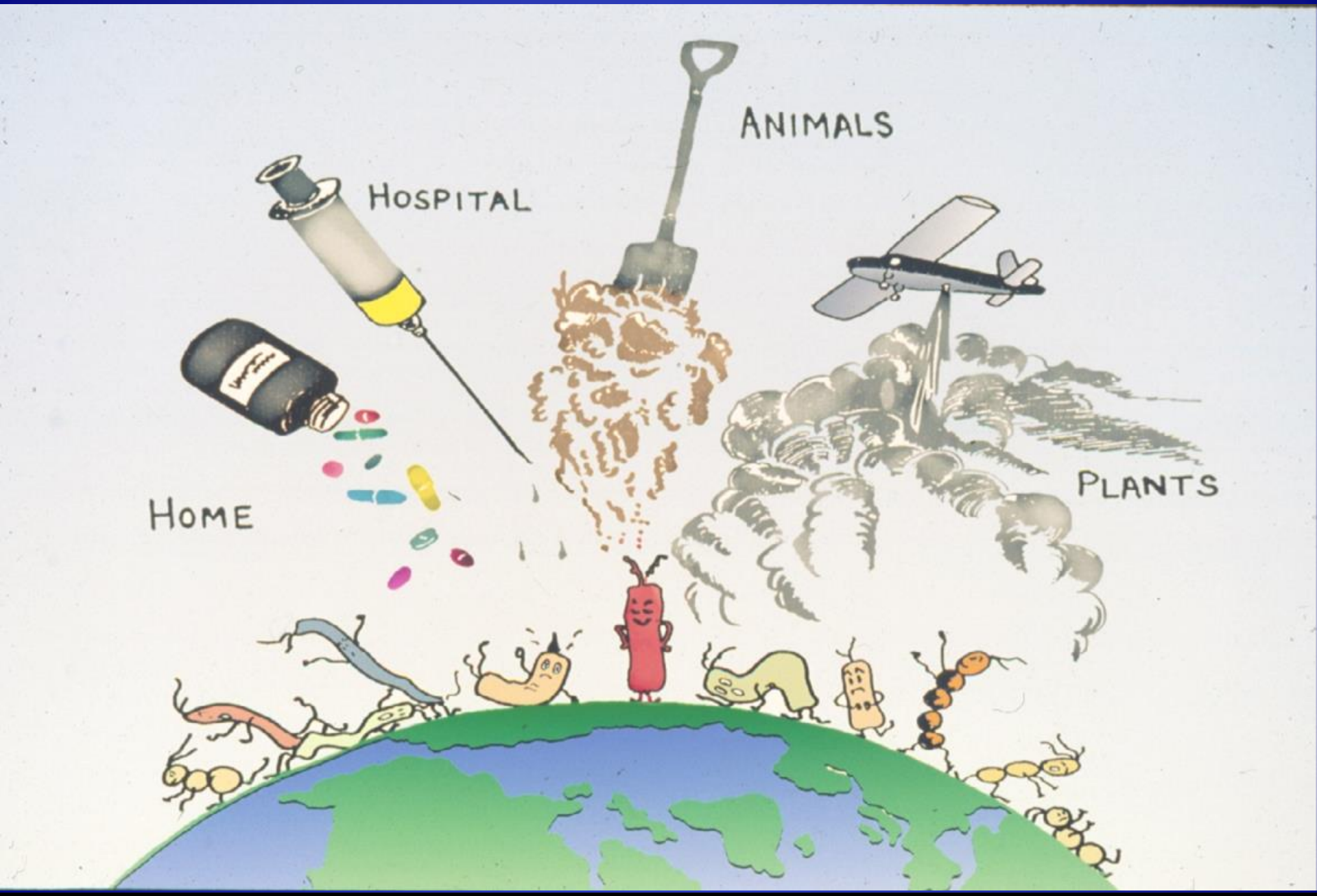
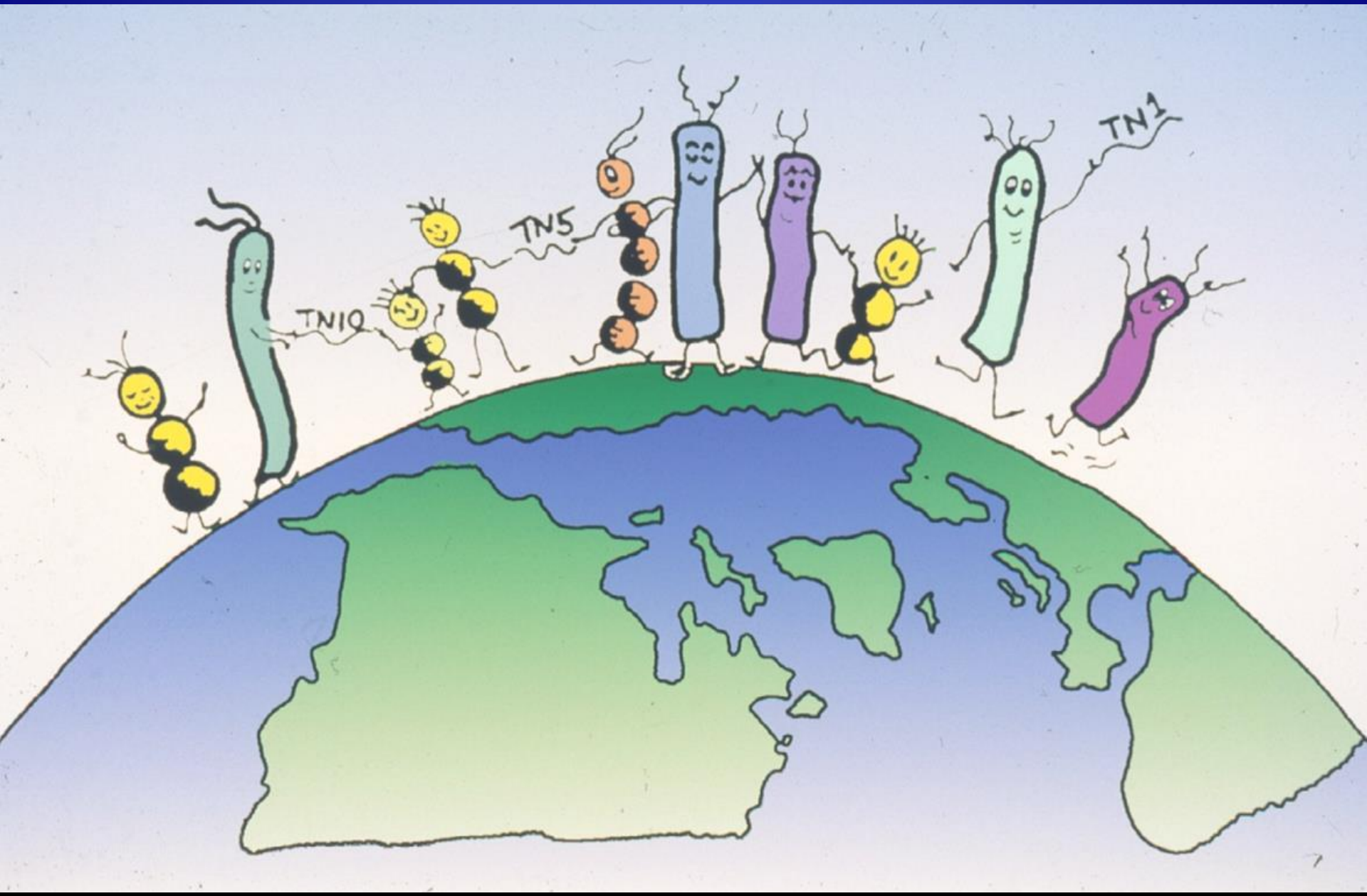
