Antimicrobial Resistance in *Salmonella* Is Associated with Increased Hospitalization — NARMS and FoodNet, 1996-2000

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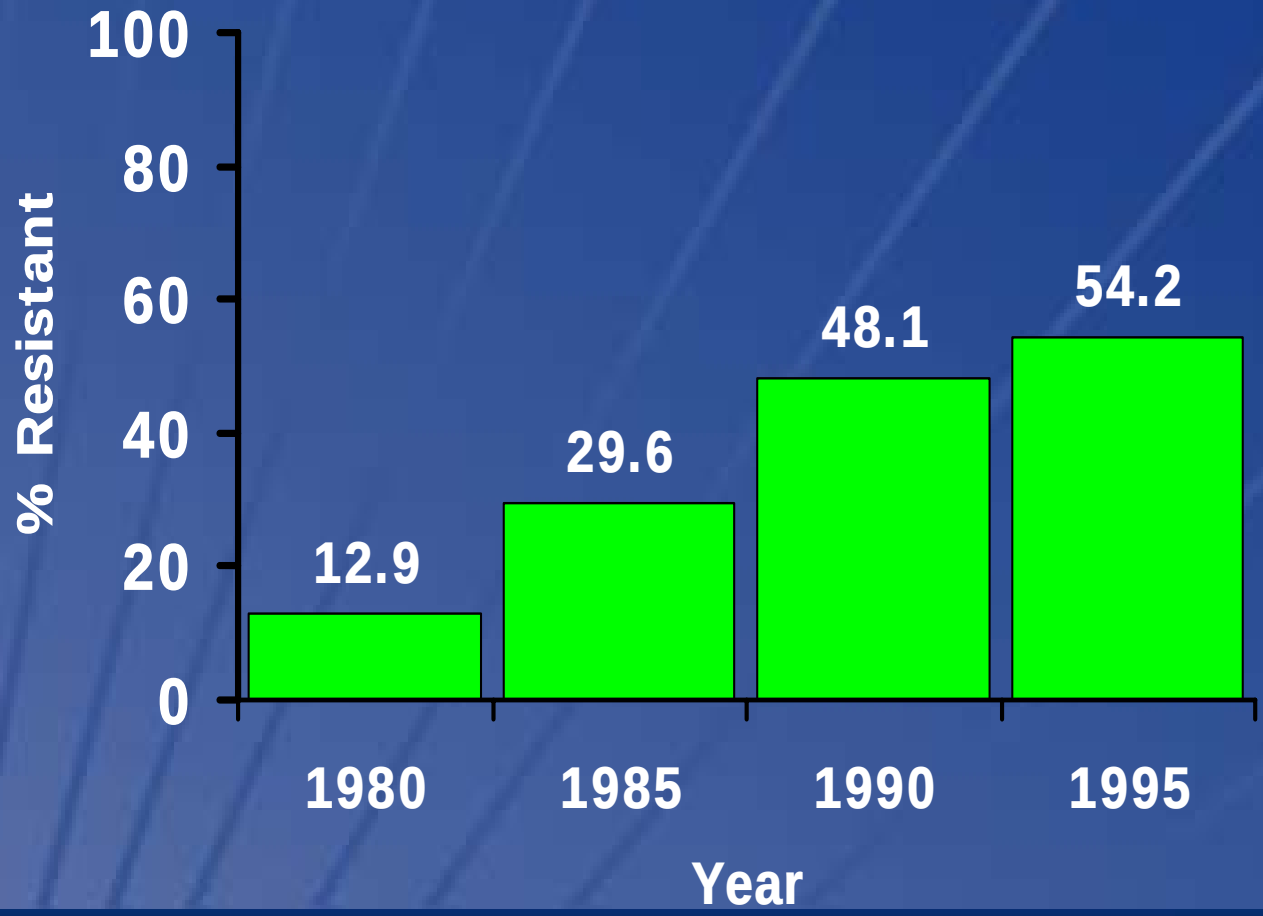
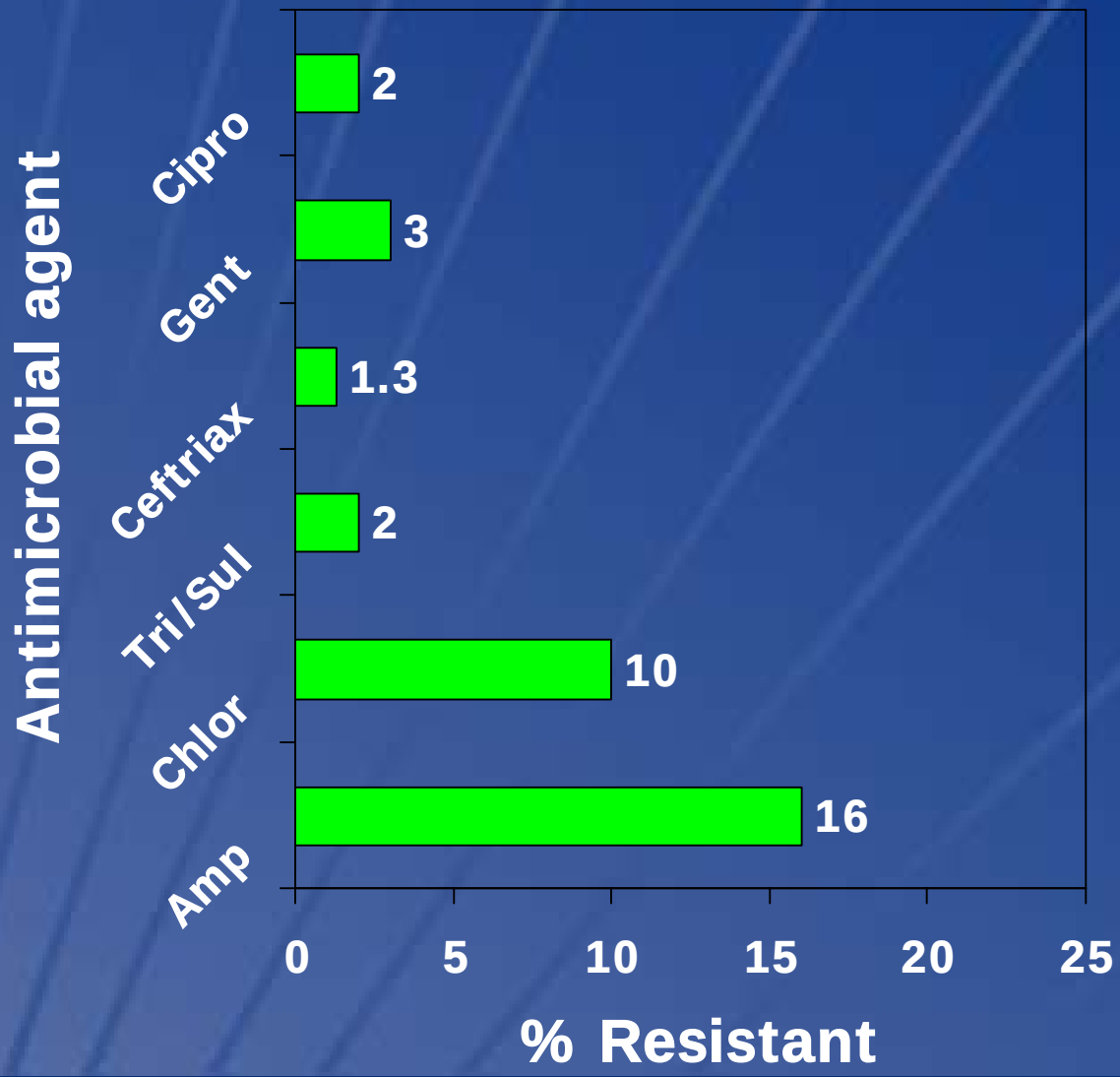
Increasing Resistance

