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Antimicrobial Resistance Documented at www.armprogram.com

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

BACKGROUND: The Antimicrobial Resistance Management Program (ARMP) was established in 1997 at the University of Florida to document trends in antimicrobial susceptibility patterns in inpatient/outpatient isolates and track resistance that may occur with specific antibiotic use.

METHODS: Institutions are enrolled at no charge and provide a minimum of 3 years of antibiogram/sensitivity report data, which are reviewed to create a customized analysis of antimicrobial susceptibility trends within the institution, benchmarked against national/regional comparators. The data, in a HIPAA-compliant non-identifying format, comprise a national aggregate database. This database was interrogated at www.armprogram.com to determine resistance patterns for nosocomial pathogens for Florida from 1997-2004.

RESULTS: As of May 2005, ARMP has enrolled 359 institutions. The database includes 28.6 million isolate-drug combinations, categorized by 48 antibiotics and 19 organisms. In Florida, 5.1 million isolate-drug combinations were collected between 1997-2004; during this time, E coli, P aeruginosa, and S aureus isolates became increasingly resistant to commonly prescribed antibiotics with the exception of P aeruginosa between 2003-2004, when susceptibility to 3 antibiotics increased. E coli susceptibility declined from 59.6% to 50.4% to ampicillin; 61.8% to 55.5% to ampicillin/sulbactam; 97% to 87.5% to ciprofloxacin; and 93.9% to 72.2% to levofloxacin. P aeruginosa susceptibility declined 79.8% to 74.2% to gentamicin; 93.3% to 87.2% to tobramycin; and 76.7% to 68.8% to ciprofloxacin; susceptibility increased from 92.2% to 94.2% to amikacin; 84.7% to 87% to ceftazidime; and 75.6% (1998) to 79.6% to cefepime (after declining through 2003). For S aureus, susceptibility to nafcillin/oxacillin declined from 64.6% to 52.0%.

CONCLUSIONS: By interrogating the national aggregate database at ARMP, susceptibility patterns for antibiotics and infectious disease organisms can be compared over time, allowing modification of use of antibacterial therapy as needed.

BACKGROUND

- Growing concern about microbial drug resistance and patient safety has led to the promotion of good antimicrobial stewardship[1]
- In 1997, ARMP was established at the University of Florida to document trends in antimicrobial susceptibility patterns in inpatient/outpatient isolates
- By tracking isolate susceptibility patterns over time, it is possible to identify whether resistance to specific antibiotics is occurring

METHODS

- Qualifying hospitals/systems participate in ARMP at no cost
- Each provides a minimum of 3 years of antibiogram or sensitivity report data
- Hospitals/systems receive a customized Antibiogram Report and Analysis detailing antimicrobial susceptibility trends within their institutions benchmarked against national, regional, and state comparators
- The data, in a HIPAA-compliant non-identifying format, become part of the ARMP national aggregate surveillance resistance database
- The database was interrogated at www.armprogram.com to determine resistance patterns for nosocomial pathogens for Florida from 1997-2004

RESULTS

NATIONAL AGGREGATE DATABASE

- As of August 2005, ARMP has enrolled 359 US institutions
  - 282 (79%) nonteaching
  - 77 (21%) teaching
- 28.6 million isolate-drug combinations are represented in the database
- Individual antibiotics and organisms captured include
  - 48 antibiotics
  - 19 organisms
- The most significant organisms are summarized in Table 1

Table 1. Significant Organisms in the ARMP Aggregate Resistance Database*

Organism	Isolates (n)
Escherichia coli	11,616,270
Staphylococcus aureus	4,960,753
Pseudomonas aeruginosa	2,747,553
Klebsiella pneumoniae	2,775,697
Proteus mirabilis	1,781,652

*as of August 25, 2005

- For the purposes of comparison, institutions are grouped in 6 geographic regions (Figure 1)

Figure 1. Geographic Distribution of Institutions
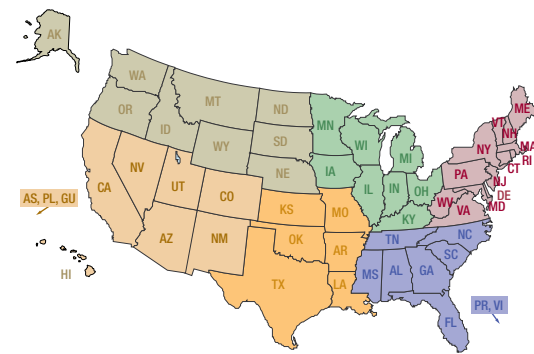
- The number of institutions from each region are:
  - North Central: 52 (14%)
  - Northeast: 107 (30%)
  - Northwest: 8 (2%)
  - South Central: 58 (16%)
 - Southeast: 106 (30%)
  - Southwest: 28 (8%)