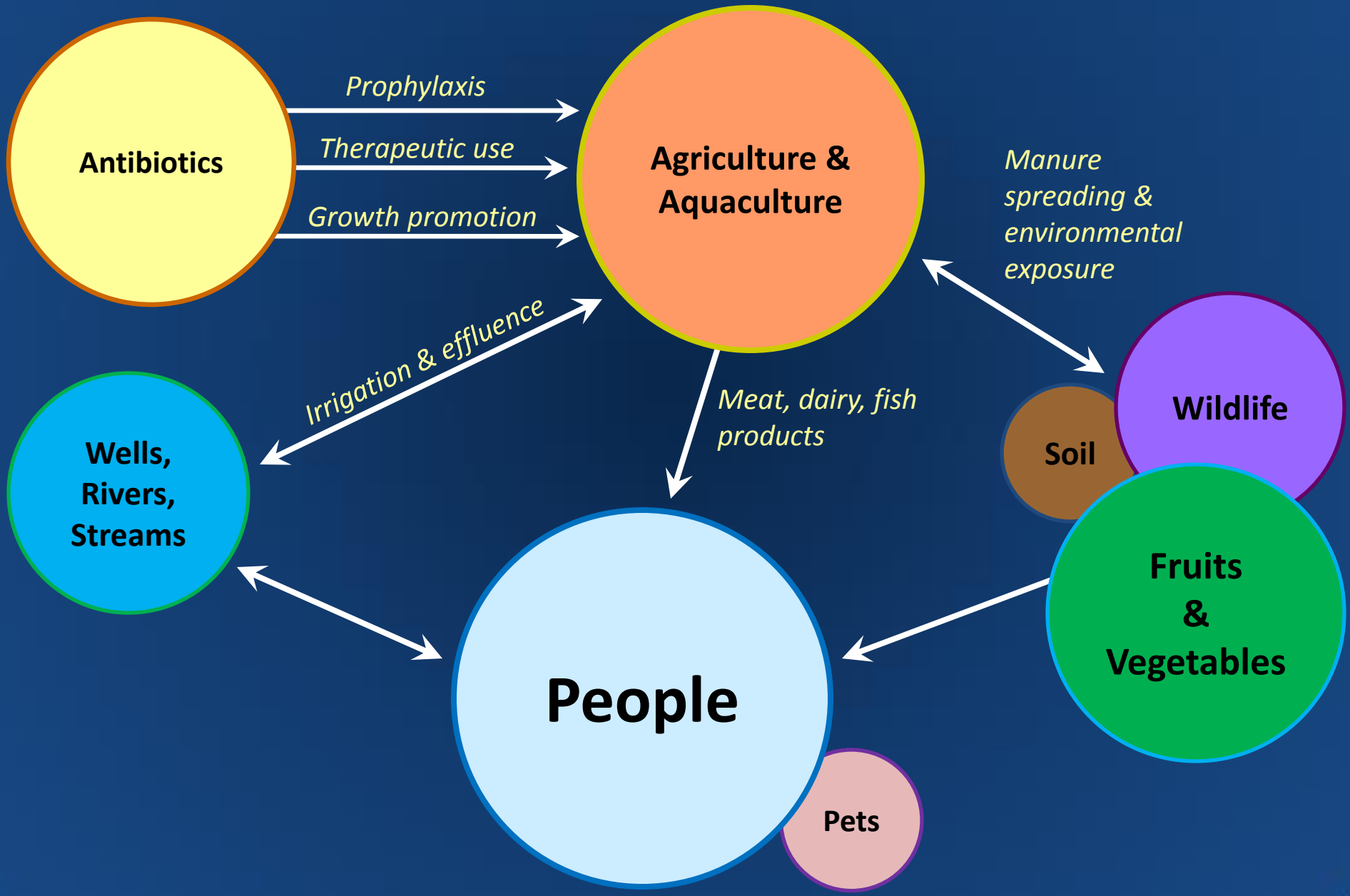

