Antibiotic Susceptibility of Pseudomonas aeruginosa and Staphylococcus aureus Isolates from US Hospital Intensive Care Units: Results of the ARM Program, 1997-2004 ICU Susceptibilities

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CHEST 2006
Critical Care Outcomes
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Bad Bugs—No Drugs!

- Review of 15 pharmaceutical companies and 7 major biotech companies revealed: 506 drugs in development (phase II/III)

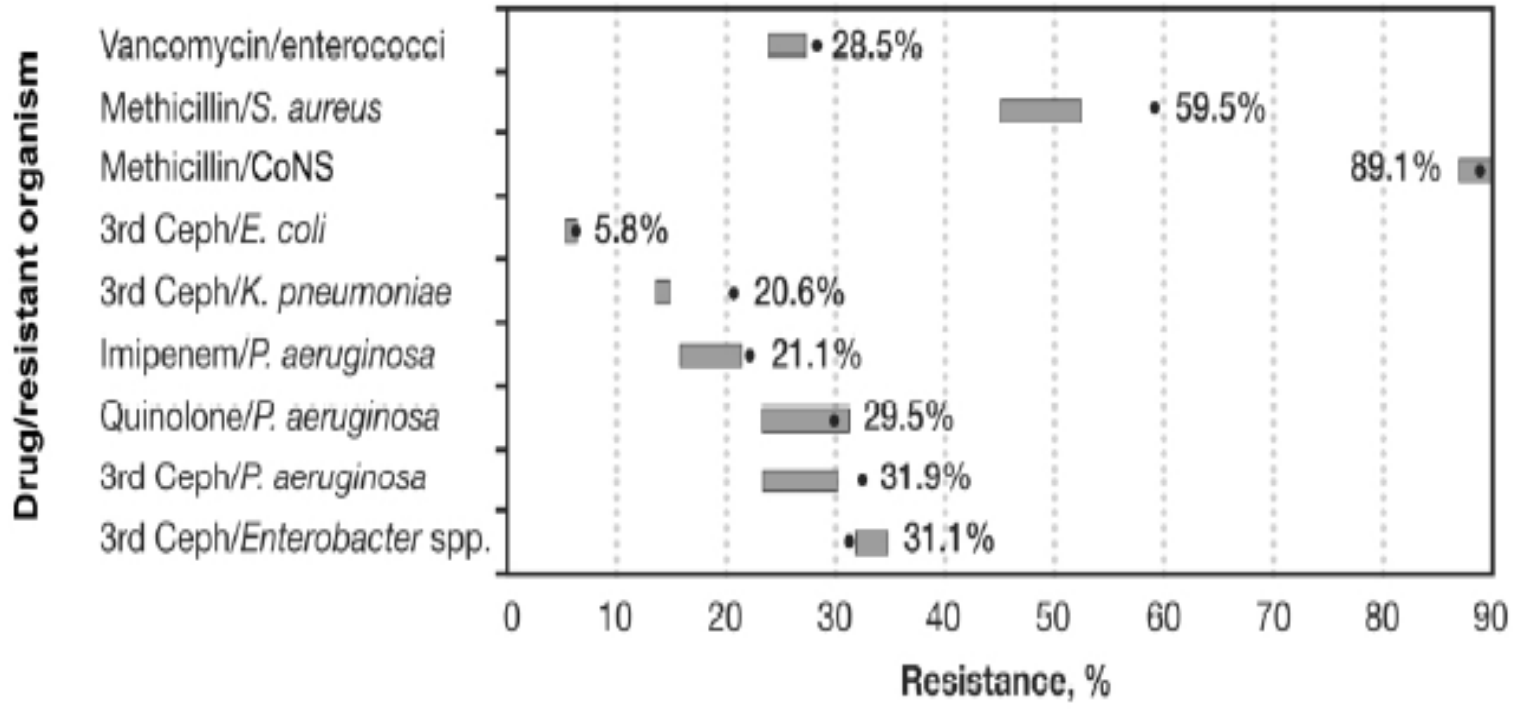
5 antibiotics
67 cancer-related
33 inflammation/pain
34 endocrine
32 pulmonary disease

IDSA 2004

Historical Perspective

- Until 1989 vancomycin resistance had not been reported; In 1994 14% of hospital-acquired enterococci were resistant to vancomycin (32% as of 2003) - *MMWR* 1993;42:597-99
- Not confined to bacteria - Candida sp.
  J Clin Microbiol 1994;32:1092-98
- Also seen with mupirocin - *JAC* 2003; 51:613-17
- Vancomycin-dependent Enterococci (VDE) – *EID* 2004; 10(7):1277-81

Resistance Rates in the ICU
NNIS System Report



No. of isolates during Jan-Dec 2003	Increase i resistance 2003 vs. 1998–200 %
2048	12
4100	11
3336	1
1355	0
1068	47
1392	15
1825	9
2119	20
1411	–6

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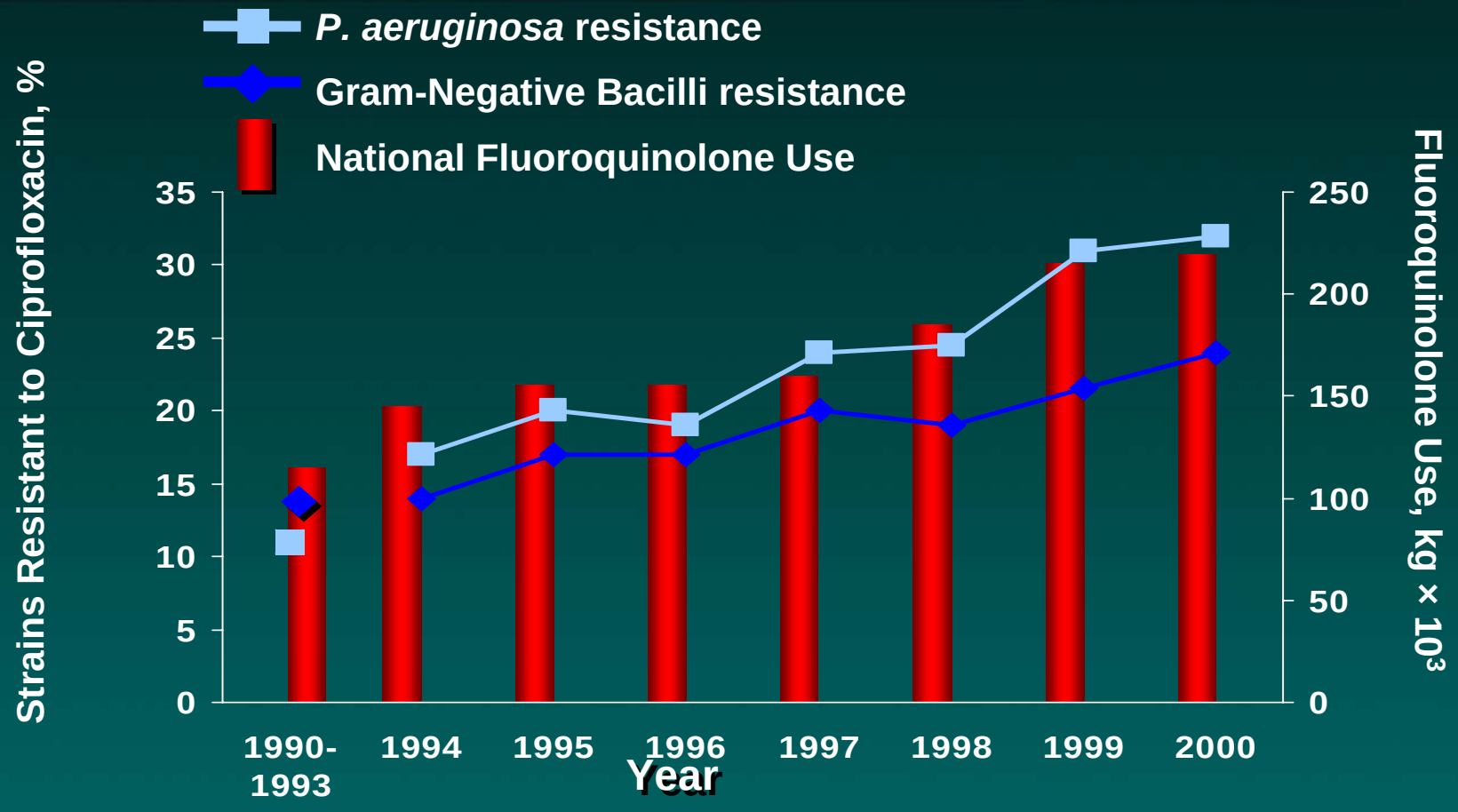
Antimicrobial Issue
Fluoroquinolone GNB Resistance in US ICUs



GNB=Gram-negative Bacilli

Neuhauser et al. *JAMA*. 2003 Feb 19;289(7):885-8.

