670

Heterogeneous variations in antimicrobial resistance within the State of Florida: Results of the Antimicrobial Resistance Management (ARM) Program

John G. Gums, PharmD, University of Florida, Gainesville, FL

John G. Gums, PharmD
625 SW Fourth Avenue
University of Florida, Gainesville, FL 32601 USA
Tel: +1.352-392-4541 Fax: +1.352-392-7766
E-mail: gums@chfm.ufl.edu

UPDATED ABSTRACT

Purpose: To prevent antimicrobial resistance, the Centers for Disease Control and Prevention recommends diagnosing and treating infection effectively by targeting the pathogen and using antimicrobials wisely based on local data. In addition to national and regional comparisons, the Antimicrobial Resistance Management (ARM) Program has the ability to benchmark local antibiotic use and resistance rates; for example, within the State of Florida.

Methods: To test the hypothesis that intrastate susceptibility patterns are not homogeneous, Florida hospitals were grouped into North/Panhandle, Central, and South regions for comparison. Significant organisms in the ARM database were selected to determine susceptibility rates to commonly used antibiotics between 1997 and 2003: Escherichia coli *(1,866,672 isolates),* Staphylococcus aureus *(1,082,963),* Pseudomonas aeruginosa *(665,702), and* Enterococcus faecium *(23,713).*

Results: In all regions, E coli *isolate sensitivity decreased to ciprofloxacin, levofloxacin, ceftriaxone, and ampicillin from 1997-2003, with the greatest decreases seen for ciprofloxacin in the South (96% to 78%); for isolate susceptibility to ampicillin/sulbactam, all regions decreased with the exception of Central, where it fluctuated from year to year. For* S aureus*, susceptibility to clindamycin, erythromycin, levofloxacin, and nafcillin/oxacillin declined in the North and South; in the Central region, each fluctuated annually.* S aureus *isolates remained 100% susceptible to vancomycin. For* P aeruginosa*, decreases in sensitivity were observed for ceftazidime, ciprofloxacin, gentamicin, imipenem, and piperacillin for all regions, with the greatest decrease in susceptibility seen for ciprofloxacin in the North (72% to 57%), and Central (77% to 67%) regions. Isolate susceptibility to gentamicin decreased in the North and South, while remaining relatively stable in the Central region. Piperacillin/tazobactam susceptibility showed the most variability among regions; while remaining relatively stable in the North and South, susceptibility decreased from 97% to 86% in the Central region.* E faecium *isolate susceptibility to vancomycin decreased substantially, with the greatest decreases occurring in the North (88% to 23%) and South (83% to 34%).*

Conclusion: These results support the hypothesis that resistance patterns within the State of Florida are not homogeneous. Data from the ARM Program can assist state-based health organizations in identifying and screening for heterogeneous differences in antimicrobial susceptibility, allowing resources to be directed to a local area with an identified specific resistance issue.

PURPOSE

- The Antimicrobial Resistance Management (ARM) Program is an ongoing study to document trends in antimicrobial susceptibility patterns in inpatient and outpatient isolates and to identify relationships between antibiotic use and resistance rates
- Hospitals can delineate if and when antimicrobial resistance occurs
  - Allows strategic intervention
  - Provides data for local, regional, national benchmarks
  - Has potential to reduce costs of antibiotics associated with inappropriate use
- For the purposes of comparison, US hospitals are grouped in 6 geographic regions
- Hospitals included from each region are as follows:
  - North Central: 14%
  - Northeast: 30%
  - Northwest: 2%
  - South Central: 16%
  - Southeast: 30%
  - Southwest: 8%

METHODS

DATA COLLECTION

- Each hospital provides a minimum of 3 years of antibiogram or sensitivity report data
- As of November 15, 2005, susceptibility data on 28.6 million isolate comparisons have been submitted by 362 institutions
  - 48 antibiotics
  - 19 organisms
- At www.armprogram.com, a Web-based analysis tool allows comparisons between antibiotic use and resistance rates for any number of parameters
- For this analysis, Florida hospitals were grouped into North (including the Panhandle), Central, and South regions to compare intrastate susceptibility patterns
- Susceptibility rates between 1997 and 2003 were determined to the following commonly used antibiotics:
  - *Escherichia coli:* ciprofloxacin, levofloxacin, ceftriaxone, ampicillin, ampicillin/silbactam
  - *Staphylococcus aureus:* erythromycin, levofloxacin, nafcillin/oxacillin, clindamycin, vancomycin
  - *Pseudomonas aeruginosa:* ceftazidime, ciprofloxacin, gentamicin, imipenem, piperacillin, piperacillin/tazabactam
  - *Enterococcus faecium:* vancomycin

RESULTS

E COLI

- In the North, Central, and South regions of the State of Florida, *E coli* isolate sensitivity decreased from 1997 to 2003 to ampicillin (Figure 1A), ceftriaxone (Figure 1C), ciprofloxacin (Figure 1D), and levofloxacin (Figure 1E)
- The greatest decreases were observed for ciprofloxacin in the South, 96% to 78% (Figure 1D)
- *E coli* isolate sensitivity to ampicillin/sulbactam was more variable in the North, Central, and South regions (Figure 1B)

