K-795

Utilizing Intrastate Surveillance to Determine Antimicrobial Resistance Patterns for *Staphylococcus aureus*: Results from the Florida Cohort of the Antimicrobial Resistance Management (ARM) Program

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ABSTRACT

Background: The Centers for Disease Control and Prevention recommends treating effectively by targeting the pathogen and using antimicrobials based on local data. The Antimicrobial Resistance Management (ARM) Program is an antibiogram-based surveillance system that benchmarks local antibiotic use and resistance rates.

Methods: To test the hypothesis that *S aureus* resistance within the State of Florida is not homogenous, Florida hospitals enrolled in the ARM program were grouped into North, Central, and South regions for comparison. *S aureus* isolates (n=1,082,963) from Florida hospitals in the ARM aggregate database were reviewed for each year from 1997-2003 for resistance to nafcillin/oxacillin, clindamycin, and erythromycin as surrogates for rates of MRSA, methylation (erm), and efflux pump-mediated (mef) drug resistance.

Results: From 1999-2003, *S aureus* isolate resistance to nafcillin/oxacillin increased from 36% to 58% in North and 36% to 46% in the South; in Central, rates decreased from 28% to 25% (2000). For clindamycin, erm increased from 32% to 39% in North; 4% to 7% in Central; and 29% to 39% in South. Resistance to erythromycin increased from 52% to 70% in North; 39% to 46% in Central, and 52% to 61% in South; mef was variable, especially in Central (Table).

Rates of mef by Region and Year (%)

	North	Central	South
1997	20	N/A	23
1998	20	28	25
1999	26	28	21
2000	25	34	25
2001	30	32	27
2002	31	45	27
2003	31	39	22

Conclusions: Awareness of heterogeneous differences in resistance patterns for *S aureus*, as demonstrated within the State of Florida, can allow better allocation of strategic resources. These data may be useful in adjusting empiric therapy.

BACKGROUND

- The Centers for Disease Control and Prevention (CDC) has identified reversing antimicrobial resistance as one of its top 8 priority health goals for the 21st century
- The Antimicrobial Resistance Management (ARM) Program was established at the University of Florida in 1997 to document trends in antimicrobial susceptibility patterns in inpatient/outpatient isolates using an antibiogram-based surveillance system
- By benchmarking local antibiotic use and resistance rates, the ARM Program can help hospitals fulfill CDC recommendations to target the pathogen, leading to more effective use of antimicrobial agents

METHODS

GENERAL DATA COLLECTION

- Each hospital is enrolled in the ARM Program at no cost and provides a minimum of 3 years of antibiogram or sensitivity report data in a HIPAA-compliant format
- All data are entered into an aggregate database
- To date, susceptibility data on 30 million drug/isolate comparisons have been submitted by 365 US institutions, 78 teaching and 287 nonteaching
  - 48 antibiotics
  - 19 organisms

SPECIFIC DATA ANALYSES

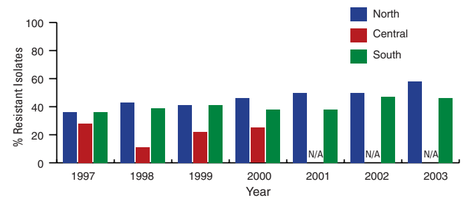
- We hypothesized that *Staphylococcus aureus* resistance within the State of Florida is heterogeneous
- To test this hypothesis, Florida hospitals enrolled in the ARM Program were grouped into North/Panhandle, Central, and South regions to compare intrastate susceptibility patterns
- Susceptibility rates between 1997 and 2003 were determined for *S aureus* isolates (n=1,082,963) for Florida hospitals to the following antibiotics as surrogates
  - Nafcillin/oxacillin for rates of methicillin-resistant *S aureus* (MRSA)
  - Clindamycin for methylation (erm)
  - Erythromycin for efflux pump-mediated (mef) drug resistance
- *S aureus* isolate resistance to ciprofloxacin and levofloxacin were also reviewed to determine if a class effect existed for these fluoroquinolones

RESULTS

MRSA

- *S aureus* isolate resistance to nafcillin/oxacillin increased from 36% in 1997 to 58% in 2003 in hospitals in the North and from 36% to 46% in the South (Figure 1)
- In hospitals in the Central region, rates decreased from 28% in 1997 to 25% in 2000 (Figure 1)

Figure 1.* S aureus *isolate resistance to nafcillin/oxacillin by region, 1997-2003



- For 1997-2003 inclusive, individual hospital *S aureus* isolate susceptibilities to nafcillin/oxacillin in each region were compared with the system average susceptibility (Figures 2A-2C)
- System average susceptibility was much higher in Central hospitals (78%; Figure 2B) than compared with those in both the North (52%; Figure 2A) and South (60%; Figure 2C)
- Overall, susceptibilities within individual hospitals in the South were more consistent with the system average susceptibility (Figure 2C)