Purpose and Methods

Risk factors for hospital-acquired pneumonia (HAP) include an ICU stay.

Using the ARM database, a national aggregate database containing ~ 30 M drug/isolate comparisons, we examined ICU isolate antimicrobial susceptibility rates of P. aeruginosa and S. aureus, two of the most common causes of HAP.

- Bug/drug comparisons for 1997-2004 were reviewed for abx used to treat HAP
  - Carbapenems (imipenem), aminoglycosides (amikacin, gentamicin, tobramycin), FQs (ciprofloxacin, levofloxacin), cephalosporins (ceftazidime, cefepime), extended-spectrum pcn abx (piperacillin), or combination piperacillin/tazobactam
- Data were variously available for NE, SE, and SW regions and summed for national total

The ARM Program

- The Antimicrobial Resistance Management Program (www.armprogram.com) is an ongoing project established in 1997 to:
  - Document trends in antimicrobial susceptibility patterns
  - Identify relationships between antibiotic use and resistance rates
- 51 frequently used antibiotics and 19 organisms tracked
- Minimum of 3 years of antibiogram/sensitivity report data for each institution included in a national aggregate surveillance database (HIPAA-compliant non-identifying format)
- Customized reports
- No cost to participant

ARM Program.com
RESISTANCE DATABASE

Home | About ARM | Trends

Thank you for visiting ARMProgram.com!

The **Antimicrobial Resistance Management (ARM) Program** is an ongoing project designed to:

- Document trends in antimicrobial susceptibility patterns
- Identify relationships between antibiotic use and resistance rates

Qualifying hospitals or systems may participate in the ARM program at **no cost to them**.

Participants receive a customized analysis of antimicrobial susceptibility trends within their hospital/system. The trends are benchmarked against national, regional, and state comparators.

- Learn more about ARM
- See national trending data
- Contact us

Click a region above,
click here for National Trends, or
click here for Custom Reports.

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A.R.M. Program: Background Data

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362 Hospitals

21% Teaching

79% Community

15%	**North Central**
30%	**Northeast**
2%	**Northwest**
16%	**South Central**
29%	**Southeast**
8%	**Southwest**

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A.R.M. Program: Background Data

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Total Isolates Compared Nationally (1990-2006): 30,027,284

- *2,836,156* Pseudomonas aeruginosa isolates
- 5,558,999 Staphylococcus aureus isolates (incl. MRSA)
  - *220,040* Streptococcus pneumoniae isolates
  - *12,176,916* E. coli isolates
  - *2,907,015* Klebsiella pneumoniae isolates

Pseudomonas aeruginosa

- Inducible, chromosomally-mediated β-lactamase
- Plasmid-mediated β-lactamase
- Loss of an outer membrane protein and plasmid-encoded imipenemase confers resistance to imipenem
- Quinolone resistance: 25-30%–Newer FQ select for resistance to whole class:

  Cip>Gem>Levo>Gati>Spar>Mox (ICAAC 2000)

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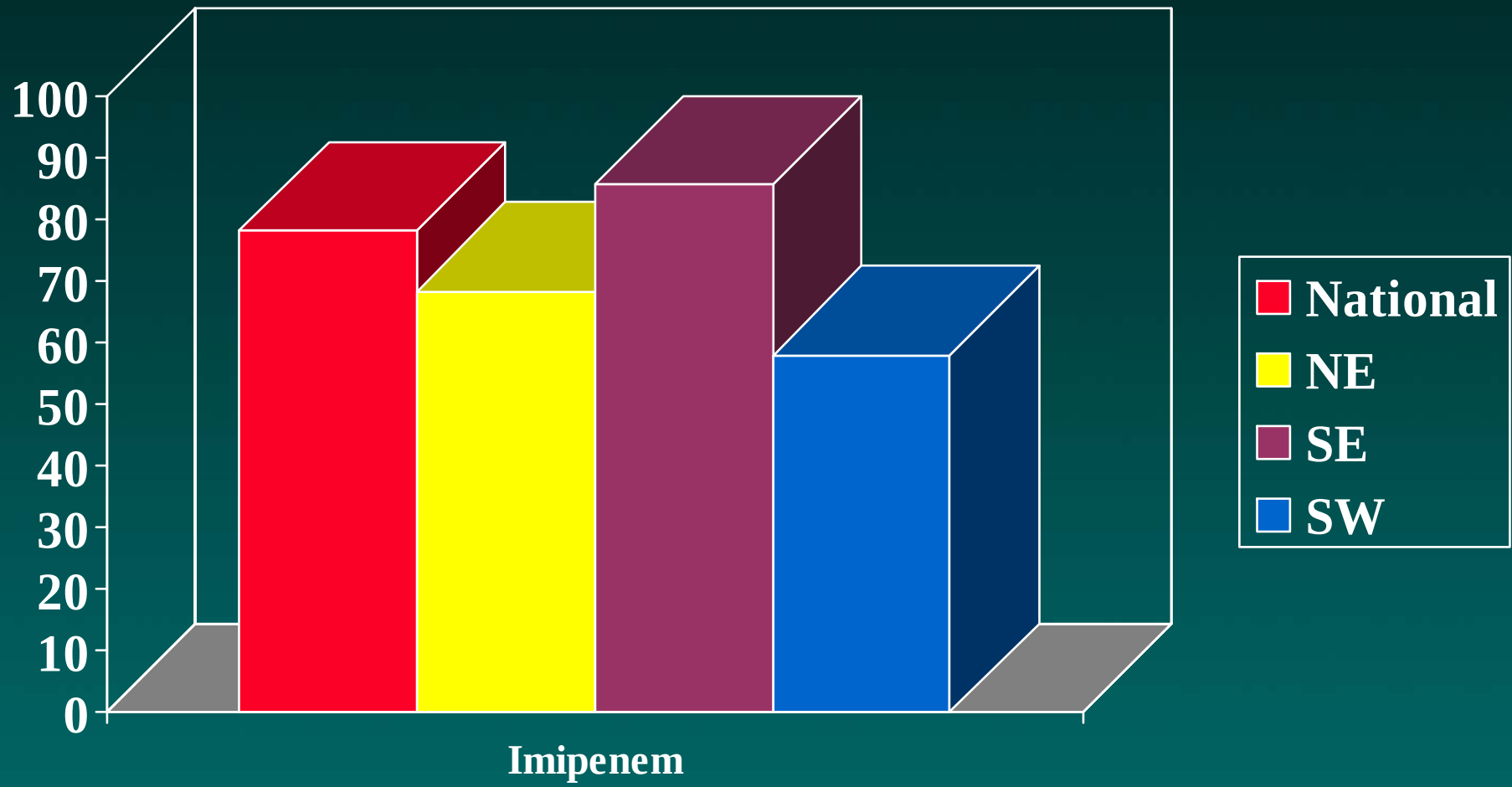
A.R.M. Program: Pseudomonas aeruginosa