ANIMALS
HOSPITAL
HOME
PLANTS

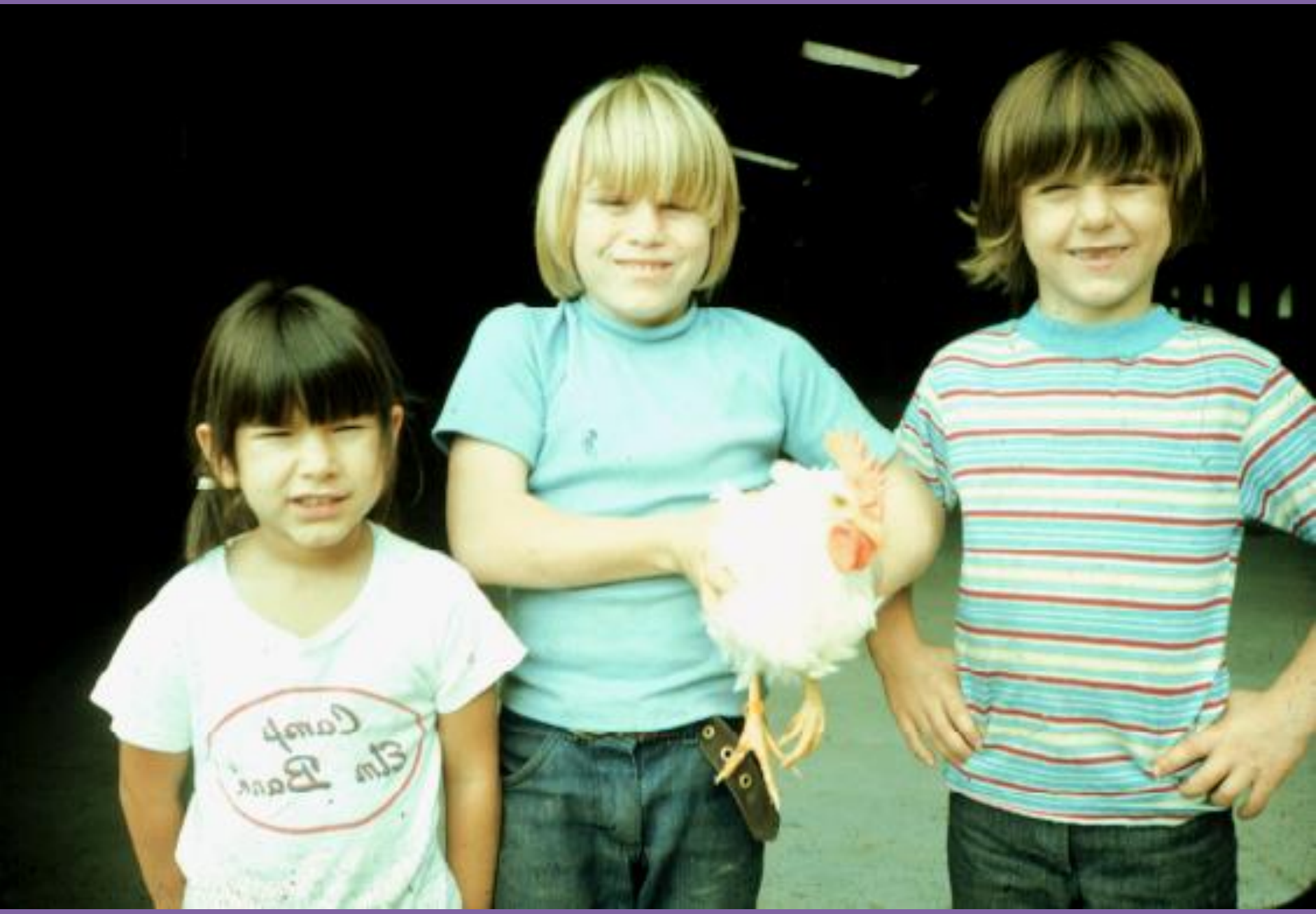

TN10
TN5
TN1

Ecologic impact of antibiotics in agriculture:

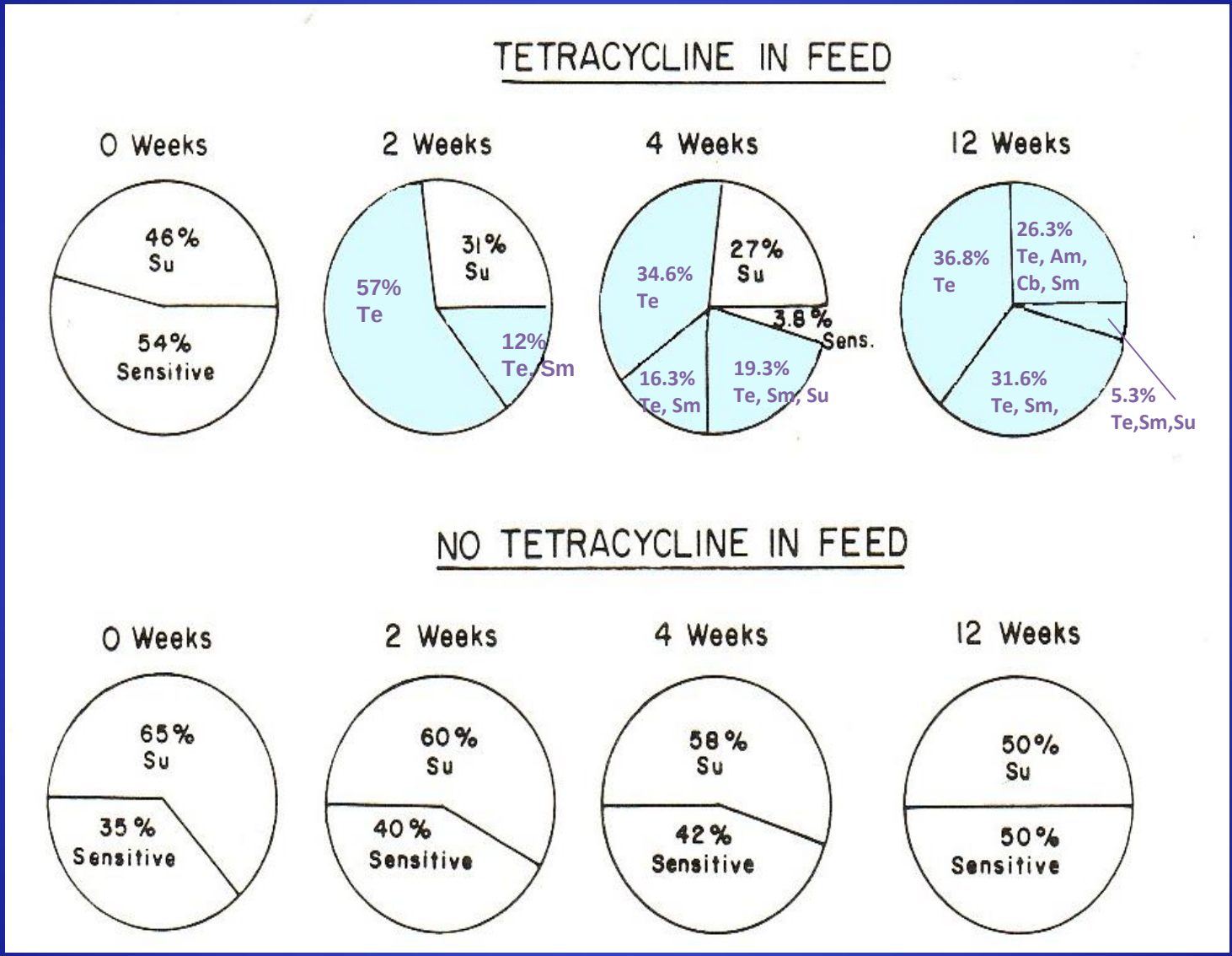
The flow of antibiotics and antibiotic-resistant bacteria