DATA FOR THE STATE OF FLORIDA

- Between 1997-2004, data on 5.1 million isolate-drug combinations were collected from institutions in Florida
- E coli, P aeruginosa, and S aureus isolate data were reviewed for susceptibility to commonly prescribed antibiotics
- Between 1997-2004, the majority of E coli, P aeruginosa, and S aureus isolates became increasingly resistant to commonly prescribed antibiotics
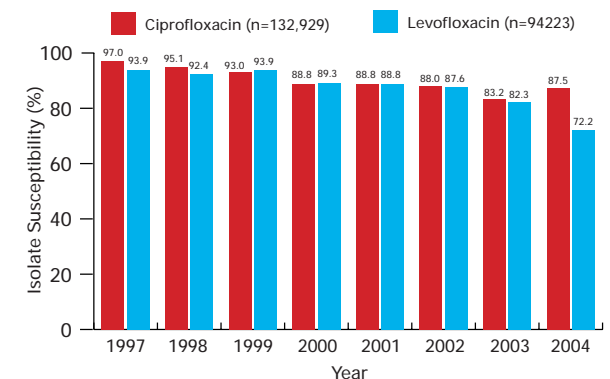
E COLI

- E coli isolate data were reviewed for susceptibility to ampicillin and ampicillin/sulbactam, and to the fluoroquinolones ciprofloxacin and levofloxacin
- During this time, isolate susceptibility declined overall to each antibiotic (Figures 2A and 2B)

Figure 2A. E coli Susceptibility to Ampicillin and Ampicillin/Sulbactam in Florida, 1997-2004
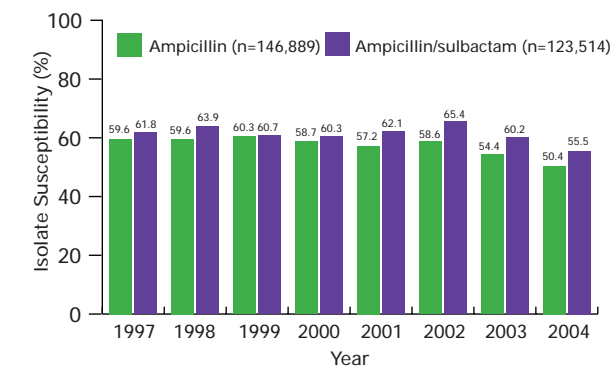
- There is a strong correlation between susceptibilities to ampicillin and susceptibilities to ampicillin/sulbactam within institutions in Florida, providing surrogate evidence that the majority of ampicillin resistant E coli isolates are hyperproducing beta lactamase

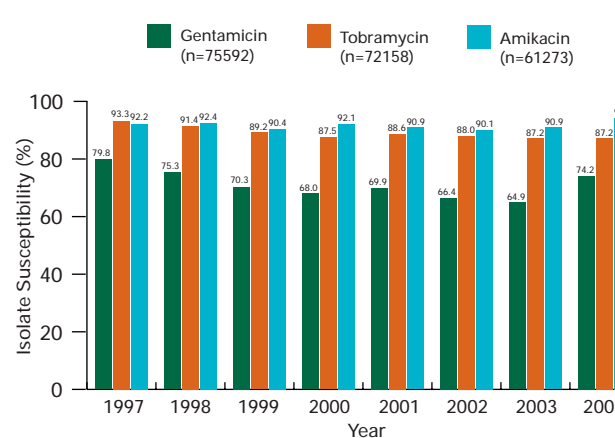### Figure 2B. E coli Susceptibility to Selected Fluoroquinolones in Florida, 1997-2004

- The close similarities in resistance patterns between the fluoroquinolones suggest that fluoroquinolone resistance to E coli within institutions in Florida is class-mediated