1997-2004 ICU Susceptibilities



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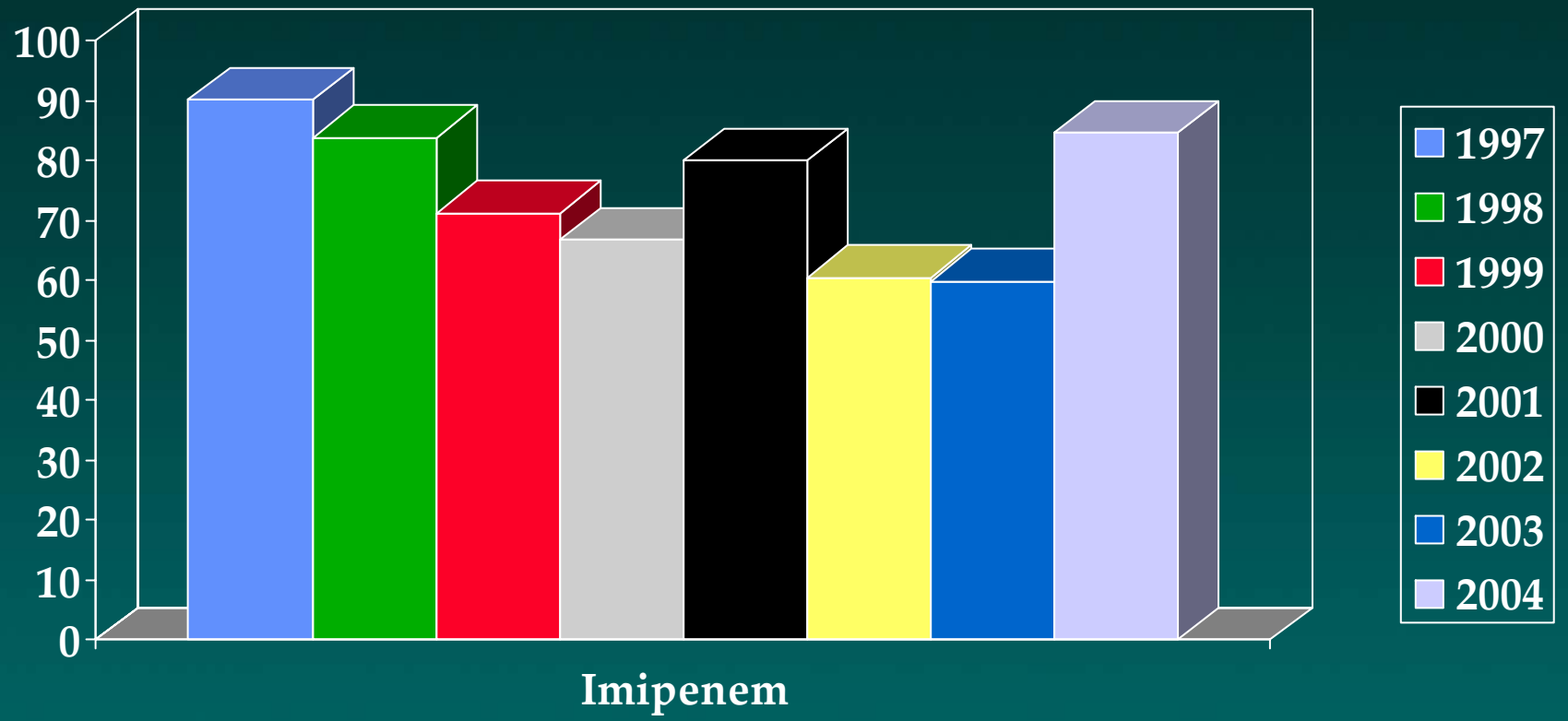

NOTE: All 1997 data from SE region; all 2004 data from NE region. Isolate comparison numbers varied from a high of 714 in 1997 to a low of 81 in 2000.

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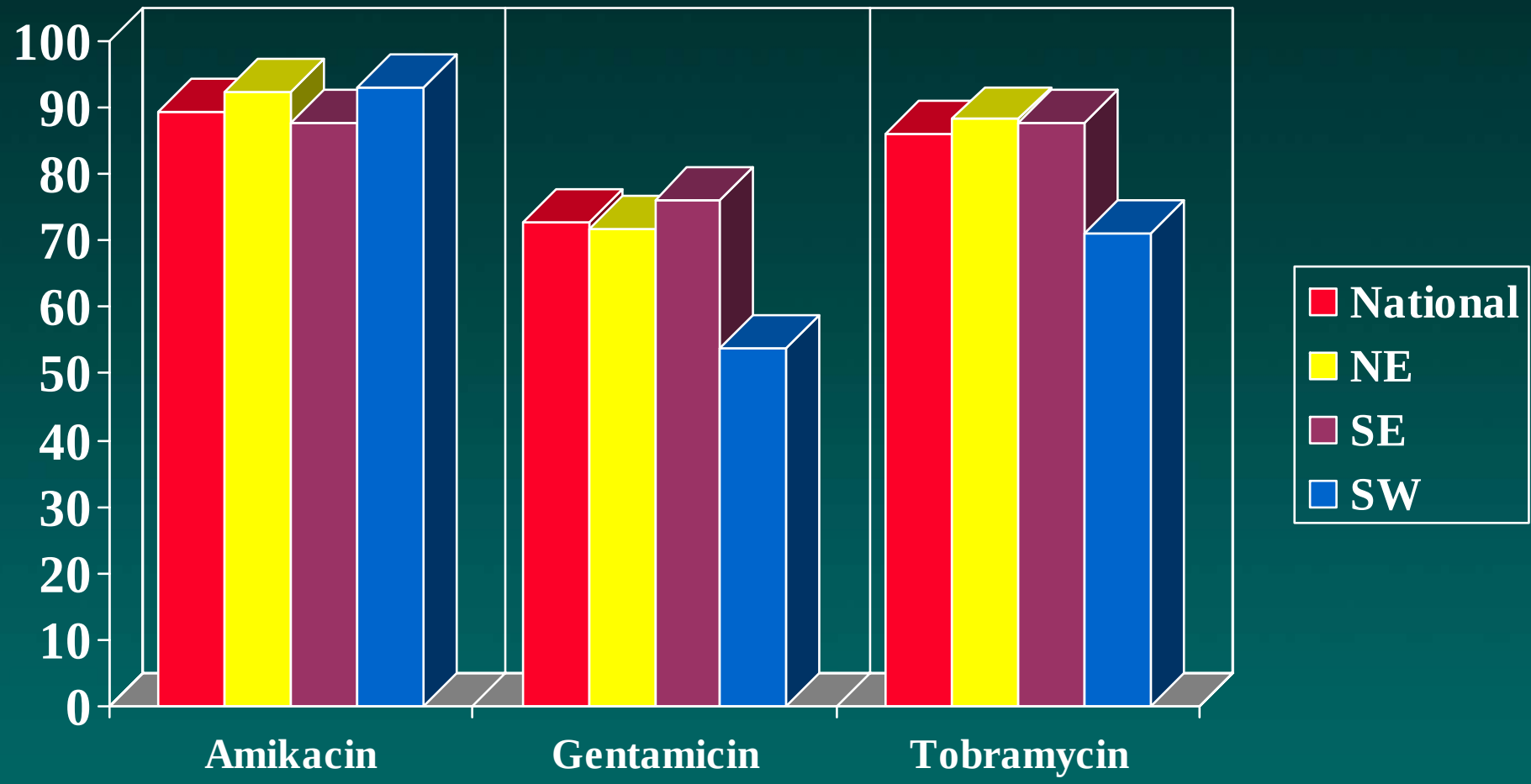
A.R.M. Program: Pseudomonas aeruginosa