Environmental Impact of Growth Promotion Use of Oxytetracycline

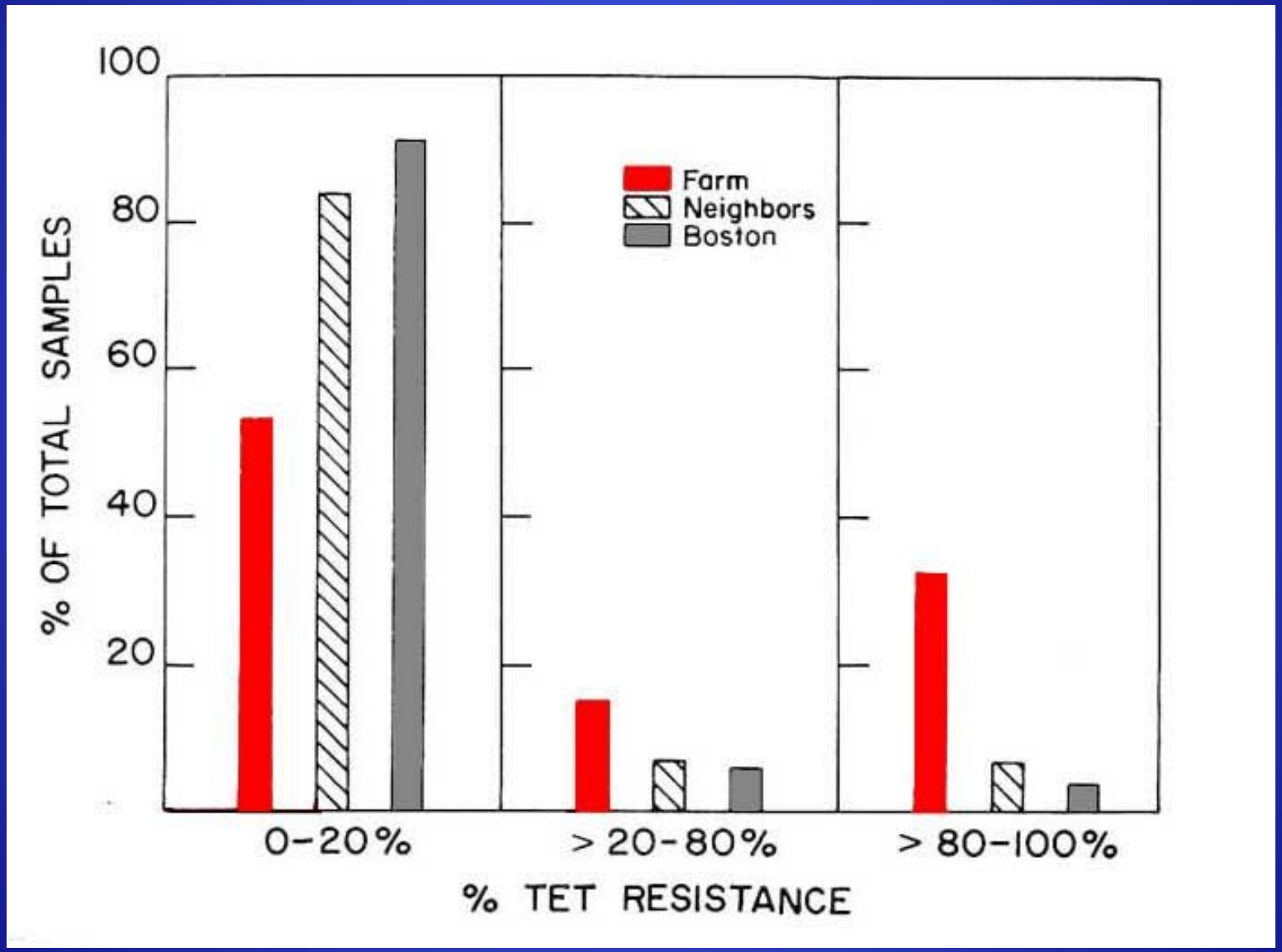


Emergence of Resistant Bacteria



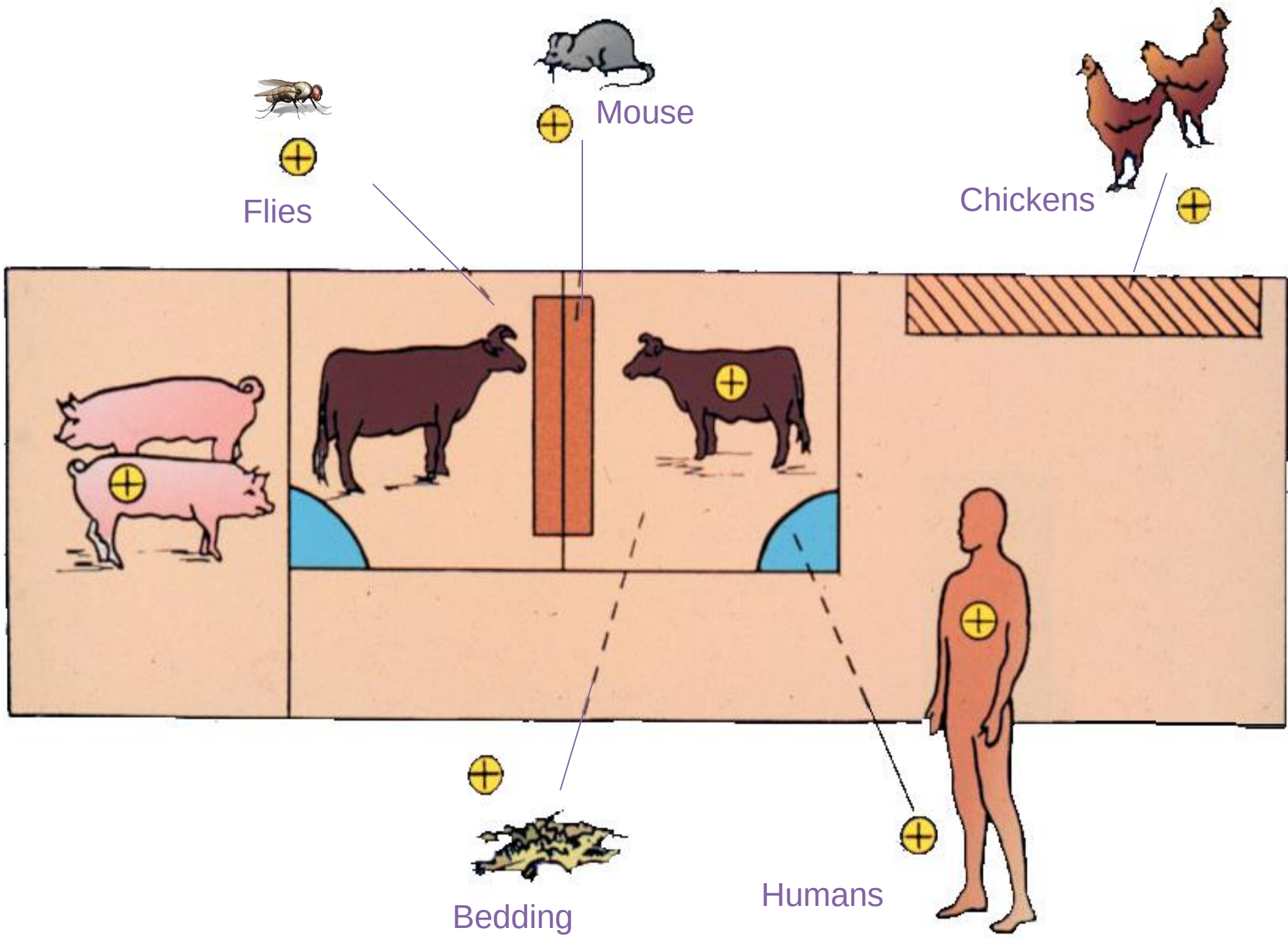
During Growth Promotion Use

