



# Antibiotic Stewardship in the NICU: An Overview

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# What is Antibiotic Stewardship?

## Definition

- Coordinated interventions designed to improve and measure the appropriate use of antibiotics

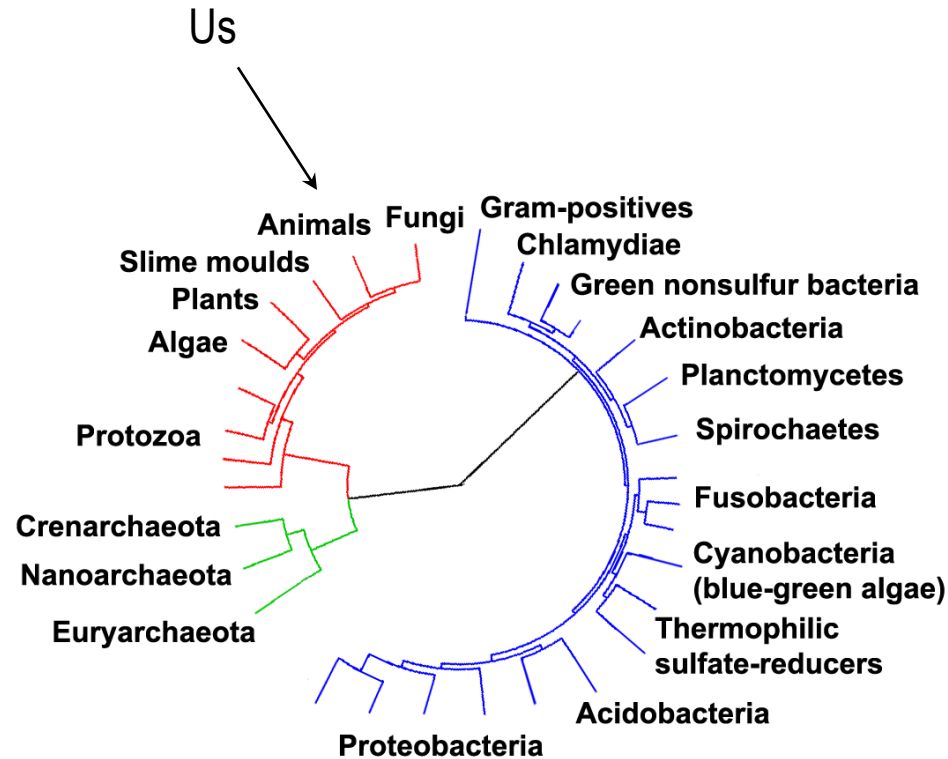
# Antibiotic Stewardship

## Overview Topics

1. The Microbial World
2. Bacteria are bad
3. Antibiotics are good
4. Bacteria are good
5. Antibiotics are bad
6. The need for a better balance