1997-2004 ICU Susceptibilities



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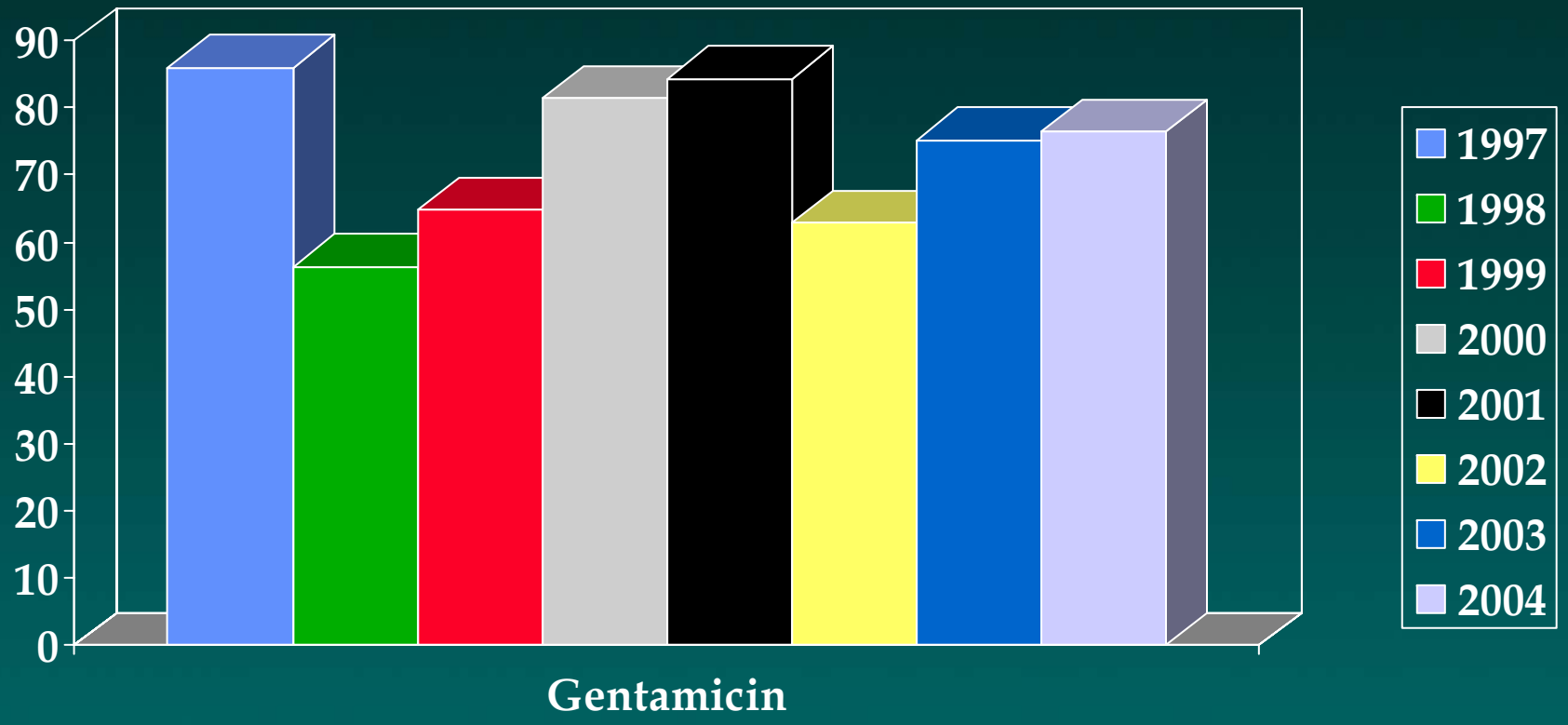

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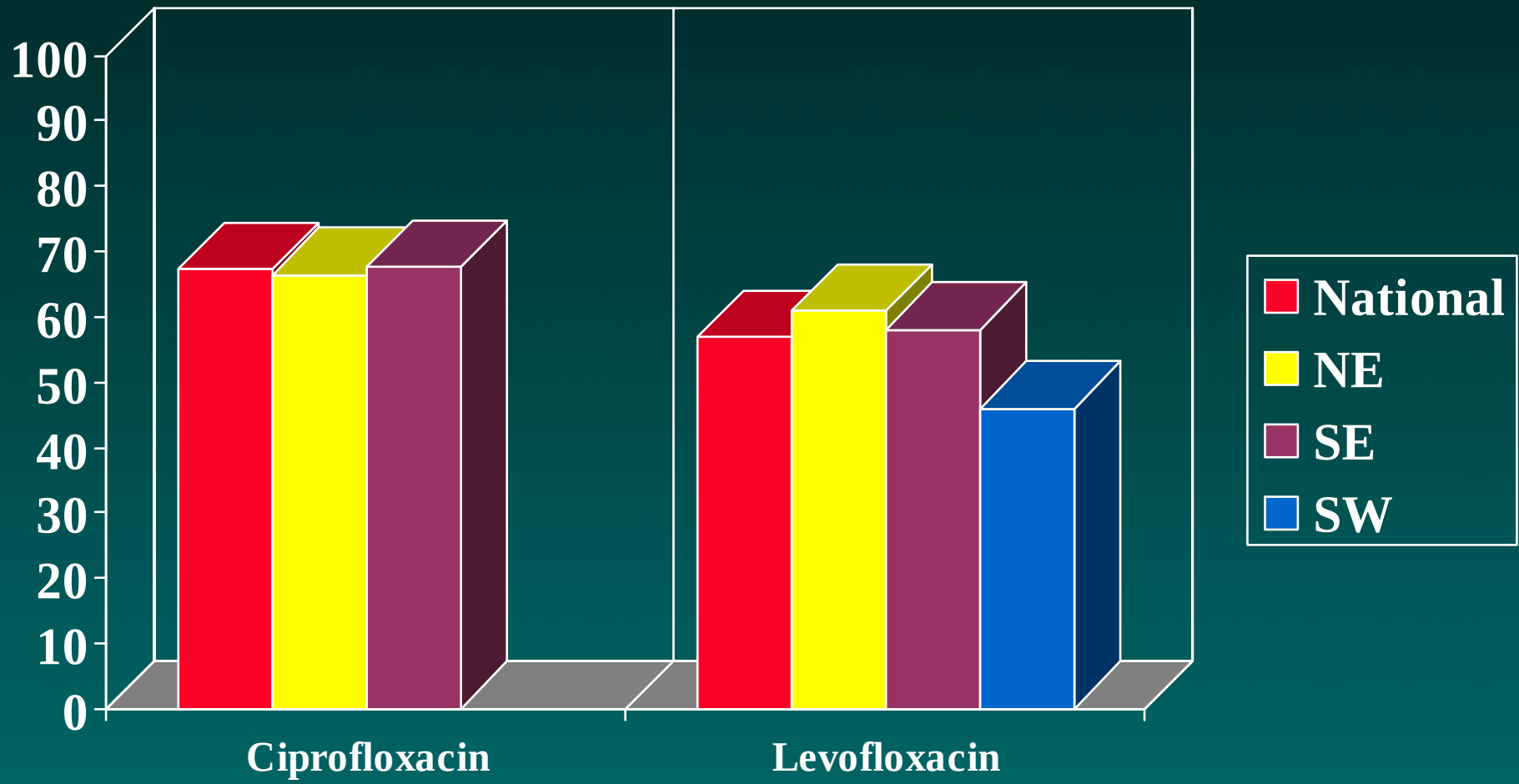