Frequency of tetracycline resistant bacteria in human fecal samples



Levy, et. al. *NEJM* 295: 583 (1976)

Spread of resistant *E. coli* on a farm

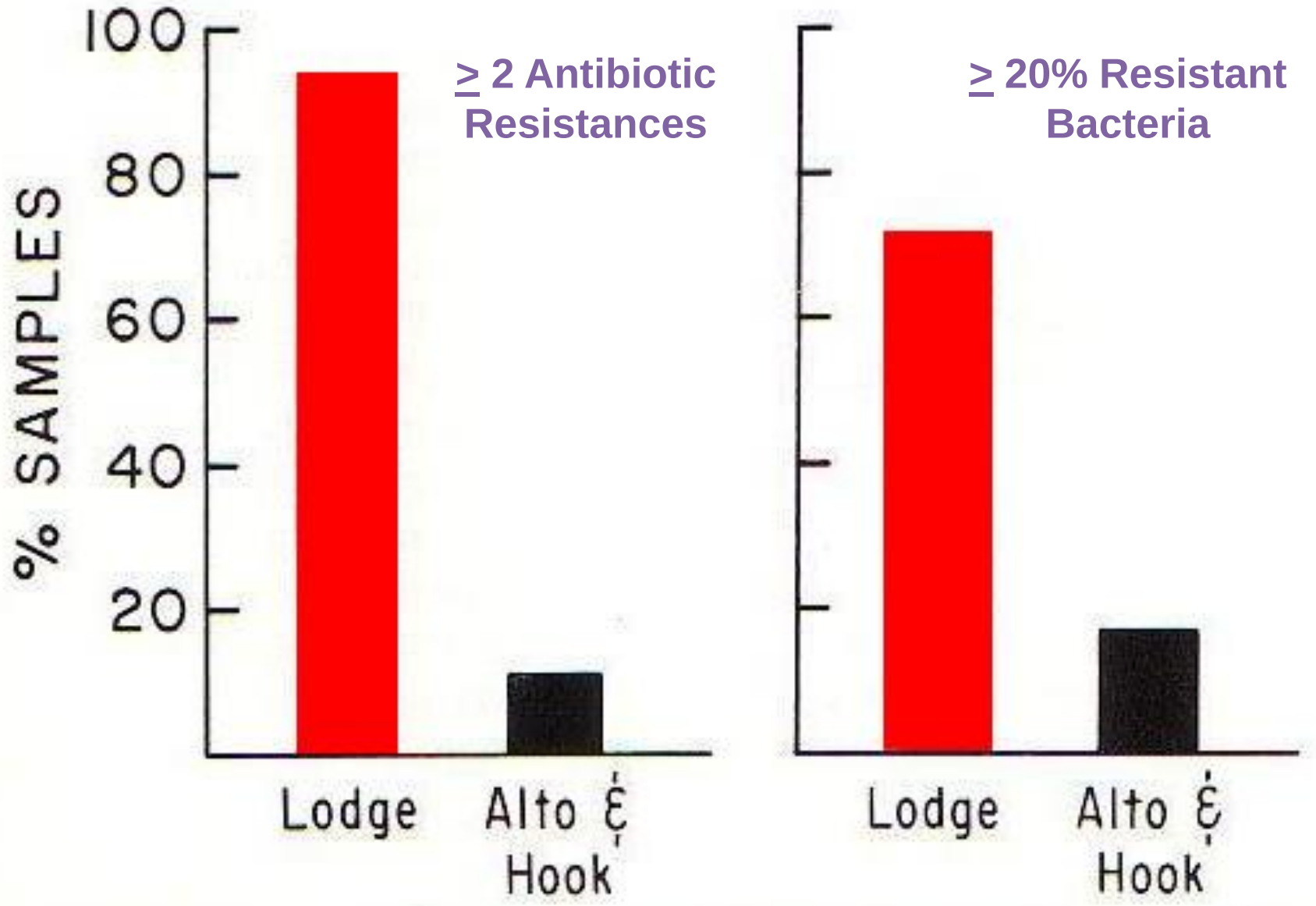

Flies
Mouse
Chickens
Bedding
Humans

Human to Animal Transfer

(Amboseli Park, Kenya)