Figures 2A-2C.* S aureus *isolate susceptibility to nafcillin/oxacillin, 1997-2003

Figure 2A. North Florida hospitals

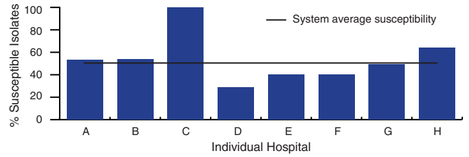


Figure 2B. Central Florida hospitals

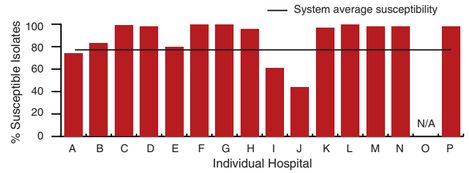
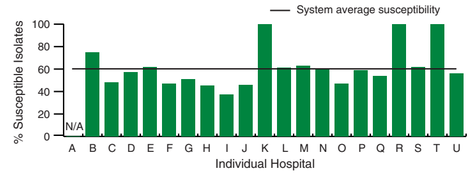


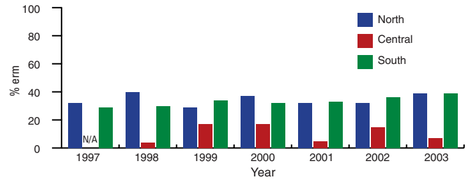
Figure 2C. South Florida hospitals



Methyation (erm)

- For clindamycin, erm increased from 32% to 39% in North; 4% (1998) to 7% in Central (after increasing and decreasing between 1999-2002); and 29% to 39% in South (Figure 3)

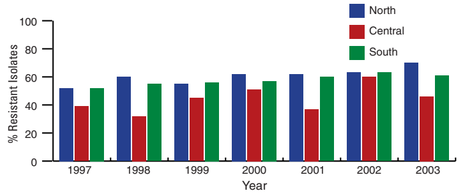
Figure 3. Rates of erm by region, 1997-2003



Efflux pump-mediated (mef) resistance

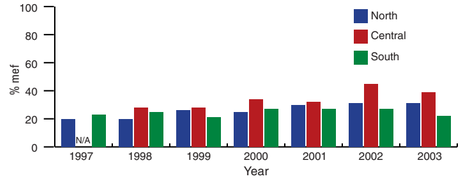
- Resistance to erythromycin increased from 52% to 70% in North; 39% to 46% in Central, and 52% to 61% in South (Figure 4)

Figure 4. Resistance to erythromycin by region, 1997-2003



- Rates of mef were variable among the regions, especially in Central, with the North and Central regions showing an increase between 1997-2003 (Figure 5)

Figure 5. Rates of mef, by region, 1997-2003



Fluoroquinolones

- *S aureus* isolate susceptibility to ciprofloxacin and levofloxacin were assessed for each region (Figures 6A-6C)
- The resistance pattern observed in the North (Figure 6A) and South (Figure 6C) Florida hospitals suggests a class effect; the pattern observed in Central Florida hospitals (Figure 6B) was more variable

Figures 6A-6C.* S aureus *isolate susceptibility to ciprofloxacin and levofloxacin in Florida hospitals by year

Figure 6A. North Florida hospitals

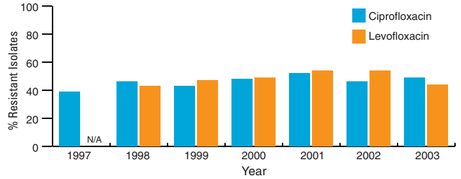


Figure 6B. Central Florida hospitals

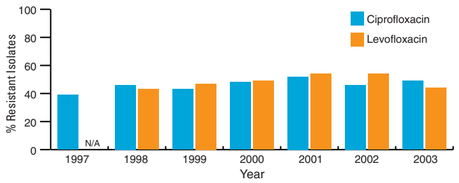
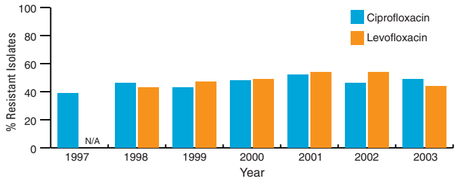


Figure 6C. South Florida hospitals



CONCLUSIONS

- Resistance patterns for *S aureus* isolates within the State of Florida are not homogeneous
- Knowledge of individual hospital susceptibility, including benchmarking within a specific region, can help pinpoint areas of resistance, allowing better allocation of resources and adjustment of empiric therapy

ACKNOWLEDGMENTS

The author would like to thank the participating institutions in the ARM Program, which make data collection possible

This research was supported, in part, with financial support from the Investigator-Sponsored Study Program of AstraZeneca and by Roche Pharmaceuticals

www.armprogram.com

A project run by the University of Florida

Presented at the 46th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC), September 28, 2006, San Francisco, California, USA