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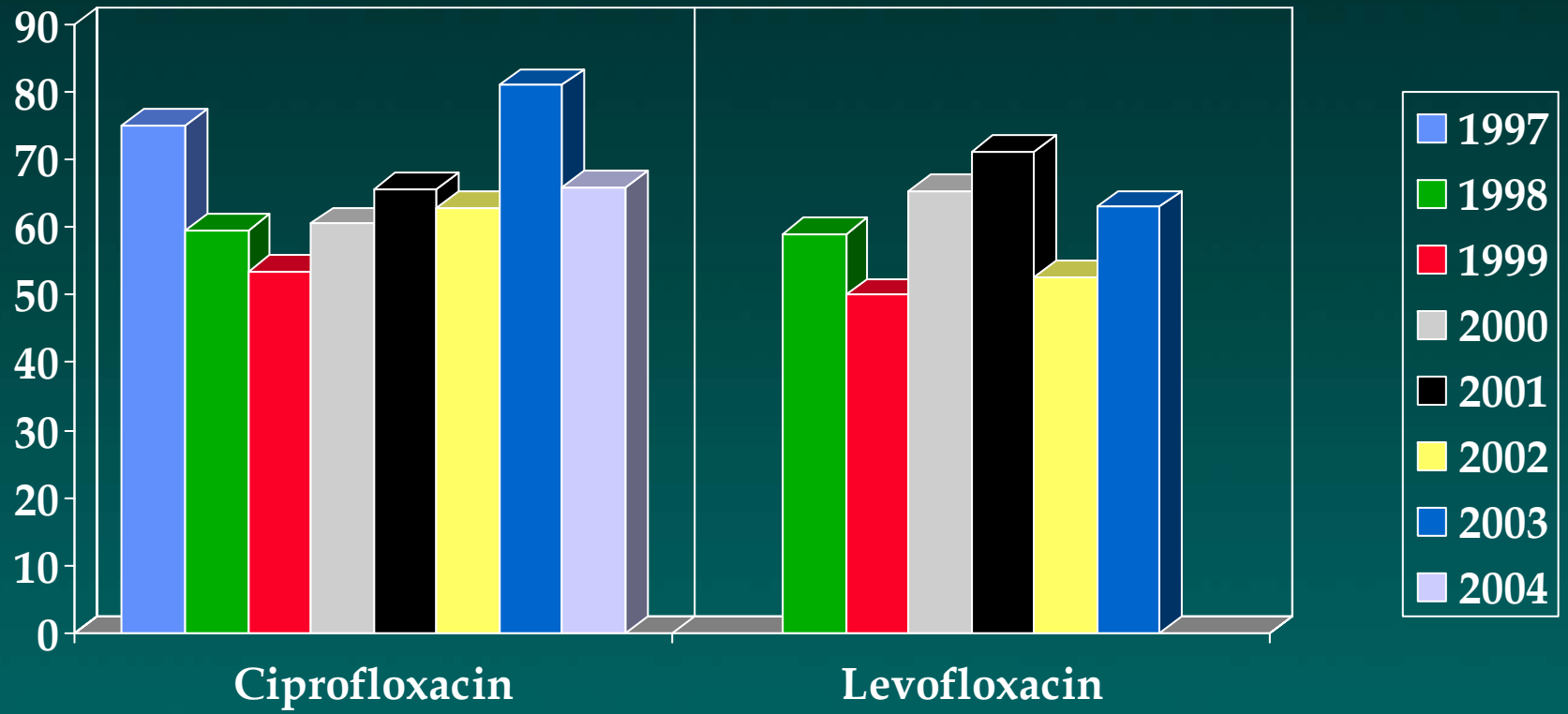

NOTE: All 1997 data from SE region; all 2004 data from NE region. Isolate comparison numbers varied from a high of 714 (cipro) in 1997 to a low of 27 (levo) in 2000.

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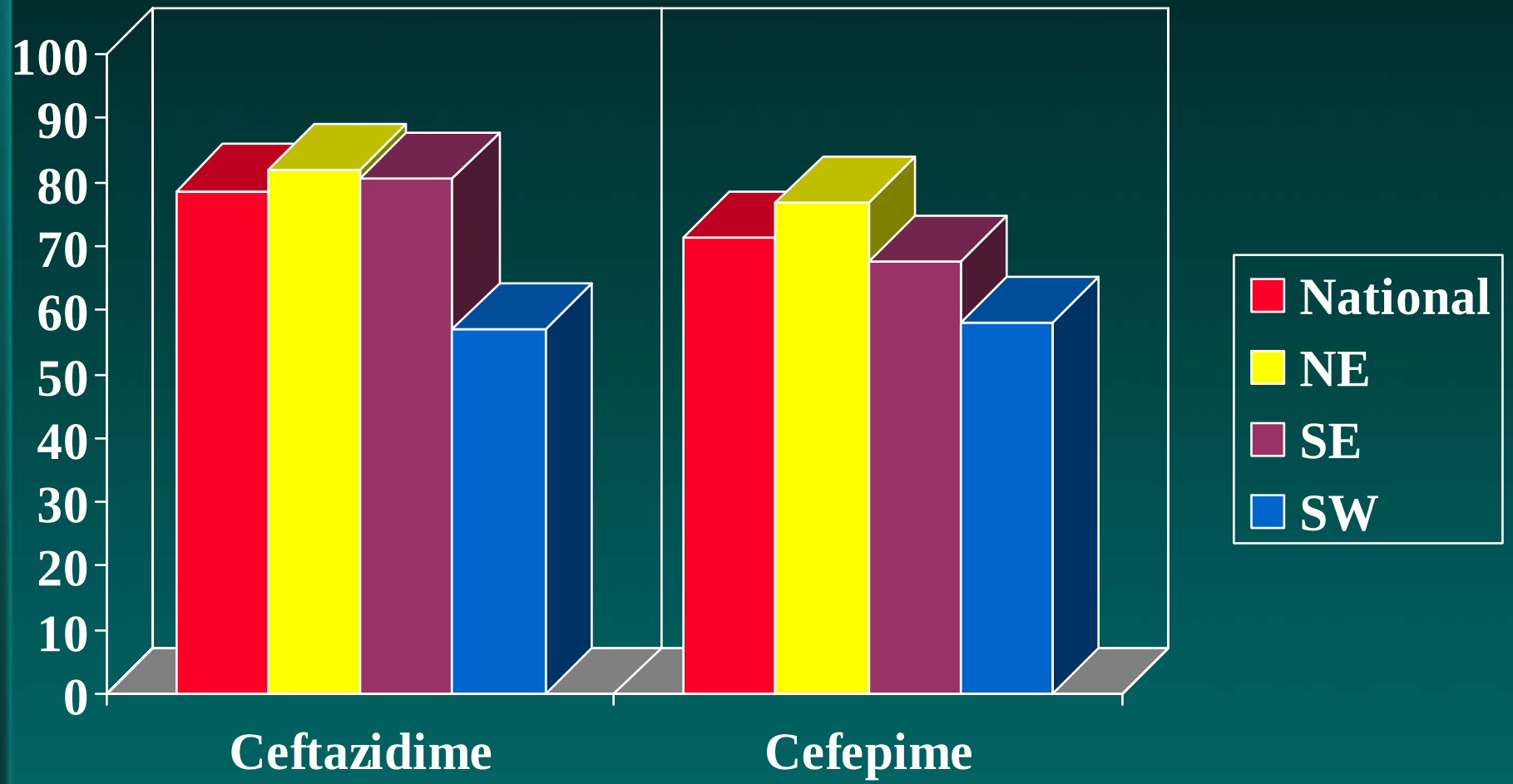
A.R.M. Program: Pseudomonas aeruginosa