# 1. We're Just a Little Part of a Big World

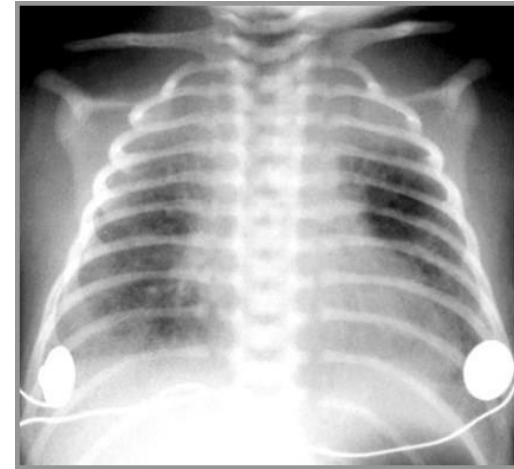
## Most of Its Inhabitants are Microbes



## 2. Bacteria are Bad We're Understandably Afraid of them



**Necrotizing Enterocolitis**



**Pneumonia**



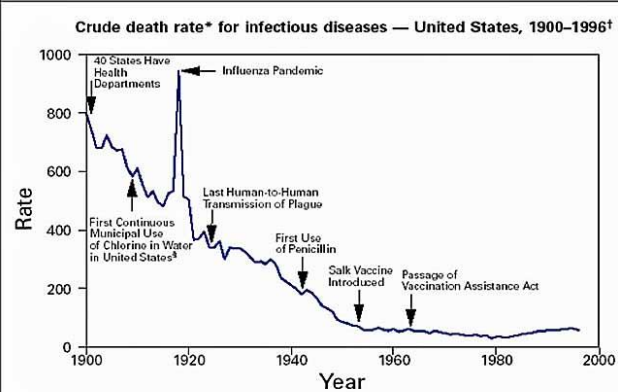
**Sepsis**

# 3. Antibiotics are good

## Have Saved Many Lives (50 fold drop)

FIGURE 1. Crude death rate for infectious diseases—United States, 1900–1996

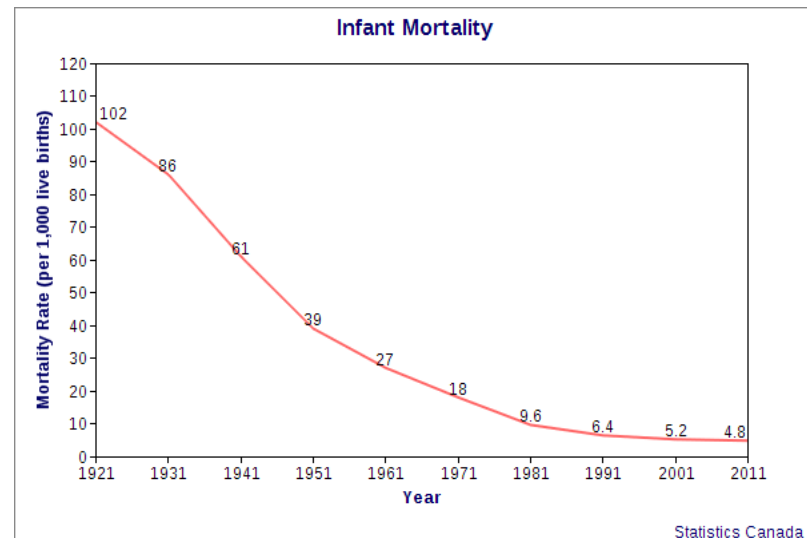
[Adapted by Rear Admiral Dr. Patrick O'Carroll, Regional Health Administrator, U.S. Public Health Service Region X]



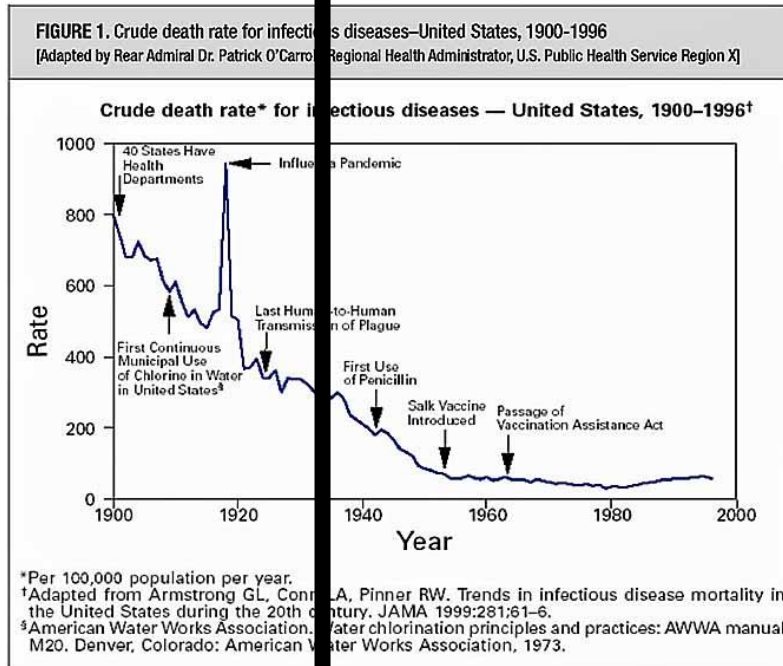
\*Per 100,000 population per year.

†Adapted from Armstrong GL, Conn LA, Pinner RW. Trends in infectious disease mortality in the United States during the 20th century. JAMA 1999;281:61–6.

‡American Water Works Association. Water chlorination principles and practices: AWWA manual M20. Denver, Colorado: American Water Works Association, 1973.



