Analysis of Antibiograms from Healthcare Facilities Performing Antimicrobial Susceptibility Testing (AST) in Wisconsin

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Revised Abstract

Antibiograms can provide clinicians and public health officials with trends of antimicrobial susceptibility at the local, regional, and national levels. Local and regional antibiograms are beneficial for facilities lacking the resources to generate their own antibiograms. Erroneous susceptibility testing results are enormous barriers to rapid detection of antimicrobial resistance, potentially leading to mistreatment. In order to examine and report the status of antimicrobial resistance in Wisconsin, a request was sent to all healthcare facilities performing antimicrobial susceptibility testing (AST) for their antibiograms from 2006. These antibiograms were combined into a cumulative statewide antibiogram. The status of antimicrobial susceptibility in Wisconsin was compared to the national data for selected organisms of clinical significance (3,4). Wisconsin 2006 susceptibility results were compared to national rates using the LEADER (3) and MYSTIC (4) programs because current susceptibility data were not available per CDC. The individual antibiograms were also evaluated using criteria from the Clinical Laboratory Standards Institute (CLSI) M100-S17 and M39-A2 documents (1,2).

Background

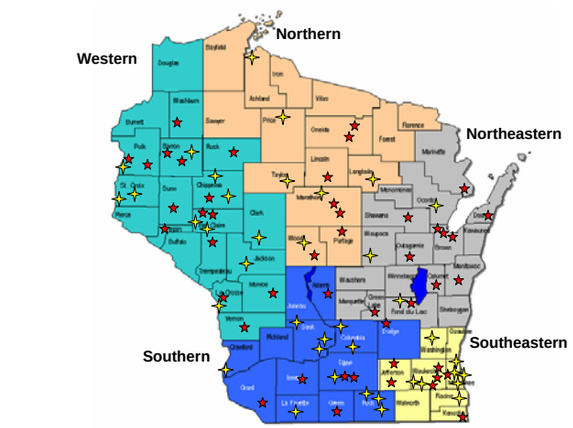
The rapid increase in the incidence of antimicrobial resistance in recent years has deemed it a major public health concern. Improper treatment of infections due to resistance to conventionally prescribed antibiotics has led to increased morbidity and mortality. Properly prepared antibiograms are important in the monitoring and control of antimicrobial resistance. Briefly, an antibiogram as defined by the Clinical and Laboratory Standards Institute (CLSI, formerly NCCLS) is an overall profile of the antibiotic susceptibility of an organism to a collection of antimicrobial agents routinely tested and used (1). Analysis of antibiograms can reveal potential novel resistance and increases in existing resistance to commonly prescribed antibiotics against an organism, and aid clinicians in the empiric treatment of infections prior to the availability of antimicrobial susceptibility results. Lack of standardization in the construction of antibiograms can result in misinterpretation of data and inappropriate prescribing of empiric antimicrobial therapy. Alternatively, consistently accurate data can not only result in the successful remedy of an infection, but also provide clinicians and health professionals with confidence in their therapeutic prescribing and their ability to question potentially misleading anecdotal reports of antibiotic resistance. To aid healthcare facilities in their preparation of antibiograms, CLSI publishes guidelines for antimicrobial susceptibility testing and the presentation of cumulative test data (1,2).

Methods

- **Preparation of cumulative antibiogram.** A request for antibiograms from 2006 was sent to all healthcare facilities performing AST in Wisconsin. The susceptibility results from each antibiogram were used to calculate the average percent susceptibility of selected antimicrobial agent-organism combinations to be included on the cumulative statewide antibiogram. The cumulative susceptibility pattern in Wisconsin for selected species/antibiotic combinations were compared to national susceptibility data.
- **Evaluation of antibiograms.** Antibiograms were evaluated based on compliance with CLSI recommendations for preparing antibiograms. CLSI recommends antibiograms include final verified results presented in tabular form; report percent susceptible (%S); report for species with 10 or more isolates and append a cautionary note of reduced statistical significance to the percent susceptibility based on testing of less than 10 isolates; include only the first isolate per patient per analysis period (usually one year); the date of the collection period; and group organisms according to morphology. Wisconsin antibiograms adherence to CLSI guidelines was compared to compliance by healthcare facilities nationwide (5). In this study data from computer-generated reports or other potentially "raw" susceptibility data were not categorized as final verified data.

Results

Figure 1. Wisconsin county map divided into regions.



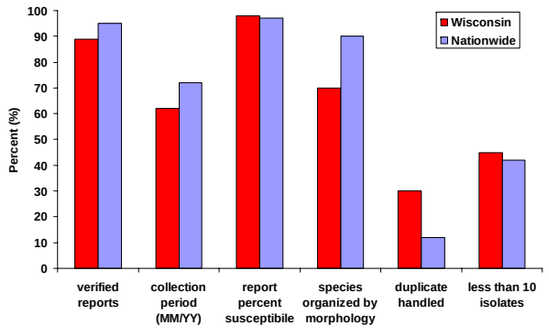
Adapted from the Wisconsin Division of Public Health – Department of Family Health & Services

Healthcare facilities performing AST but did not sent in antibiogram

Healthcare facilities contributed antibiogram

- **47 of the 87 (54%) healthcare facilities that perform AST contributed antibiograms**

Figure 2. Comparison of antibiograms in Wisconsin and nationwide meeting CLSI recommendations



Nationwide data is from Zapantis et.al., 2005 JCM 43:2629. It includes antibiograms from 2000-2002 (5).