1997-2004 ICU Susceptibilities



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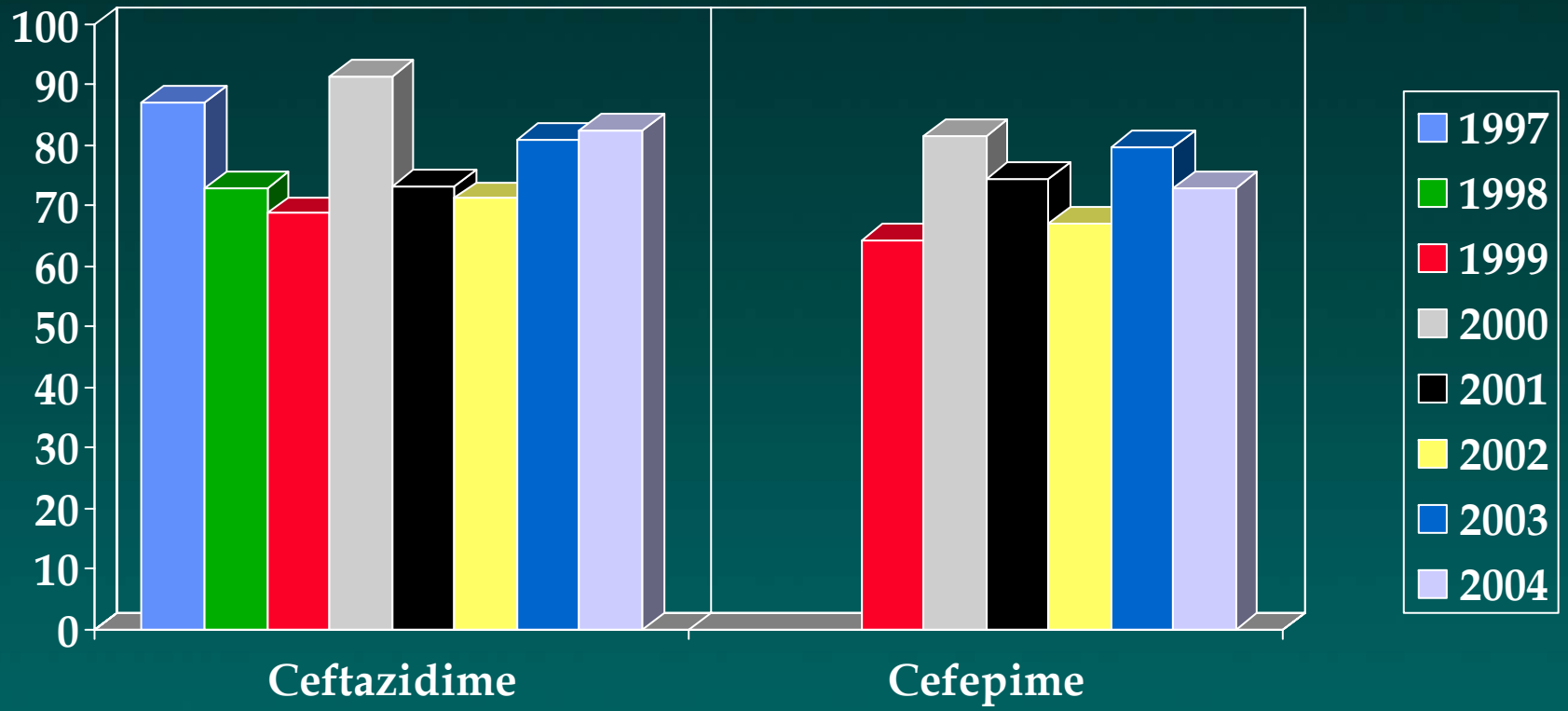

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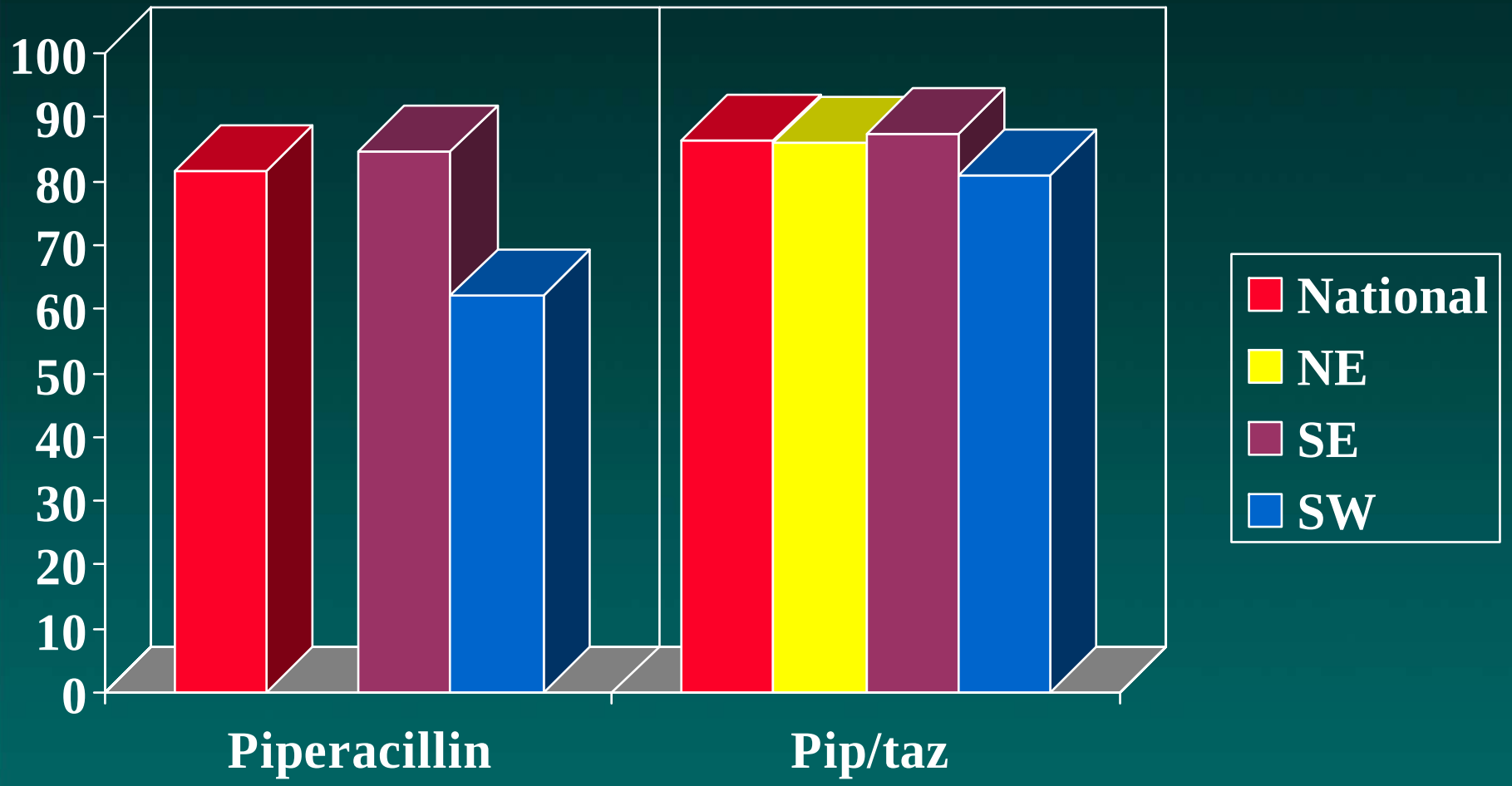
A.R.M. Program: Pseudomonas aeruginosa

1997-2004 ICU Susceptibilities



Gram-Positive Organisms

Staphylococcus aureus

- ~50% of all isolates are MRSA (SENTRY/MRL Data)
- 90% of MRSA isolates are resistant to quinolones
- Vancomycin still effective; resistance is increasing - 3,797 isolates, 286 hospitals = 8.6% MRSA > 2mcg/cc vancomycin (1999)

Vancomycin Intermediate *Staphylococcus aureus* (VISA)

- VISA (MIC = 8 μg/cc)
- May 1996: First reported in Japan
- July 1997: Peritonitis in a long-term peritoneal dialysis patient (Michigan)
- August 1997: Bloodstream infection with long-term MRSA colonization (New Jersey)
- Report immediately to State Health Department
- Isolation mandatory
- Contact FDA for drug therapy options

MMWR Sept. 5, 1997:46(35)

Vancomycin Resistant *Staphylococcus aureus* (VRSA)

- June 2002--catheter exit site in a 40 y.o. dialysis patient with DM, PVD, & CRF (oxacillin >16 μg/cc, vancomycin > 128 μg/cc).
  (*MMWR* July 5, 2002;51(26):565-67)
- April 2002--MRSA bacteremia treated with vancomycin and rifampin. Also infected with VRE and *K. oxytoca.*
- Resistant isolate contained the vanA gene from *enterococci*.
- September 20, 2002--Pennsylvania: possible osteomyelitis (vancomycin=64 μg/cc), contained mecA and vanA genes.
  (*MMWR* Oct. 11, 2002;51(40):902-3)
- April 23, 2004 – New York: LTCF, urine culture – microscan MIC = 4 μg/cc, E test = MIC = >256 μg/cc; mecA (oxacillin) and vanA (vancomycin) genes present.