# But The Drop in Infection Is Only Partly From Antibiotics



Pre-antibiotic era

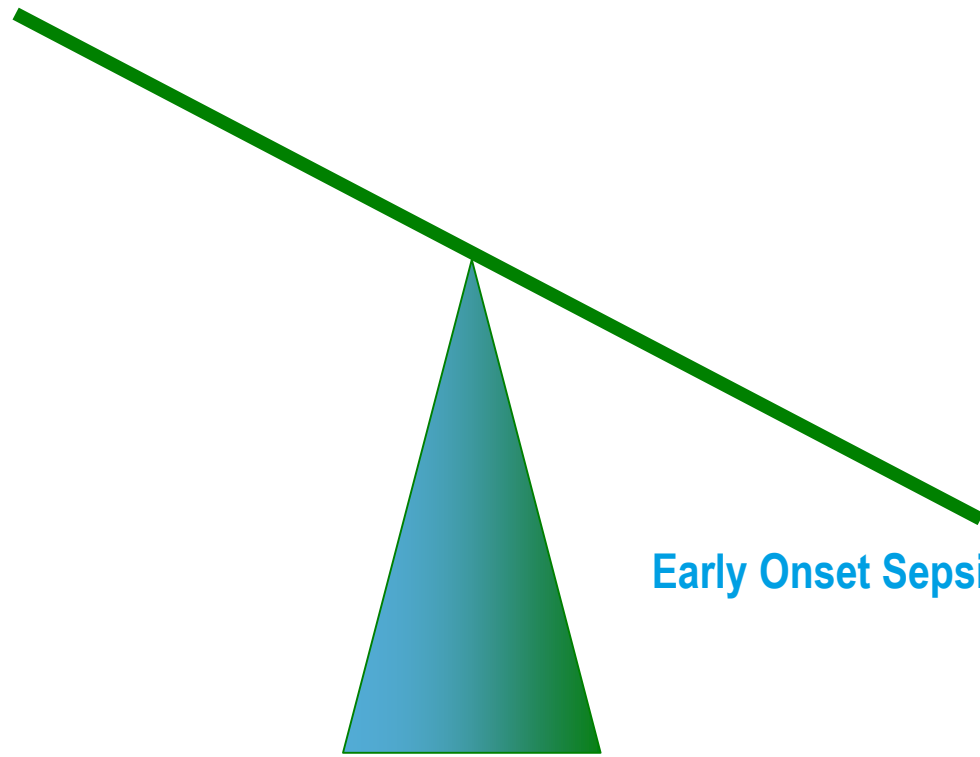
Antibiotic era

# Current Imbalance

## Low Neonatal Infection rate, High Antibiotic Use

Blood Cultures: 15%

Antibiotics : 10%



Early Onset Sepsis incidence:  $<0.05\%$



# Others Side Effects of Imbalance

## Maternal Complications from NICU



- Disruption of mother-baby bonding
- Disruption of breast feeding initiation
- Elevated maternal postpartum depression risk
- Vulnerable child syndrome risk

Lu, J Gastroenterol 2015

# 4. Bacteria are good

## Our (Internal) Microbiome Promotes Health



- Examples
  - Suppress pathogenic bacteria
  - Encourage immunological homeostasis
  - Support GI physiology

# 5. Antibiotics are Bad

## They Disrupt the Microbiome, Causing Harm

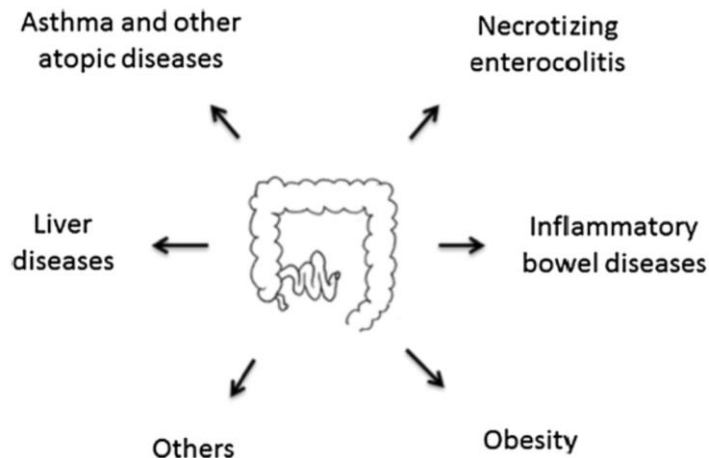
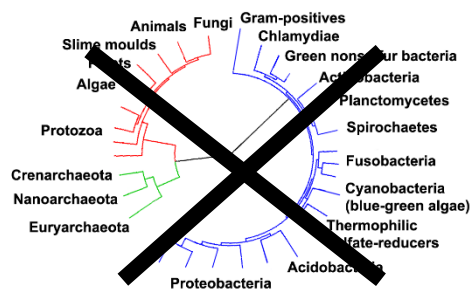