Proportion of S. Typhimurium Resistant to ≥ 1 antimicrobials



Non-Typhoidal *Salmonella* Resistant to Selected Agents — NARMS, 2000



Objective

- Human health effects of resistance difficult to assess
  - Treatment failures and death uncommon
- To determine if patients infected with resistant *Salmonella* are more likely to be hospitalized than patients infected with susceptible *Salmonella.*

Data Sources

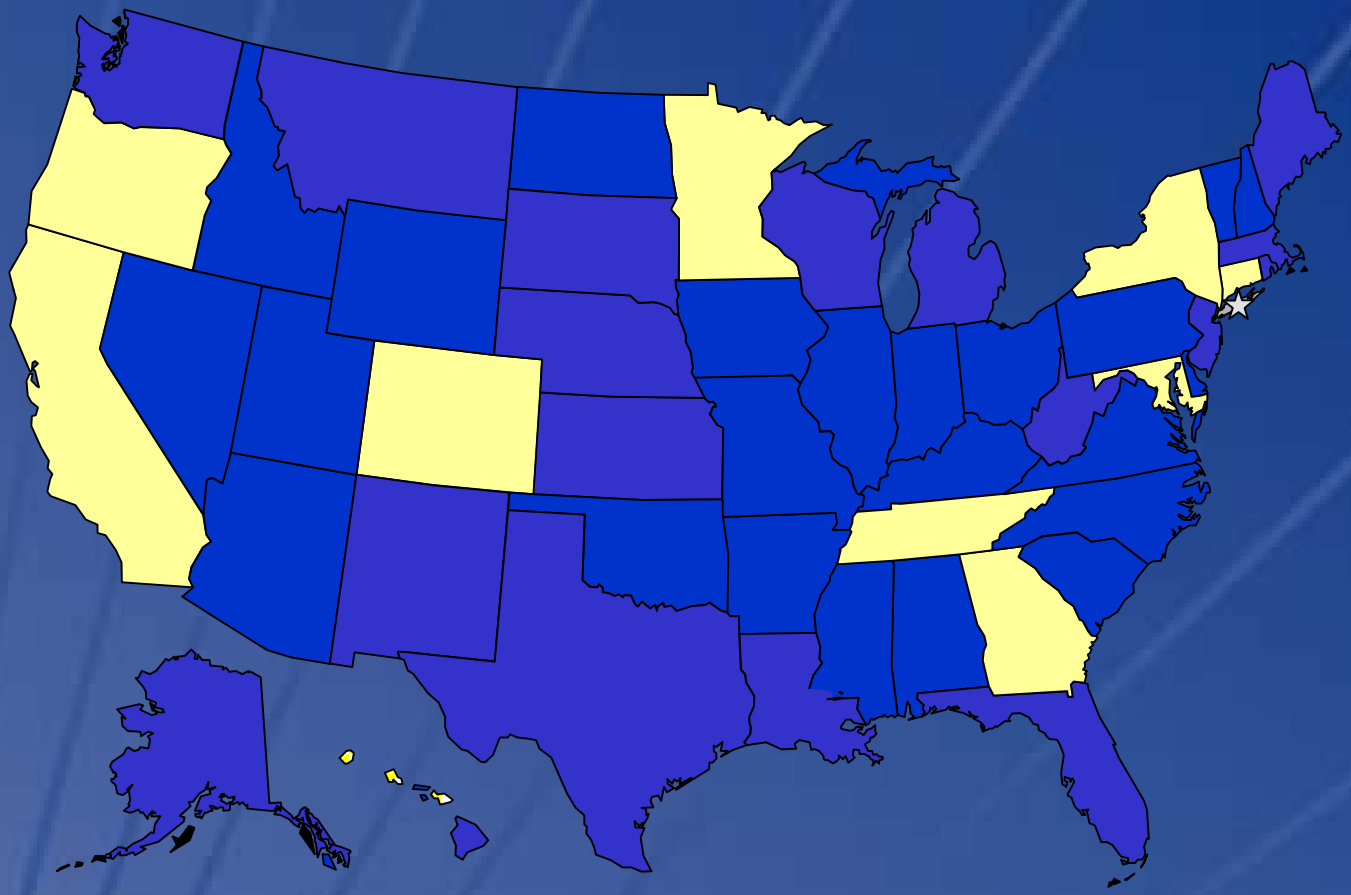
- National public health surveillance systems coordinated by CDC
  - FoodNet
  - NARMS
- Data collected from 1996-2000

FoodNet

- Foodborne Diseases Active Surveillance Network – established 1996 through EIP program
- All or part of 9 states in the U.S.
- Active surveillance of >450 clinical laboratories for culture-confirmed enteric infections.

Foodborne Diseases Active Surveillance Network (FoodNet)

[Population 33 million or 11% of US population]



