Outpatient Antimicrobial Susceptibility: Comparison With Inpatient Susceptibility Patterns

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***Abstract*: Because specific outpatient epidemiologic data on the susceptibility of organisms are not readily available to guide empiric antibiotic therapy in the ambulatory setting, we reviewed all positive culture reports of clinical specimens (n = 935) isolated exclusively from outpatients of the Eastern Carolina Family Practice Center over a 1-year period. Eighty percent were from urine cultures, 12 percent from wound cultures, and 5 percent from sputum cultures. An antibiogram was developed that showed a pattern of bacterial resistance similar to that reported elsewhere.**

More than 80 percent of urinary tract infections were caused by *Escherichia coli*, *Klebsiella pneumoniae*, and *Proteus mirabilis*. More than 50 percent of skin and soft tissue infections were caused by *Staphylococcus aureus* and other *Staphylococcus* species. Susceptibilities of these organisms were compared with those reported by the local hospital, and antimicrobial resistance patterns were similar, which suggests that the choice of empiric antibiotic therapy can follow susceptibility patterns derived from either inpatient or outpatient laboratories in areas with similar resistance patterns.

Further research into the epidemiology and susceptibility of organisms isolated from outpatients is needed. Whether the susceptibility of inpatient and outpatient antimicrobial resistance found in this investigation can be extrapolated to other geographic areas remains to be determined. (J Am Bd Fam Pract 1989; 2:223-6.)

The rational selection of empiric antibiotic therapy should include consideration of local patterns of microbial susceptibility. Hospital epidemiologic susceptibility reports (antibiograms) and published drug- or organism-specific susceptibility profiles are often available to provide the clinician with information about patterns of microbial susceptibility in the inpatient setting. However, such reports are rarely available in the outpatient setting. Thus, the clinician frequently selects antibiotic therapy for outpatients on the basis of personal clinical experience, local hospital antibiogram reports, or published susceptibility reports. Because the comparability of bacterial sensitivity in the inpatient and outpatient settings is unknown, hospital-based reports might not be relevant and may lead to inappropriate antimicrobial selection.

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We investigated the epidemiology and susceptibility of bacteria isolated from clinical specimens of ambulatory, community-dwelling patients. An antibiogram (reference chart of organisms and antibiotic susceptibility) was developed for selected pathogens and compared with the local hospital antibiogram for the most commonly encountered organisms. Our data show, with some notable exceptions, that bacterial isolates and susceptibility patterns are similar in the two settings for common infections.

Methods

All positive culture reports on patients receiving care at the Eastern Carolina Family Practice Center for the period January–December 1987 were reviewed, and the bacterial isolates and antibiotic susceptibility patterns were recorded. The Center provides primary care for approximately 18,000 active patients, who are generally representative of the surrounding population for age, sex, and race. Culture and sensitivity reports were performed in the Department of Clinical Pathology and Diagnostic Medicine, East Carolina University, without significant changes in collection, isolation, or susceptibility-testing protocols during the study period.

Only positive cultures tested by disk susceptibility[1] were included in the study. Susceptibility testing was not performed on organisms that were believed to be contaminants, organisms usually sensitive to commonly used antibiotics, or when technical laboratory difficulties precluded such testing.

Each culture and sensitivity report was reviewed and the percentage of organisms susceptible to each antibiotic tested was calculated by dividing the number of positive cultures showing susceptibility by the number of positive cultures tested for susceptibility. The calculation was not performed when fewer than five isolates were tested.

A similar hospital antibiogram was obtained from the Pitt County Memorial Hospital in Greenville, North Carolina, a primary and tertiary care facility serving a population similar to the Eastern Carolina Family Practice Center. Both antibiograms were drawn from similar time periods.

Although hospital-isolated organisms were tested by dilution methods and outpatient-isolated organisms by disk diffusion, interpretations of dilution and disk susceptibility testing yield similar results.[1,2] Hospital and outpatient susceptibility results for selected organisms were compared, and differences were evaluated using the z-test. The criterion level for statistical significance was $P \leq 0.01$ to take into account the multiple testing.

Results

Susceptibility testing was conducted on 325 of 935 positive cultures (34.8 percent). The remaining positive cultures were not tested for reasons already given. Of the 325 positive cultures tested, 261 (80.3 percent) were urine cultures, 39 (12.0 percent) were wound cultures, and 17 (5.2 percent) were sputum cultures. The remaining 8 (2.5 percent) positive cultures were from eye, ear, stool, or body-fluid cultures.