- **98% of Wisconsin antibiograms from 2006 were generated annually with 62% including the month and year in which samples were collected.**
- **30% of Wisconsin antibiograms clearly stated the manner in which duplicates were handled, 21% noted exclusion of duplicate isolates, and 9% suggested the potential of duplicate isolates in their antibiograms**

Figure 3. Comparison of resistance trend in Wisconsin to the national susceptibility pattern

A. Gram-negative organisms

LEADER is a surveillance program collecting samples from 50 medical centers in the USA (3). The MYSTIC program used 15 medical centers geographically dispersed across the USA (4).

Enterococcus spp. (2006)	Percent Susceptible (%S) (no. tested)			
	LEADER (547)[c]	Wisconsin (5225)	Wisconsin *E. faecalis* (5032)	Wisconsin *E. faecium* (376)
Linezolid	97.4	96.2	98.65	96.9
Ampicillin	67.8	95.5	98.6	34.3
Ciprofloxacin	46.4	42.97	55.5	23.47
Erythromycin	8	18.35	19.2	7.5
Gentamicin (high level)	76.2	89.7	73.3	91.7
Levofloxacin	49.2	56	56.6	21.4
Penicillin	67.3	90.8	98.2	25.1
Quinupristin/dalfopristin	31.1	33	21.95	89.98
Streptomycin (high level)	68.2	71.3	69.7	37.45
Vancomycin	71.7	96.8	98.7	70.7
[c] *E. faecalis* (340), *E. faecium* (185), others (22)				

S. aureus (2006)	Percent Susceptible (%S) (no. tested)	
	Wisconsin (9838)	LEADER (2913)
Linezolid	100	>99.9
Ceftriaxone	55.9	45.1
Ciprofloxacin	58.4	52.5
Clindamycin	71.2	75
Erythromycin	47.7	34
Gentamicin	99.1	96.8
Levofloxacin	64.6	54.4
Oxacillin	62.1	43.4
Penicillin	7.4	9.5
Quin/dalfo	99.8	99.9
Tetracycline	95.6	94
Trimeth/Sulfa	99.2	97.3
Vancomycin	99.99	99.9

CoN *Staphylococcus* (2006)	Percent Susceptible (%S) (no. tested)	
	Wisconsin (7070)	LEADER (808)
Linezolid	100	98.4
Ceftriaxone	50.2	51.1
Ciprofloxacin	47.5	42.2
Clindamycin	63.1	59.9
Erythromycin	38.96	28.8
Gentamicin	84.5	71.3
Levofloxacin	49.2	42.3
Oxacillin	42.3	23.1
Penicillin	11.2	12.1
Quin/dalfo	100	99.3
Tetracycline	84.2	86.9
Trimeth/Sulfa	64.9	61.9
Vancomycin	99.99	100

Figure 3B. Gram-negative organisms

E. coli (2006)	Percent susceptible (%S) (no. tested)	
	Wisconsin (43,899)	MYSTIC (641)
Meropenem	100	100
Imipenem	99.96	100
Ceftriaxone	98.2	95
Ceftazidime	98	95
Cefepime	98.4	97.5
Piper/tazo	98.8	96.4
Gentamicin	94.2	86.9
Tobramycin	95.2	86.4
Ciprofloxacin	88.2	72.4
Levofloxacin	88.9	72.9

P. aeruginosa (2006)	Percent susceptible (%S) (no. tested)	
	Wisconsin (6116)	MYSTIC (606)
Meropenem	96.2	86.5
Imipenem	88.7	80.2
Ceftazidime	87.5	82
Cefepime	86.5	84.2
Piper/Tazo	93.7	88.6
Gentamicin	84.7	84.2
Tobramycin	94.5	89.9
Ciprofloxacin	71.9	73.9
Levofloxacin	73.8	71.8

Klebsiella spp. (2006)	Percent susceptible (%S) (no. tested)		
	MYSTIC (619)[a]	Wisconsin *K.oxytoca* (1260)	Wisconsin *K. pneumoniae* (7414)
Meropenem	91	100	100
Imipenem	90.6	100	99.9
Ceftriaxone	85.1	97.2	98.8
Ceftazidime	86.4	98.6	99
Cefepime	90.1	97.99	99
Piper/tazo	84.7	95.7	98.2
Gentamicin	92.4	98.4	99
Tobramycin	85.9	99.2	98.95
Ciprofloxacin	81.9	97.5	97.9
Levofloxacin	82.7	98.1	98.3
[a] Includes *K. ornithinolytica (1), K. oxytoca (89), K. pneumoniae (529)*			

Conclusions

- Evaluation of antibiograms collected from Wisconsin healthcare facilities indicated hospitals and clinics need to improve communication of the manners in which duplicates are handled and warning antibiogram users of the potential lowered statistical significance of test results of less than ten isolates for an organism.
- Duplicate isolates have the potential to elevate resistance rates. The importance of this may be unrealized by clinicians. Hence it is important that as recommended by CLSI duplicate isolates should be excluded from susceptibility reports generated for the purpose of guiding clinicians in choosing empiric treatment regiment.
- Susceptibility data for several major pathogens are comparable to reported national data.

References

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