January 1, 2002

FoodNet Case Reports

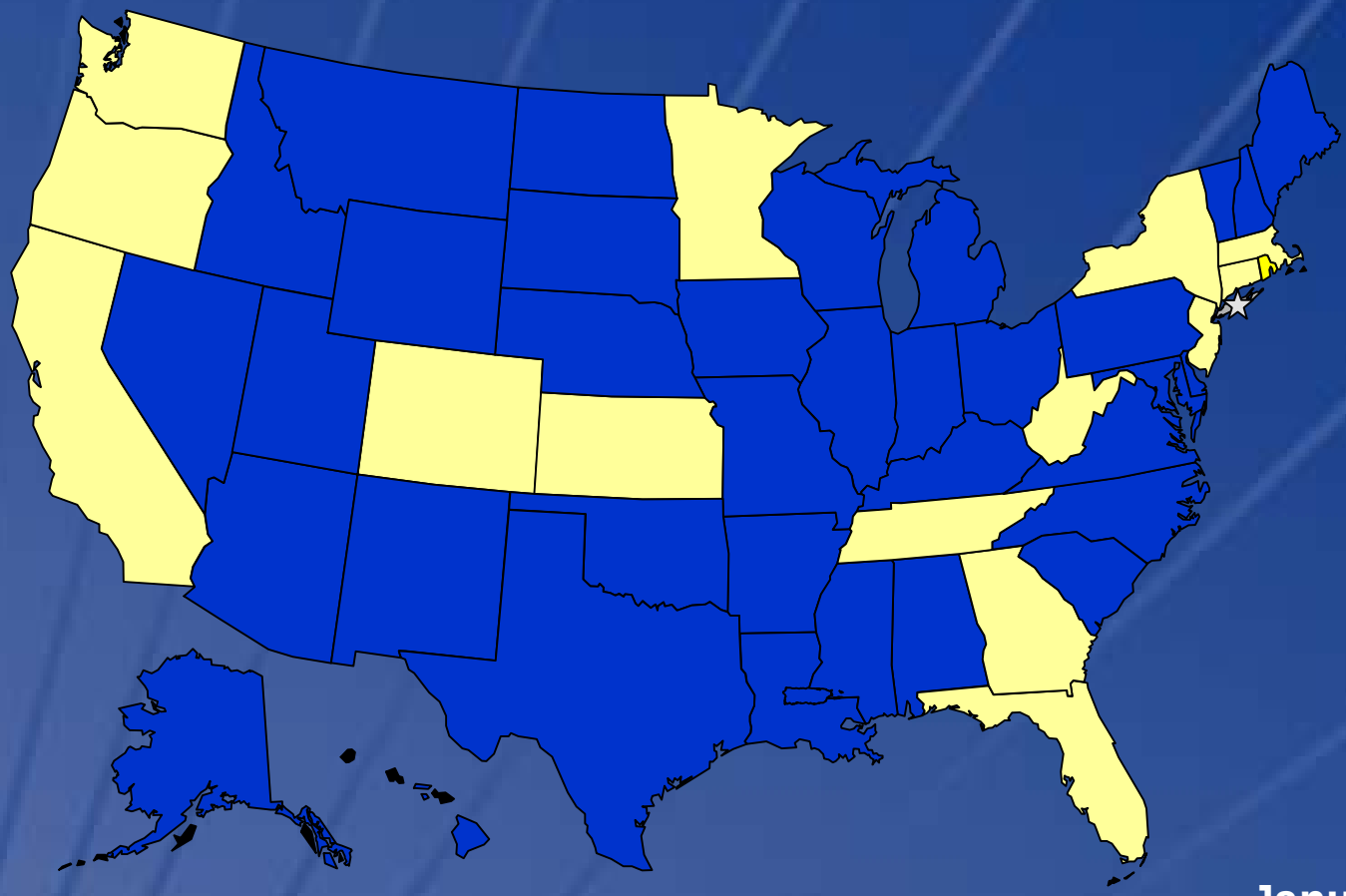
- Patient demographics
- Pathogen, species, serotype, source
- Hospitalization
  - at time of culture collection
  - 7 days after culture collection

NARMS

- National Antimicrobial Resistance Monitoring System – established 1996 through ELC program
- Public health laboratories forward every 10th non-Typhoidal *Salmonella* to CDC
  - From 1996-2000, surveillance in 17 states
  - Each FoodNet site was a NARMS sites

National Antimicrobial Resistance Monitoring System (NARMS)

[Population 103 million or 38% of US population]