Table 1 shows the most commonly isolated organisms from positive urine and wound cultures. Gram-negative organisms including *Escherichia coli*, *Klebsiella pneumoniae*, and *Proteus mirabilis* accounted for 83.2 percent of all positive urine cultures tested for susceptibility. *Staphylococcus aureus* and other *Staphylococcus* species were the predominant organisms in wound cultures, accounting for 59 percent of all positive wound cultures tested.

Table 1. Organisms Isolated from Positive Urine and Wound Cultures.

Urine Cultures	Percent	Wound Cultures	Percent
Escherichia coli	64.4	*Staphylococcus aureus*	48.7
Klebsiella pneumoniae	10.0	*Staphylococcus* species	10.3
Proteus mirabilis	8.8	*Proteus mirabilis*	10.3
Other gram-negative rods*	7.7	*Klebsiella pneumoniae*	7.7
Staphylococcus species	3.4	*Psuedomonas aeruginosa*	7.7
Streptococcus agalactiae	3.4	Other‡	15.3
Other†	2.3	Total	100.0
Total	100.0		

*Includes *Flavobacterium* species, *Pasteurella multocida*, *Proteus* species, *Psueudomonas* species, *Citrobacter freundii*, *Citrobacter diversus*, *Citrobacter* species, *Enterobacter aerogenes*, *Enterobacter cloacae*, *Klebsiella oxytoca*, *Klebsiella* species, *Morganella morganii*, *Providencia rettgeri*, *Serratia liquefaciens*, and *Pseudomonas aeruginosa*.
†Includes Group D *Enterococcus* and *Staphylococcus aureus*.
‡Includes *Achromobacter* species, *Escherichia coli*, *Serratia marcescens*, *Streptococcus pyogenes*, and *Streptococcus agalactiae*.

The antibiogram for the outpatient setting is presented in Table 2. Tables 3 and 4 compare the inpatient and outpatient susceptibility patterns of the predominant organisms with various antibiotics for urine and wound cultures. Antibiotic susceptibility was similar in the two settings with two exceptions. *Escherichia coli* showed more resistance to mezlocillin in the inpatient setting, and *Staphylococcus aureus* resistance to ampicillin was much greater in the inpatients ($P < 0.01$). However, neither of these differences was considered clinically important, because such resistance would not likely have an impact on empiric antibiotic selection.

Discussion

Several journals are devoted to reporting the susceptibility of bacteria to antibiotics,[3-5] and an extensive amount of literature exists on the subject. However, the majority of publications have described the sensitivity of organisms to a particular antibiotic or group of antibiotics to determine the antibiotic's spectrum of activity. Epidemiologic studies, such as the antibiogram described in this report, which assist in empiric antibiotic selection, are rarely reported in the literature. With rare exception, published susceptibility reports have used bacterial isolates either from inpatients only or from inpatients and outpatients combined.[6-11] This report presents bacterial susceptibilities based exclusively on outpatient clinical isolates.

Table 2. Outpatient Antimicrobial Susceptibility (Percent) as Determined by Disk Susceptibility Testing for the Period January–December 1987.*

	Staphylococcus aureus % (no.)	*Staphylococcus* Species % (no.)	*Streptococcus agalactiae* % (no.)	*Escherichia coli* % (no.)	*Proteus mirabilis* % (no.)	*Klebsiella pneumoniae* % (no.)	*Pseudomonas aeruginosa* % (no.)	Other Gram-Negative Rods % (no.)	Other % (no.)
Penicillin G	25 (28)	90 (10)	100 (12)						40 (5)
Ampicillin	30 (27)	90 (10)	100 (12)	69 (173)	100 (35)	3 (30)		28 (25)	67 (6)
Nafcillin	96 (28)	50 (10)	83 (12)						20 (5)
Carbenicillin							100 (14)		
Trimethoprim-sulfamethoxazole	96 (26)	90 (10)	17 (6)	93 (174)	97 (35)	80 (30)		84 (25)	100 (5)
Sulfisoxazole				82 (172)	89 (35)	73 (33)	27 (15)	63 (24)	
Nitrofurantoin				98 (167)	17 (24)	69 (26)		67 (18)	
Tetracycline	89 (28)	70 (10)	17 (12)	75 (173)	3 (35)	75 (28)		56 (25)	17 (6)
Chloramphenicol	100 (28)	100 (10)	100 (12)				7 (15)		80 (5)
Clindamycin	93 (28)	90 (10)	83 (12)						40 (5)
Erythromycin	89 (28)	80 (10)	83 (12)						33 (6)
Amikacin	100 (28)	100 (10)	0 (12)		100 (10)		73 (15)	75 (8)	20 (5)
Gentamicin				97 (177)	97 (35)	100 (30)	47 (15)	85 (27)	
Tobramycin	100 (28)	10 (10)	8 (12)	98 (169)	100 (35)	100 (30)	87 (15)	93 (27)	80 (5)
Cefazolin	97 (29)	100 (10)	92 (12)	93 (175)	100 (35)	93 (30)		52 (25)	40 (5)
Cefonicid				93 (157)	100 (35)	93 (30)		68 (25)	
Cefoxitin				93 (174)	100 (35)	90 (30)		64 (25)	
Cefotaxime							43 (14)		
Ceftizoxime									
Mezlocillin				84 (173)	100 (35)	83 (30)	67 (15)	85 (26)	
Ticarcillin				79 (173)	100 (35)	13 (30)	100 (15)	65 (26)	
Vancomycin	100 (28)	100 (10)	100 (12)						83 (6)