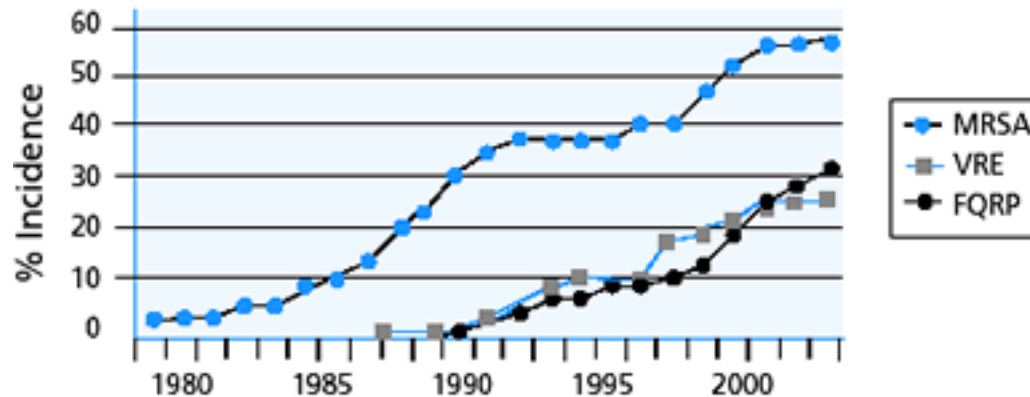
Fig. 1 Diseases associated with an aberrant neonatal gut microbiota

Lu, J Gastroenterol 2015

# Antibiotics are Bad

## They Cause Antibiotic Resistance

Resistant Strains Spread Rapidly

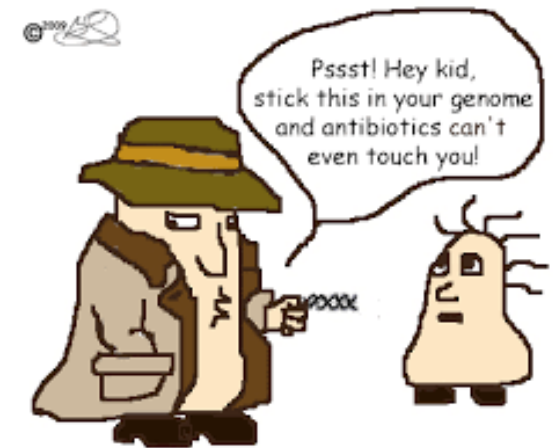


Source: Centers for Disease Control and Prevention

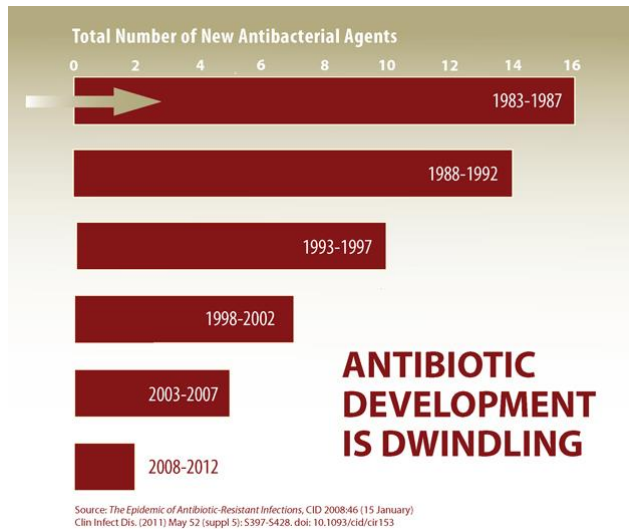
MRSA = Methicillin-resistant *Staphylococcus Aureus*

VRE = Vancomycin-resistant Enterococci

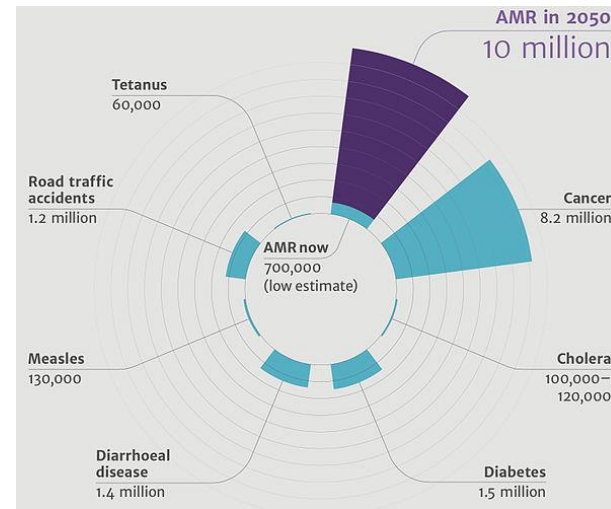
FQRP = Floroquinolone-resistant *Pseudomonas aeruginosa*