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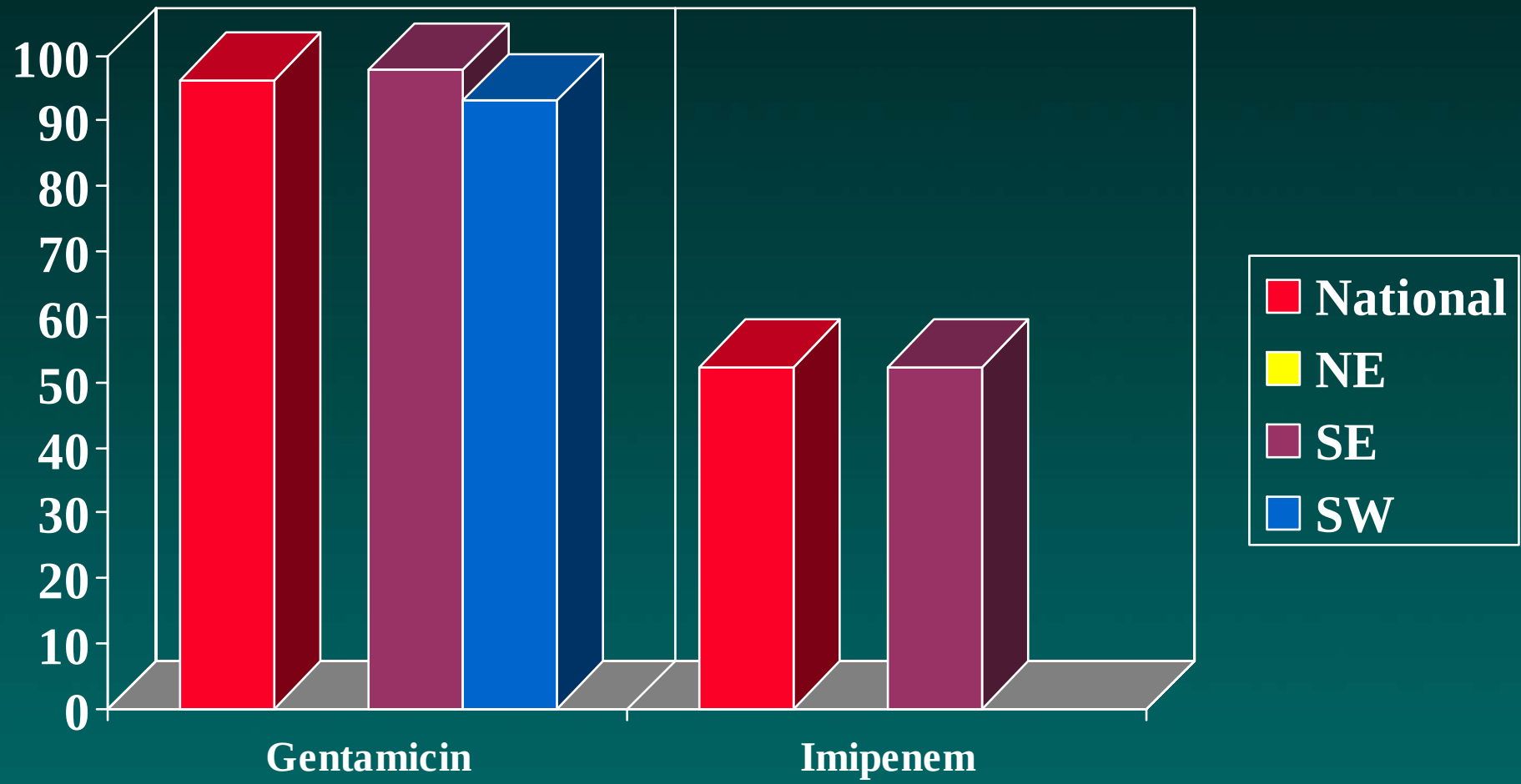
A.R.M. Program: Staphylococcus aureus

1998-2004 ICU Susceptibilities



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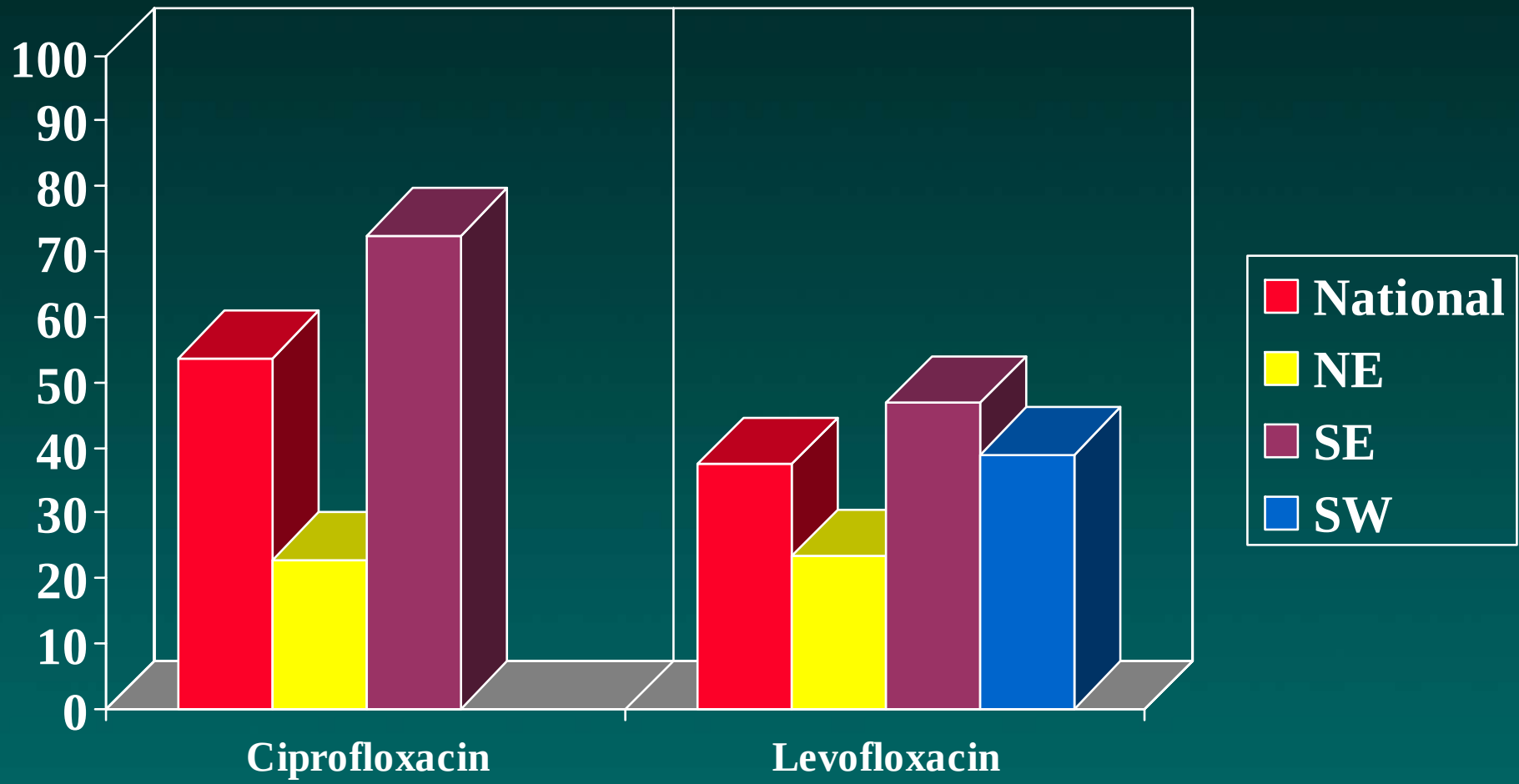