P AERUGINOSA

- P aeruginosa isolate data were reviewed for susceptibility to the aminoglycosides gentamicin, tobramycin, and amikacin; the third-generation cephalosporin ceftazidime; the fourth-generation cephalosporin cefepime; and the fluoroquinolones ciprofloxacin and levofloxacin
- Between 1997-2004, susceptibility to gentamicin, tobramycin, and ciprofloxacin declined, while susceptibility to amikacin, ceftazidime, and cefepime increased (Figures 3A, 3B, and 3C)

Figure 3A. P aeruginosa Susceptibility to Selected Aminoglycosides in Florida, 1997-2004

- Gentamicin susceptibilities in Florida are suppressed compared to those of tobramycin or amikacin; this is to be expected since it is assumed that gentamicin is the preferred-use aminoglycoside

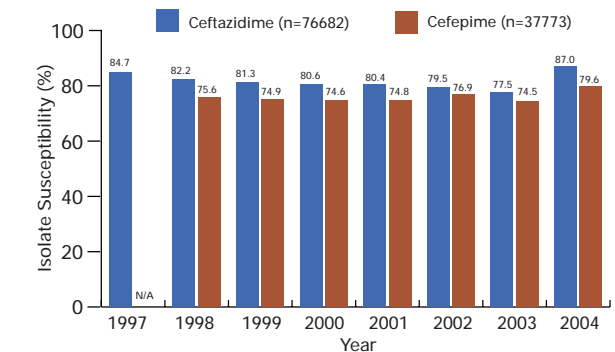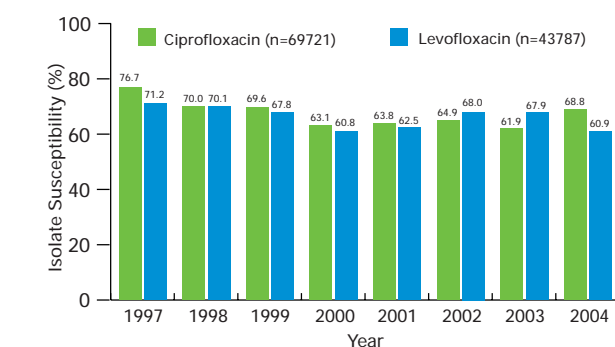### Figure 3B. P aeruginosa Susceptibility to Selected Cephalosporins in Florida, 1997-2004

### Figure 3C. P aeruginosa Susceptibility to Selected Fluoroquinolones in Florida, 1997-2004

- As with E coli, similarities in resistance patterns between the fluoroquinolones suggest that fluoroquinolone resistance to P aeruginosa within institutions in Florida is class-mediated

S AUREUS

- Under the assumption that the reciprocal to nafcillin/oxacillin susceptibility data is accepted as methicillin-resistant S aureus (MRSA) activity, S aureus isolate data were reviewed for susceptibility to nafcillin/oxacillin
- During this period, the MRSA level increased (Figure 4)

Figure 4. Increase in MRSA Level Activity in Florida, 1997-2004
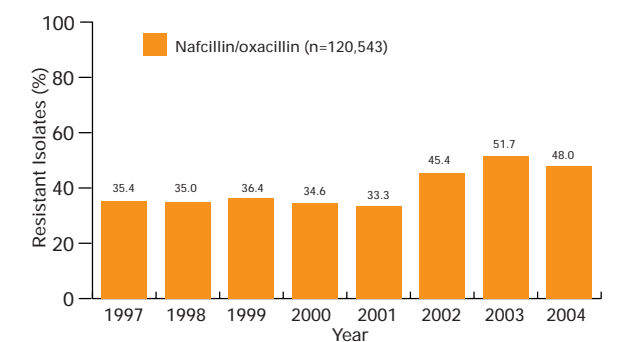
CONCLUSIONS

- The ARMP national aggregate database at www.armprogram.com allows susceptibility patterns for antibiotics and infectious disease organisms to be compared over time
- ARMP can work with institutions to delineate occurrence and extent of antimicrobial resistance before it becomes significant
  - Allows modification of use of antibacterial therapy as needed
  - Has potential to reduce costs of antibiotics associated with inappropriate use
  - Provides data for local, regional, national benchmarks

References

1. Owens RC Jr., Fraser GL, Stogsdill P. Antimicrobial stewardship programs as a means to optimize antimicrobial use. Pharmacotherapy. 2004;24:896-908.

www.armprogram.com
A project run by the University of Florida
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