# New Antibiotic Development Can't Keep Up Development Slowing, Deaths Rising



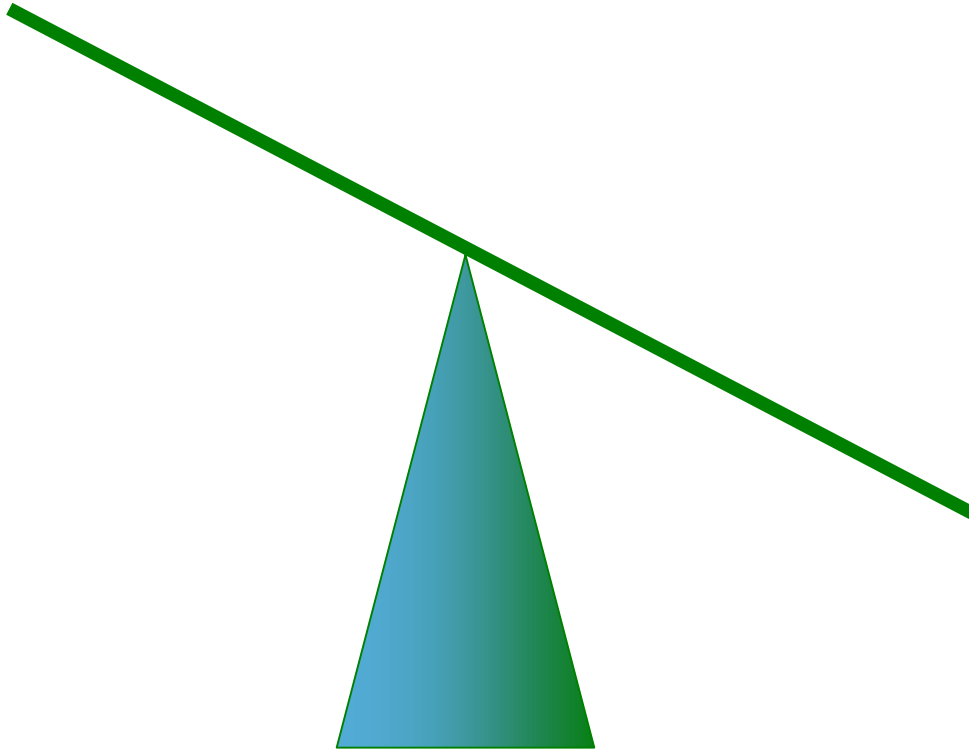
10 fold drop in new antibiotics since 1980s



10 fold increase in deaths  
from antibiotic resistance by 2050?

# Antibiotic Stewardship

## Striking a Better Balance of Benefit and Risk

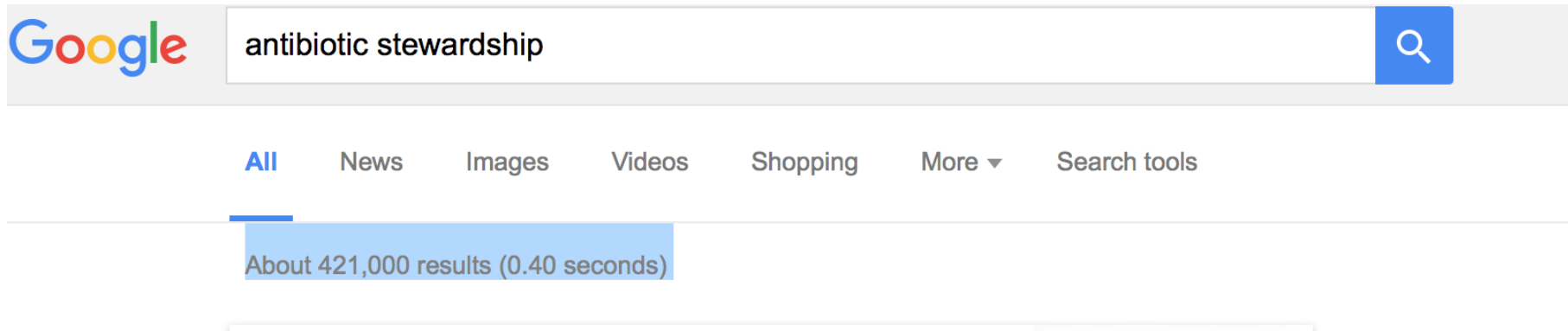


# Antibiotic Stewardship It Can Work

- Meta-analysis (Lancet 2016)
  - N=145 studies

Intervention	Mortality (RR)
Guideline Driven Choice of Initial Antibiotics	35% less
Guideline driven de-escalation of antibiotics	64% less