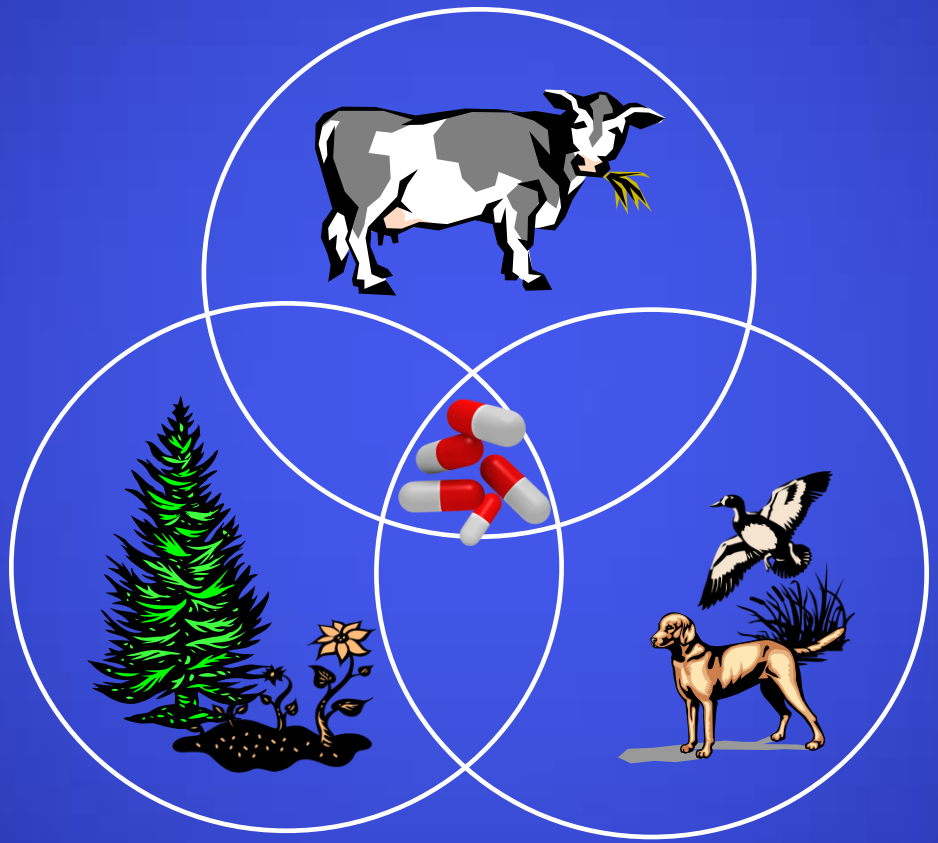
Rolland R,M et al. App Env Microb 49: 791 1985

Antibiotic Resistance Frequency Among Enteric Bacteria of Wild Baboons



Rolland R,M et al. App Env Microb 49: 791 1985

Antibiotics are ecologic drugs



A drug-resistant flora emerges and spreads


I'LL HAVE THE GAZPACHO, LEEKS VINAIGRETTE WITH SHRIMP, MARINATED ZUCCHINI, ORANGE MOUSSE, A BOTTLE OF CÔTES DU RHÔNE ROUGE '59, AND BRING SOME SHIT FOR MY FLY.

Antibiotics Are Also Societal Drugs

Individual Usage Affects Family, Community, Society

Sequential antibiotic therapy for acne promotes the carriage of resistant staphylococci on the skin of contacts

Yvonne W. Miller, E. Anne Eady, Richard W. Lacey, Jonathan J. Cove, Derrick N. Joanes and William J. Cunliffe

“POSTER CHILDREN” FOR ANTIBIOTIC RESISTANCE

Gram-Positive

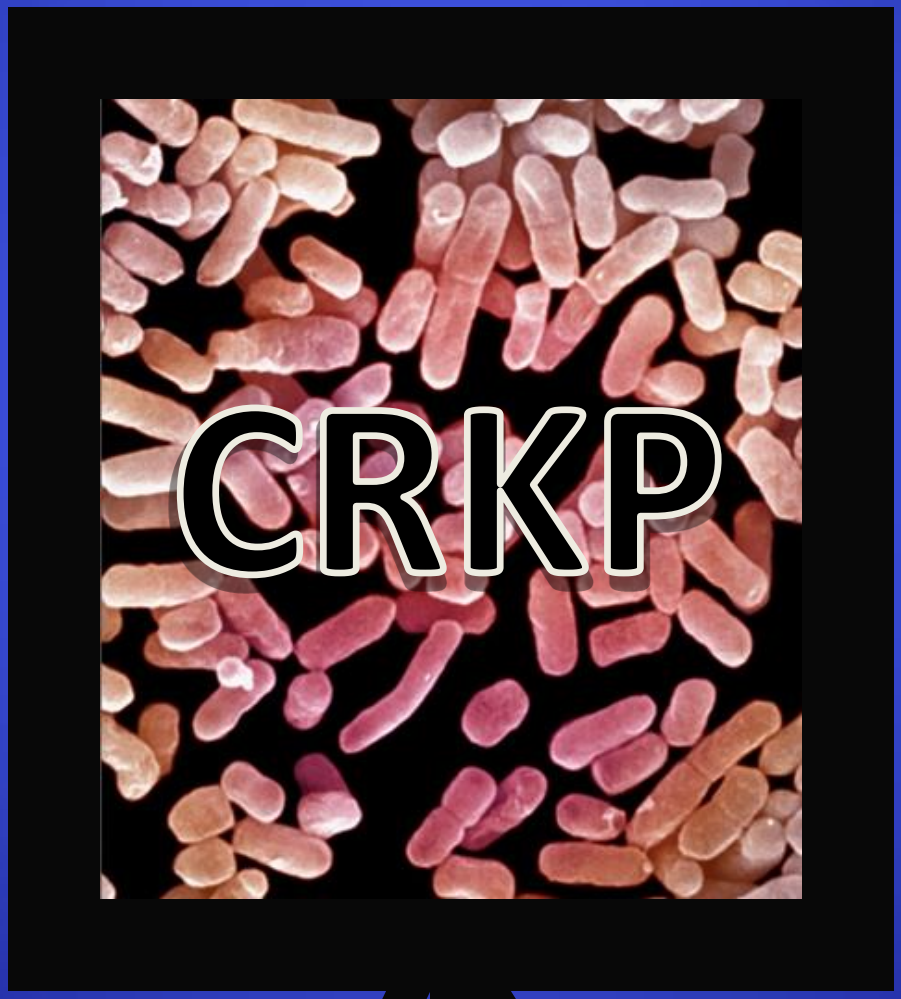
MRSA

- Most invasive organism that we face today; attacks healthy children and adults.

- Community acquired and hospital acquired

About 11,000 deaths from MRSA (U.S., CDC Report, 2013)

Gram-Negative



Klebsiella pneumoniae

- Carbapenem-resistant: KpC, CRKP
- NDM-1 carbapenemase

Annual Cost of Antibiotic Resistance in U.S. Hospitals

> 20 Billion Dollars

Roberts *et al.* CID 49:1175 (2009)

Lessons Learned

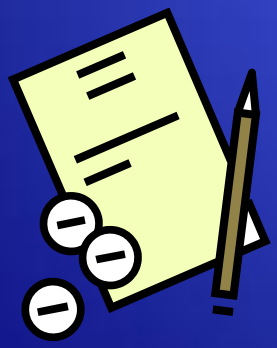
- Given enough antibiotic and time, resistance will appear.
- Once selected, a drug resistance will not disappear, although it may drop in frequency.
- Resistance develops in steps: from *less susceptibility* to *resistance*.
- Resistant bacteria like to accumulate resistances.