Figure 1A. Ampicillin

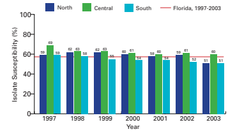


Figure 1B. Ampicillin/sulbactam

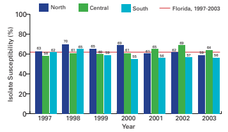


Figure 1C. Ceftriaxone

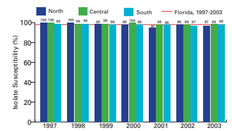


Figure 1D. Ciprofloxacin

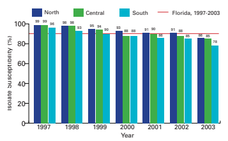
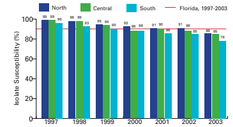


Figure 1E. Levofloxacin



- To determine the extent to which susceptibilities within individual hospitals varied within each region, *E coli* isolate susceptibility to ciprofloxacin was determined for hospitals in the ARM Program in the North (Figure 2A), Central (Figure 2B), and South Florida (Figure 2C) regions
- Although the average for each region was similar (91%, 91%, and 90%, respectively), intraregional differences were quite varied, especially in the South, where it ranged from 72% to 99% (Figure 2C)

Figure 2A. E coli *isolate susceptibility to ciprofloxacin in North Florida hospitals*

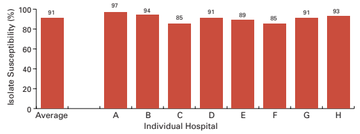


Figure 2B. E coli *isolate susceptibility to ciprofloxacin in Central Florida hospitals*

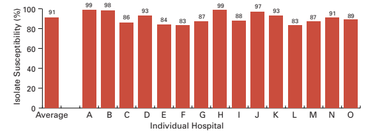
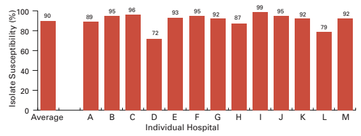


Figure 2C. E coli *isolate susceptibility to ciprofloxacin in South Florida hospitals*



S AUREUS

- From 1997-2003, *S aureus* isolates remained 100% susceptible to vancomycin in all regions in Florida (data not shown)
- Susceptibility to nafcillin/oxacillin declined in the North and South regions; greater fluctuations were observed in the Central region (Figure 3A)
- Similar resistance patterns were seen clindamycin (Figure 3B), erythromycin (Figure 3C), and levofloxacin (Figure 3D)

Figure 3A. Nafcillin/oxacillin

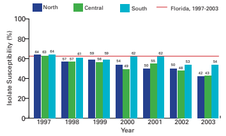


Figure 3B. Clindamycin

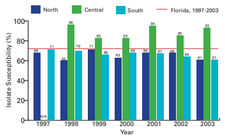


Figure 3C. Erythromycin

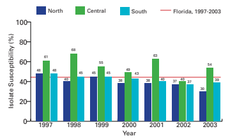
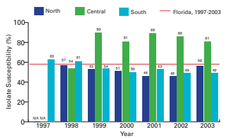


Figure 3D. Levofloxacin



P AERUGINOSA

- For *P aeruginosa*, decreases in sensitivity were observed for ceftazidime (Figure 4A), ciprofloxacin (Figure 4B), imipenem (Figure 4D), and piperacillin (Figure 4E) for all regions
- The greatest decrease in susceptibility was seen for ciprofloxacin in the North (72% to 57%), and Central (77% to 67%) regions (Figure 4B)
- Gentamicin susceptibility decreased in the North and South, while remaining relatively stable in the Central region (Figure 4C)
- Piperacillin/tazobactam showed the most variability among regions; while remaining relatively stable in the North and South, susceptibility decreased from 97% to 86% in Central

Figure 4A. Ceftazidime

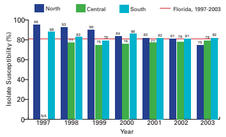


Figure 4B. Ciprofloxacin

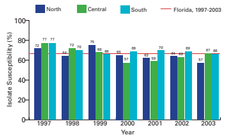


Figure 4C. Gentamicin

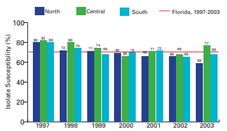


Figure 4D. Imipenem

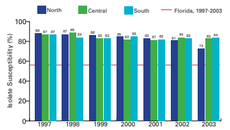


Figure 4E. Piperacillin

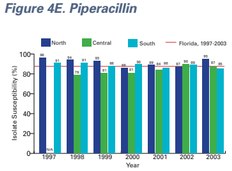
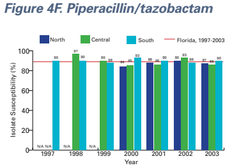


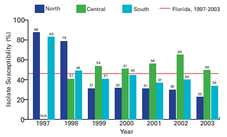
Figure 4F. Piperacillin/tazobactam



E FAECIUM

- The greatest decreases in *E faecium* isolate susceptibility to vancomycin were observed in the North (88% to 23%) and South (83% to 34%)

Figure 5. Vancomycin



CONCLUSION

- The Centers for Disease Control and Prevention recommends diagnosing and treating infection by targeting the pathogen and using antimicrobials wisely based on local susceptibility data
- These data demonstrate that resistance patterns of *E coli, S aureus, P aeruginosa,* and *E faecium* within the State of Florida are regionally heterogeneous
- The ARM Program can assist state-based health organizations in identifying and screening for such differences in antimicrobial susceptibility, allowing resources to be directed to a local area with an identified specific resistance issue

ACKNOWLEDGMENTS

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

www.armprogram.com
A project run by the University of Florida
Presented at the 2005 American Society of Health-System Pharmacists (ASHP) Midyear Clinical Meeting, December 8, 2005, Las Vegas, Nevada

Disclosure

Authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation:
John Gums : Nothing to disclose