# Antibiotic Stewardship Huge Area of Interest



A screenshot of a Google search interface. The search bar contains the text "antibiotic stewardship" and a magnifying glass icon. Below the search bar, the "All" tab is selected and highlighted in blue. Other tabs include "News", "Images", "Videos", "Shopping", "More", and "Search tools". Below the tabs, a blue box displays the text "About 421,000 results (0.40 seconds)".

Google antibiotic stewardship

All News Images Videos Shopping More Search tools

About 421,000 results (0.40 seconds)



# Antibiotic Stewardship

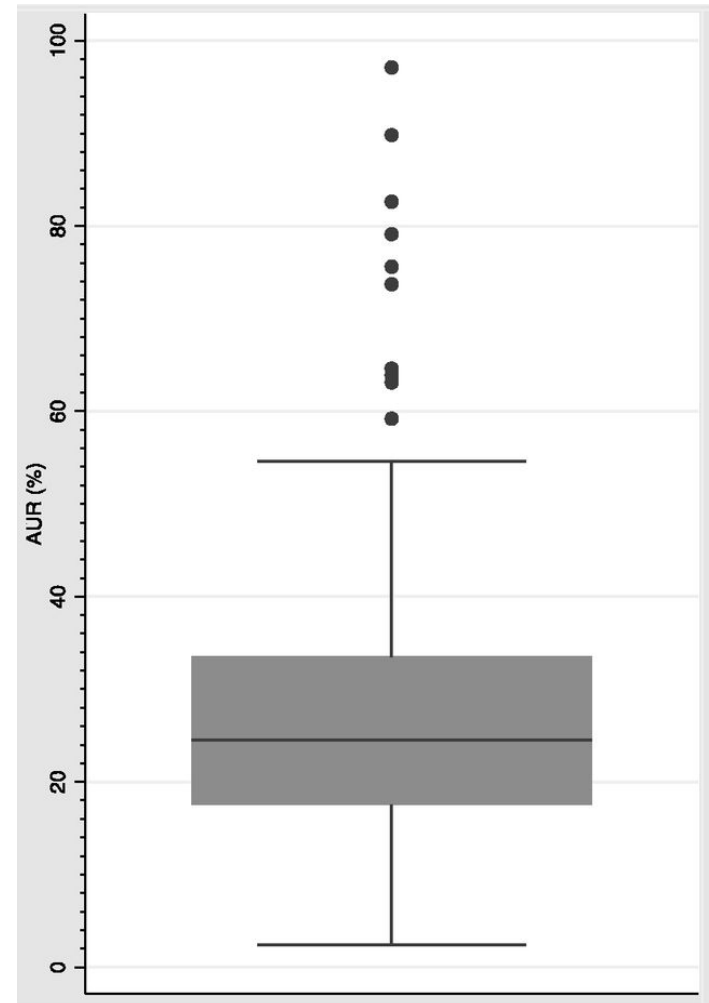
## Legally Mandated

- California
  - Senate Bill 739 (2006)
  - Senate Bill 1311
- Federal
  - CMS Executive Order (2015)

# Antibiotic Stewardship

## Demonstrated Deficiency in California NICUs

- Schulman 2015
  - N=127 California NICUs
  - Measure:
    - % patient days with one or more iv antibiotics
  - Results
    - 2% to 97%!
  - Unrelated to:
    - Proven infection
    - NICU level
    - NEC
    - Surgical volume
    - Mortality



# Antibiotic Stewardship Overview

## Thanks!



- Thanks to
  - Nami Jhaveri, MD
  - Carol Glaser, MD
  - My colleagues in CPQCC and KP

# Antibiotic Stewardship

## Striking a Better Balance of Benefit and Risk

- M** Microbiology guides therapy wherever possible
- I** Indications should be evidence based
- N** Narrowest spectrum required
- D** Dosage appropriate to the site and type of infection
- M** Minimise duration of therapy
- E** Ensure monotherapy in most situations