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Antimicrobial Susceptibility Trends from 1990-2000: Preliminary Results of the Antimicrobial Resistance Management (ARM) Program

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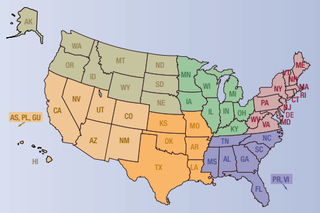
What is the Antimicrobial Resistance Management (ARM) Program?

PURPOSE

- The Antimicrobial Resistance Management (ARM) Program is an ongoing study to document trends in antimicrobial susceptibility patterns in US hospitals and to identify relationships between antibiotic use and resistance rates in given disease states
- 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
- More than 100 hospitals have enrolled to date
- For the purposes of comparison, US hospitals are grouped in 6 geographic regions (see map, below)

ARM Program Regions



DATA COLLECTION

- Each hospital provides a minimum of 3 years of data based on retrospective chart review
- Individual antibiotics and organisms are captured in the database
  - 46 antibiotics
  - 19 organisms
- A Web-based analysis tool allows comparisons between antibiotic use and resistance rates for any number of parameters
  - One year with another year
  - Groups of years to other groups of years
  - Hospital to hospital
  - Hospital to hospital system
  - Hospital to state
  - Within a state
  - Hospital to region
  - Hospital to national
  - State to state
  - State to region
  - State to national
  - Region to national

ABSTRACT

PURPOSE: This ongoing study was established to document trends in antimicrobial susceptibility patterns in US hospitals and identify relationships between antibiotic use and resistance rates.

METHODS: Data from 1990-2000, in the form of antibiograms and sensitivity reports from hospitals across the United States, were reviewed for resistance rates. In-patient and outpatient isolates were represented. A web-based analysis tool was developed to examine trends in resistance for individual hospitals, hospital systems, and selected geographic quadrants of the United States.

RESULTS: To date, 88 hospitals (66 non-teaching, 22 teaching) have submitted 10,315,361 total isolates. Isolate numbers per organism ranged from 289 (VRE) to 4,930,449 (*E. coli*). *P. aeruginosa* resistance was documented to ciprofloxacin (25.52%, n=115,545), imipenem (14.24%, n=110,894), gentamicin (21.21%, n=131,079), and ceftazidime (11.85%, n=133,881). *E. coli* resistance was noted to ampicillin (35.95%, n=296,583), ampicillin-sulbactam (30.19%, n=243,785), and piperacillin (30.69%, n=234,129). There was no surrogate evidence for *E. coli*-induced ESBL activity (cefazolin susceptibility 92.49% vs. ceftriaxone susceptibility 99.55%). *S. aureus* resistance is accelerating: ciprofloxacin (38.24%, n=155,653), levofloxacin (38.31%, n=60,838), and erythromycin (72.15%, n=227,150). The overall level of MRSA was 36.67% in 210,310 isolates. The documented level of VISA isolates was 0.04%. *S. pneumoniae* non-susceptibility to penicillin was 37.45% among 21,127 isolates. Significant differences were noted between cefotaxime susceptibility (69.20%) and ceftriaxone susceptibility (80.41%) of pneumococcus.

CONCLUSION: Antimicrobial resistance is accelerating. Recognition of local resistance patterns is essential to determine strategies for intervention. Ongoing efforts through the ARM program will help institutions identify and solve growing resistance problems.

BACKGROUND

- The emergence of antimicrobial resistance is a complex problem driven by many interconnected factors, in particular use and misuse of antimicrobials[1]
- Costs associated with treating antimicrobial resistant infections represent a significant burden to society: extra inhospital costs of 5 hospital-acquired infections caused by 6 common kinds of drug-resistant bacteria are estimated to be at least $1.3 billion annually (in 1992 dollars)[2-4]
- Data from the ARM program are anticipated to complement existing and emerging consensus guidelines for the treatment of a number of disease states

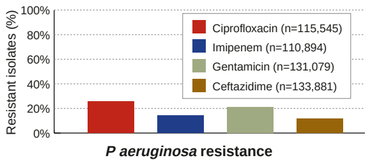
METHODS

- Data from antibiograms and sensitivity reports collected from hospitals across the United States from 1990 through 2000 were reviewed for resistance rates
- Inpatient and outpatient isolates were represented
- A Web-based analysis tool was developed to allow hospitals to examine trends in resistance within their own institutions and to compare resistance rates locally, regionally, and nationally

RESULTS

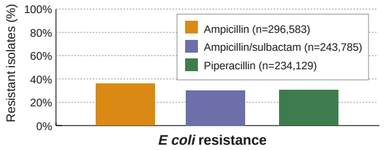
- 88 hospitals (66 nonteaching, 22 teaching) have submitted 10,315,361 total isolates
- Isolate numbers per organism ranged from 289 (vancomycin-resistant enterococcus, or VRE) to 4,930,449 (*Escherichia coli*)
- *Pseudomonas aeruginosa* resistance was documented to ciprofloxacin, imipenem, gentamicin, and ceftazidime (Figure 1)

Figure 1. P aeruginosa *resistance, 1990-2000*



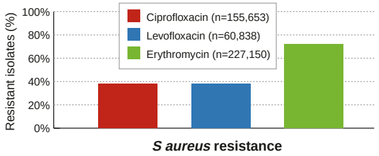
- *E coli* resistance was noted to ampicillin, ampicillin/sulbactam, and piperacillin (Figure 2); there was no surrogate evidence for *E coli*-induced ESBL activity (cefazolin susceptibility 92.5% vs. ceftriaxone susceptibility 99.6%)

Figure 2. E coli *resistance, 1990-2000*



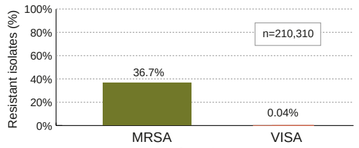
- *Staphylococcus aureus* resistance was noted to ciprofloxacin, levofloxacin, and erythromycin (Figure 3)

Figure 3. S aureus *resistance, 1990-2000*



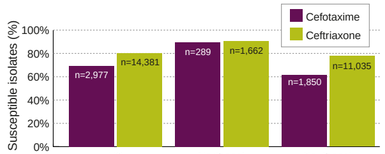
- The overall documented levels of methicillin-resistant *S aureus* (MRSA) and vancomycin intermediate-resistant *S aureus* (VISA) isolates are shown in Figure 4.

Figure 4. Overall level of MRSA and VISA isolates, 1990-2000



- *Streptococcus pneumoniae* nonsusceptibility to penicillin was 37.45% among 21,127 isolates
- Differences were noted between susceptibility of *S pneumoniae* to cefotaxime and ceftriaxone for all 88 hospitals; these rates were higher in the Northeast and lower in the Southeast (Figure 5)

Figure 5. S pneumoniae *susceptibility, 1990-2000*



CONCLUSION

- Ongoing efforts through the ARM Program will help institutions identify and solve growing resistance problems
- Recognition of local resistance patterns is essential for hospitals to determine strategies for intervention

REFERENCES

1. *WHO Global Strategy for Containment of Antimicrobial Resistance.* WHO/CDS/CSR/DRS/2001.2a:4.
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