January 1, 2001

CDC™

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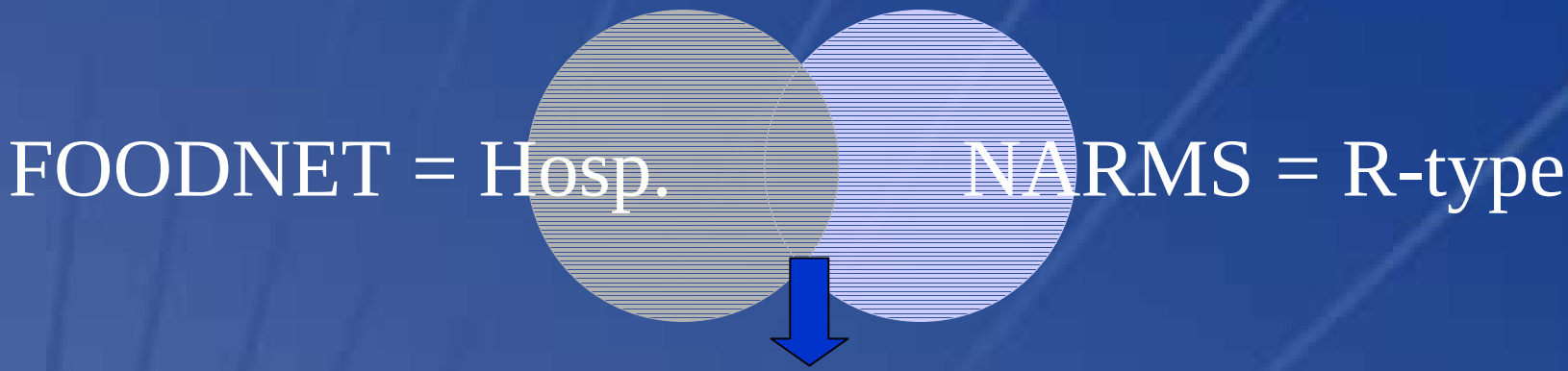
NARMS

- Susceptibility testing of 14 antimicrobial agents used in human medicine
- NCCLS methods

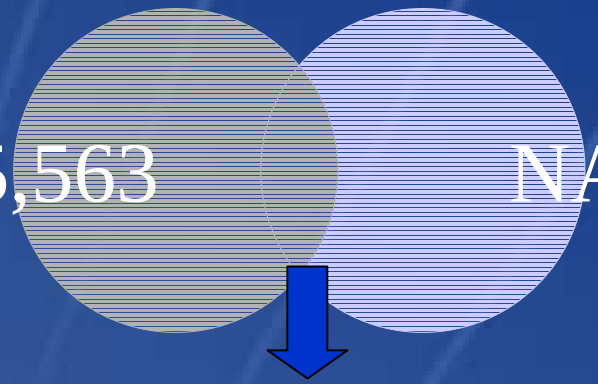
Methods

- Data on hospitalization from FoodNet linked to susceptibility testing from NARMS



Linked data set =
Hosp and R-Type

Results



1123 linked, non-Typhoidal

1020 known hospitalization

Study Population
(n=1020)

- 557 (55%) female
- 163 (16%) non-white
- Median age: 25 years
  - Inter-quartile range: 5 → 42
- 238 (23%) hospitalized within 7 days of culture collection

Microbiology

- 68 (7%) of isolates from blood
- Five most common serotypes

Serotype	N (%)
Typhimurium	299 (29)
Enteritidis	192 (19)
Heidelberg	70 (7)
Newport	52 (5)
Montevideo	28 (3)

63% of isolates in study

Isolate Resistance Patterns

- Resistance to $\geq$ 1 antimicrobial in 318 (31%) isolates
- Resistance to a clinically important antimicrobial in 63 (6%) isolates
  - Clinically important = cephalosporins, aminoglycosides, or quinolones

Univariate Analysis: Risk Factors for Hospitalization

- Resistance to any antimicrobial was associated with hospitalization within 7 days (crude OR 1.4, 95% CI 1.1-2.0)
- Other risk factors
  - Serotype, bloodstream infection, age, non-white race, state of residence.

Multivariate Analysis
(n=1020)

Outcome	Pan Susceptible	Resistant to ≥ 1	Adjusted* OR (95% CI)
Hospitalized	149/702 (21%)	89/318 (28%)	1.5 (1.0-2.2)

*Other covariates = serotype, bloodstream infection, age, race, state

Clinically Important Antimicrobial Resistance

- Clinically important resistance
  - Cephalosporins
  - Aminoglycosides
  - Quinolones
- Compare hospitalization rate of patients with pan-susceptible (n=702) infections to patients with clinically important resistance (n=63)

Multivariate Analysis
(n=765)

Outcome	Pan Susceptible	Clinically Important Resistance	Adjusted* OR (95% CI)
Hospitalized	149/702 (21%)	22/63 (35%)	2.2 (1.2-4.0)

*Other covariates = serotype, bloodstream infection, age, race, surveillance site

Conclusions

- Antimicrobial resistance in non-Typhoidal *Salmonella* is associated with an increased rate of hospitalization
  - For any resistance → 50% increase in odds
  - For clinically important resistance → 120% increase in odds
- Important finding because demonstrates significant human health consequences of resistance

Further Study

- Failure of empiric therapy?
- Co-morbid conditions and prior antimicrobial therapy?
- Increased virulence?