Combating Antimicrobial Resistance: Core Actions

1. Prevent infections and the spread of resistance

2. Track resistance patterns

3. Develop new antibiotics and diagnostic tests



4. Improve antibiotic use

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The Antibacterial Craze

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Now Joy's got a smart new way to fight germs.

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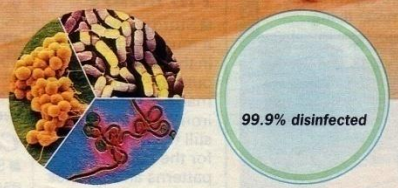
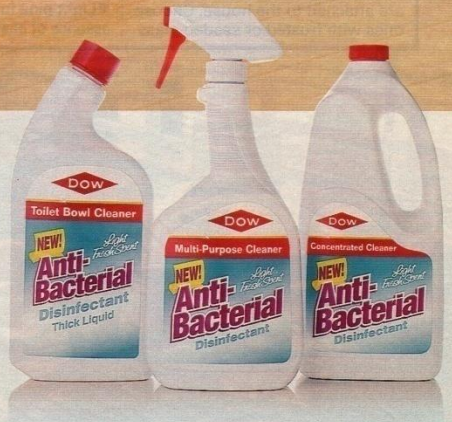


Not just clean, *Microscopically Clean.*

New Dow Antibacterial Cleaners clean like no ordinary cleaners can. They cut through the toughest grease and dirt and they kill 99.9% of household germs. So your home doesn't just look clean, it's *Microscopically Clean.*



INTRODUCING NEW! DOW ANTIBACTERIAL CLEANERS. DOW

Find cleaning tips at www.dowclean.com.

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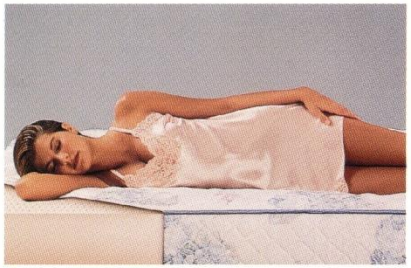
TO ORIGINAL PURCHASER



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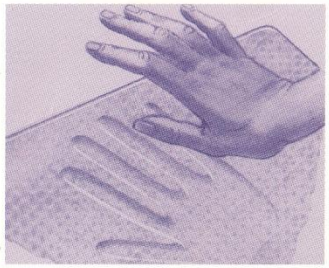
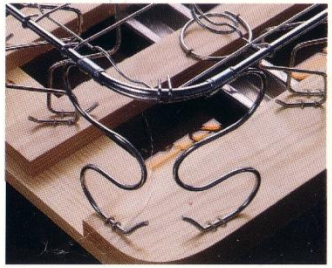


Molds and responds to your body contours dramatically reducing pressure points for improved circulation.



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Since 1894
The mattress of choice.™


Anti bacterial goods
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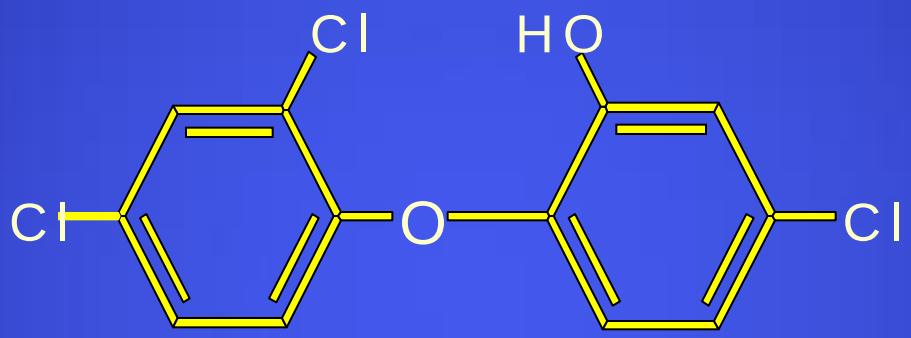
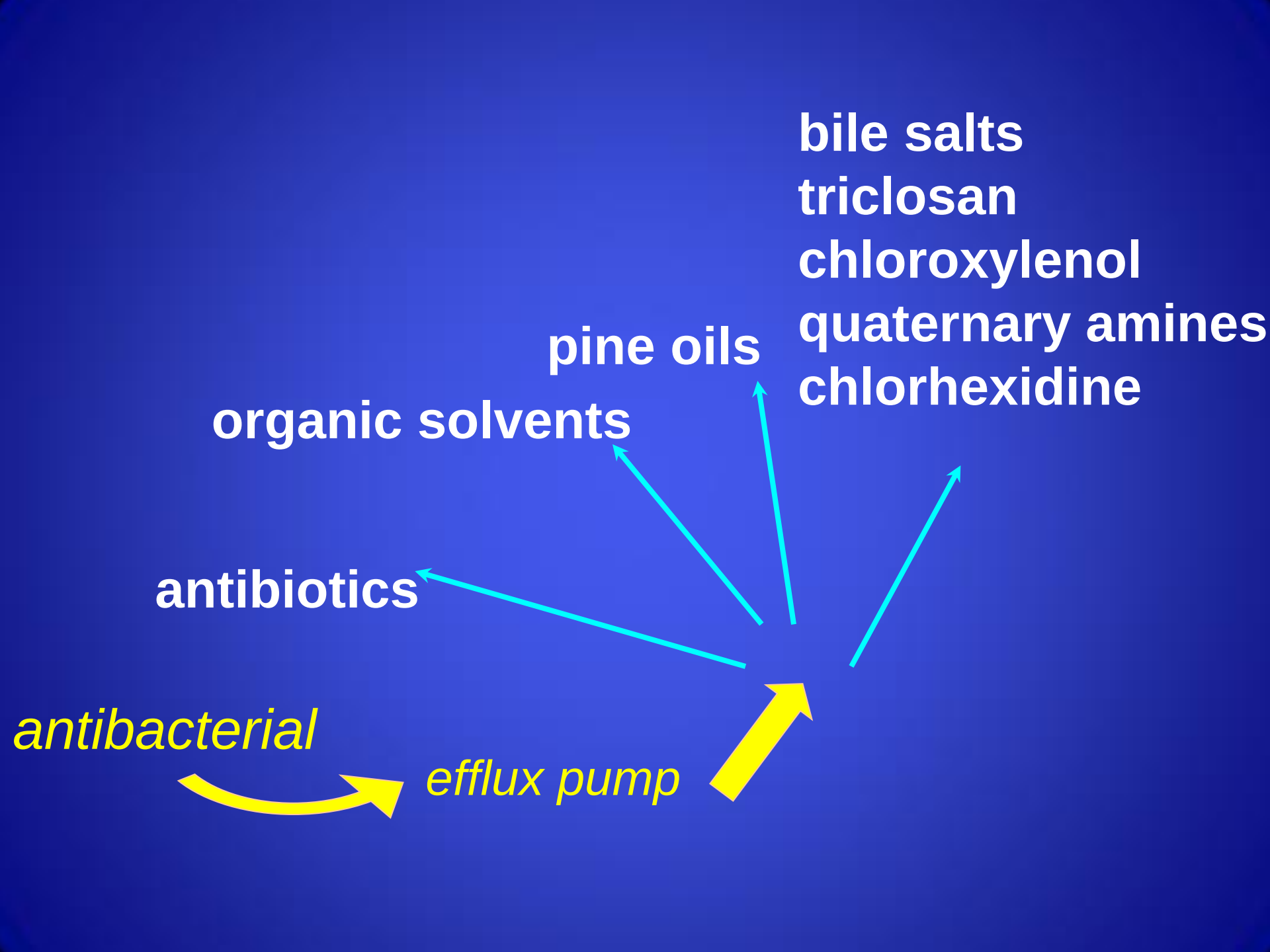
Anti bacterial goods
抗菌加工