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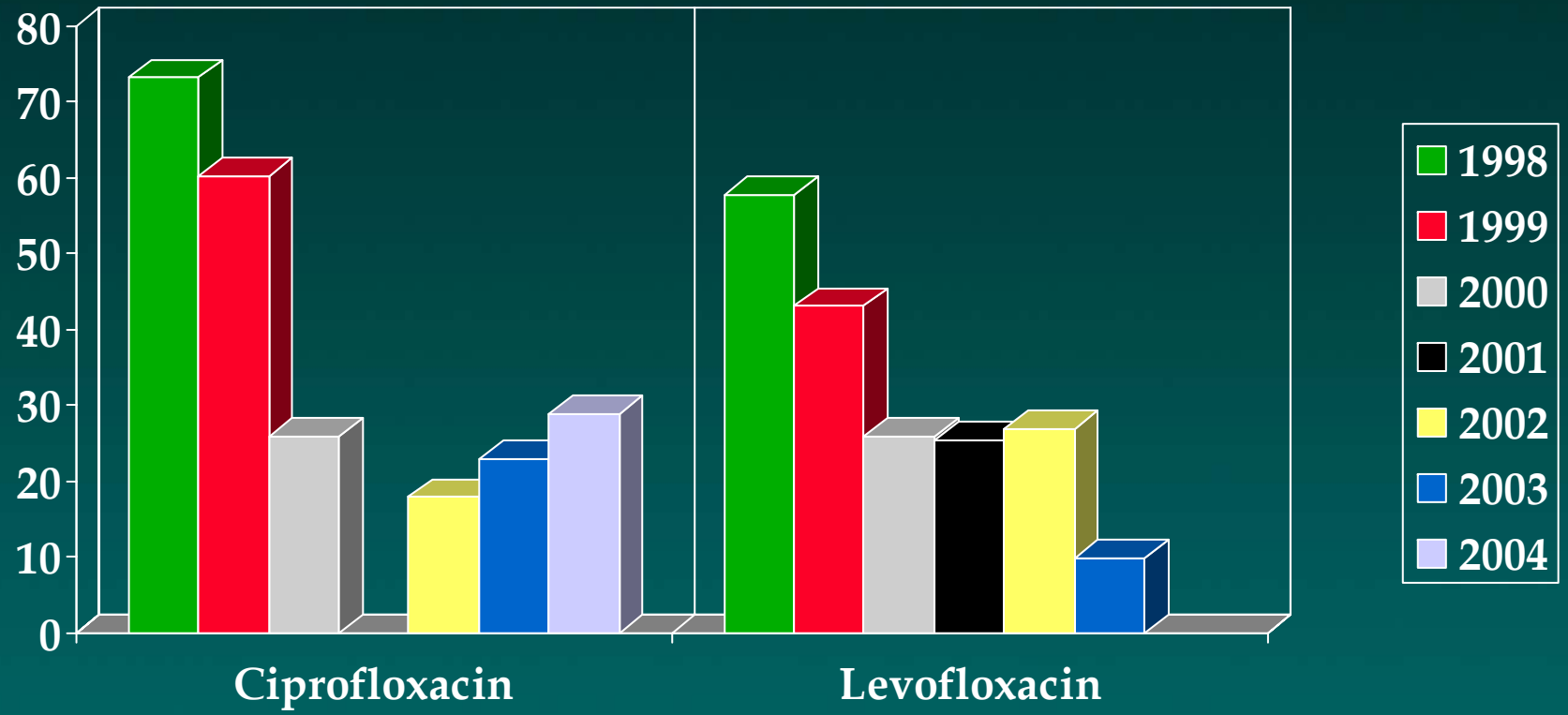

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A.R.M. Program: Staphylococcus aureus

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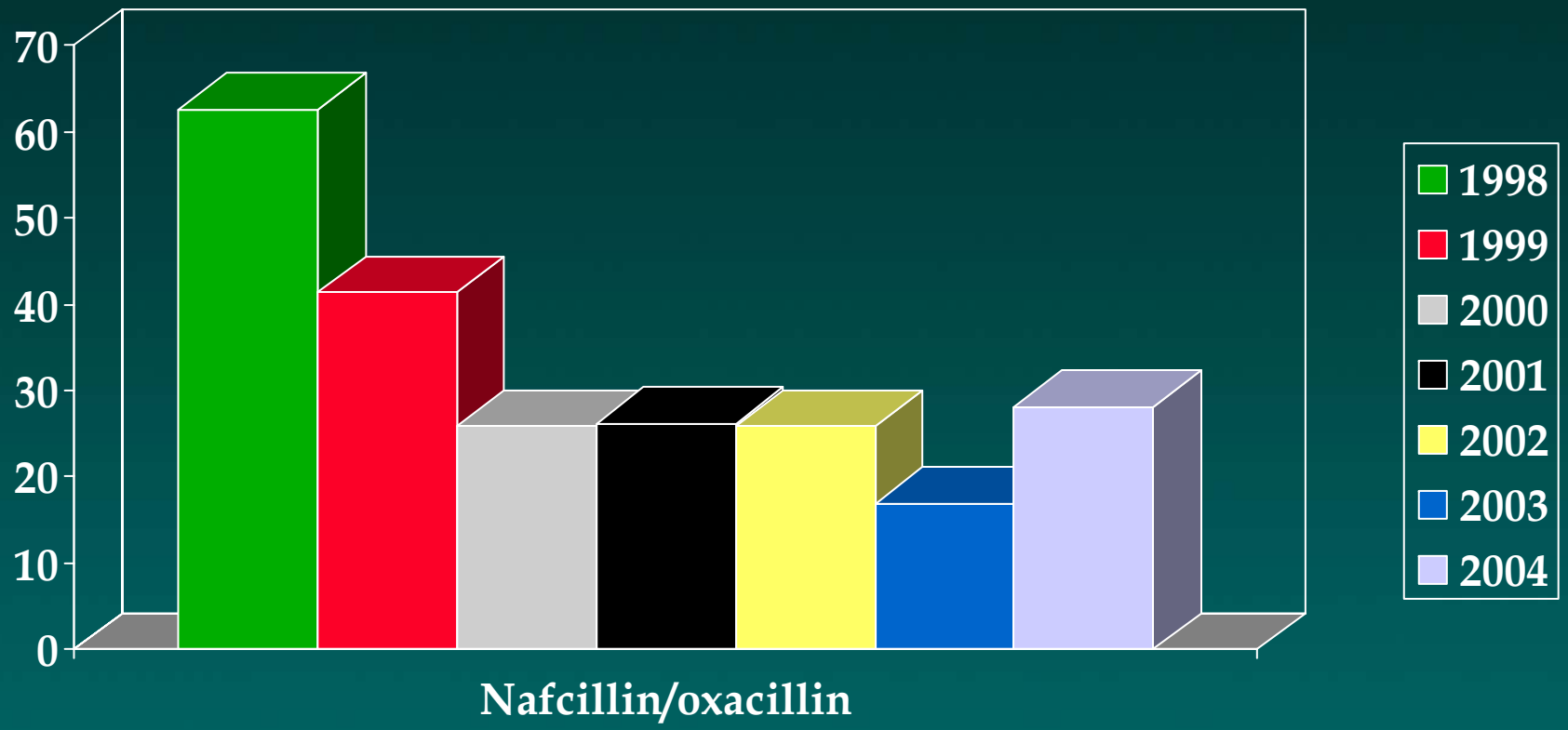

NOTE: All 1998 data from SE region, 2000 data from NE region. Isolate comparison numbers varied from a high of 1019 in 2002 to a low of 193 in 2000.

Conclusions and Clinical Implications

P. aeruginosa ICU isolates most resistant to FQs, most susceptible to amikacin, pip/taz, and tobramycin. S. aureus isolates most resistant to levofloxacin and most susceptible to amikacin and gentamicin.

Optimal therapy for HAP should include assessment of risk factors, *including local antimicrobial resistance patterns*. These data suggest that HAP should not be treated with FQs if P. aeruginosa or S. aureus are suspected of being the infectious organism.

ICU data from the ARM Program supports Published recommendations from IDSA, (*Am J Infect Control* 2004; 32:470-85) and consistent with NNIS surveillance (CDC)