*Blanks = not tested or fewer than 5 isolates; number of organisms tested shown in parentheses.

The distribution of bacteria isolated from urine cultures in this study was somewhat different from that reported in another outpatient population by Rubin, et al.[12-14] Although both studies show a predominance of gram-negative organisms, individual organisms were isolated with varying frequencies. For example, *Escherichia coli* was isolated from approximately 64 percent of positive urine cultures in this study, but from 89 percent by Rubin; *Klebsiella pneumoniae* comprised 10 percent of positive cultures in our study, but 2 percent in Rubin's population. These findings likely represent local differences in patient populations or in frequency of these pathogens in different communities and underscore the value of determining local epidemiologic patterns periodically.

Table 3. Inpatient and Outpatient Susceptibilities (Percent) for *Escherichia coli*, *Klebsiella pneumoniae*, and *Proteus mirabilis*.

	Escherichia coli		*Klebsiella pneumoniae*		*Proteus mirabilis*	
	Inpatient	Outpatient	Inpatient	Outpatient	Inpatient	Outpatient
Ampicillin	66%	69%	13%	3%	100%	100%
Trimethoprim-sulfamethoxazole	87	93	86	80	90	97
Tobramycin	99	98	96	100	100	100
Gentamicin	99	97	96	100	99	100
Cefazolin	99	93	99	93	99	100
Mezlocillin	69	84*	94	83	100	100

*$P < 0.01$.

Table 4. Inpatient and Outpatient Susceptibilities (Percent) for *Staphylococcus aureus*.

	Inpatient	Outpatient
Penicillin	12%	25%
Ampicillin	10	30*
Nafcillin	95	96
Trimethoprim-sulfamethoxazole	99	96
Chloramphenicol	98	100
Clindamycin	93	93
Erythromycin	87	89
Vancomycin	100	100

*$P < 0.01$.

Even though the frequency of particular organisms in urine cultures varied, the susceptibilities of *Escherichia coli*, *Klebsiella pneumoniae*, and *Proteus mirabilis* in this report were similar to that of Tolkoff-Rubin and Rubin.[14] Indeed, microbial susceptibility patterns generally followed previously reported patterns.[15]

In selecting initial empiric antibiotic therapy in the outpatient setting, physicians draw upon the literature and their own experiences to determine: (1) which organisms are most likely to be causative, and (2) which agents provide optimal antimicrobial activity within the limits of patient tolerance and cost effectiveness. Antibiograms in the hospital setting have been used to identify emerging patterns of resistance for certain organisms and their frequencies among total isolates in that setting. The same information has not been readily available for ambulatory patients.

Bacterial resistance was similar in inpatient and outpatient settings when we compared susceptibility patterns for organisms commonly causing urinary tract and wound infections. Although knowledge of local susceptibility patterns may not be absolutely necessary in selecting an appropriate antibiotic for empiric therapy of initial, uncomplicated urinary tract infection in outpatients, this knowledge has greater clinical use for patients with a recurrent urinary tract infection and perhaps for patients with skin and soft tissue infections, as well as other infections.

Whether the concept of using inpatient susceptibility data in the outpatient setting for empiric antibiotic selection can be extrapolated to other locations remains to be explored. Our data show the importance of comparing inpatient and outpatient sensitivities. Findings from this report suggest that empiric antibiotic therapy in the outpatient setting may be based on published susceptibility patterns and on local inpatient susceptibility data, if the local inpatient population reflects that of the local outpatient population.

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