Triclosan


bile salts
triclosan
chloroxylenol
quaternary amines
chlorhexidine
pine oils
organic solvents
antibiotics
antibacterial
efflux pump

President Obama's *National Action Plan for Combating Antibiotic-Resistant Bacteria*

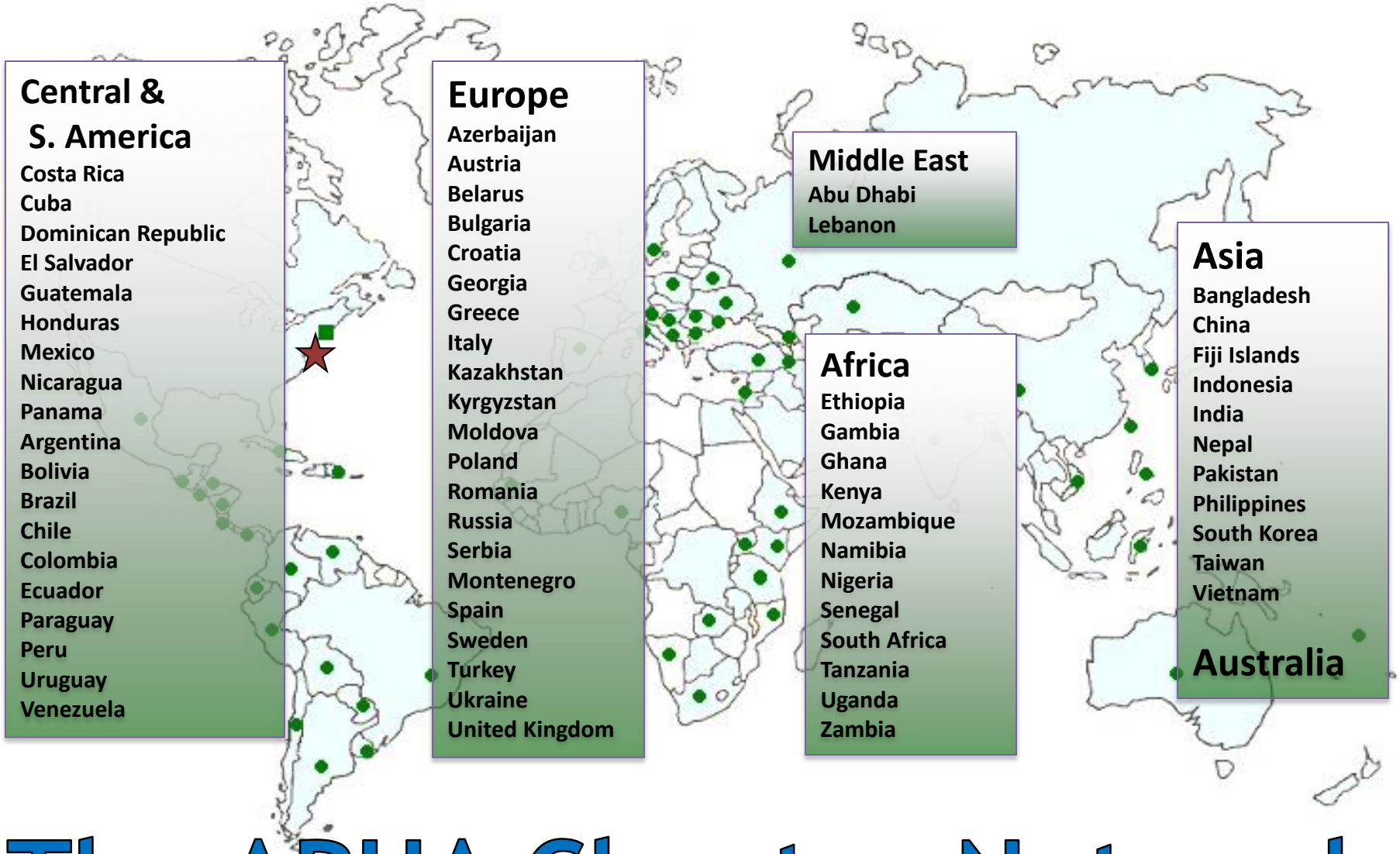
Vision: The United States will work domestically and internationally to prevent, detect, and control illness and death related to infections caused by antibiotic-resistant bacteria by implementing measures to mitigate the emergence and spread of antibiotic-resistance and ensuring the continued availability of therapeutics for the treatment of bacterial infections.

National Action Plan for Combating Antibiotic-Resistant Bacteria

The 5 goals include:

- Slow the emergence of resistant bacteria; prevent spread of resistant infections
- Strengthen national “One-Health” surveillance efforts
- Advance development and use of rapid and innovative diagnostic tests
- Accelerate basic & applied research for development of new therapeutics
- Improve international collaboration and capacities for antibiotic resistance control

Global response to antibiotic access and resistance



The APUA Chapter Network

Antimicrobials in the new millennium: Making peace with microbes