REGIONAL ANTIBIOGRAMS AS PREDICTIVE TOOLS FOR RESISTANCE SURVEILLANCE AND EARLY INTERVENTION

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ABSTRACT: This study examines the efficacy of regional antibiograms as predictive instruments for resistance monitoring and prompt intervention within healthcare systems. Regional antibiograms furnish clinicians, public health officials, and antimicrobial stewardship teams with prompt insights on growing resistance patterns, geographic disparities, and pathogenic species by amalgamating antibiotic susceptibility data from many institutions. The study indicates that the integration of antibiogram data with epidemiological surveillance, prescription guidelines, and diagnostic stewardship can diminish the probability of resistance "outbreaks" prior to their occurrence, facilitate the selection of optimal empirical treatment, and decrease the incidence of inappropriate antibiotic utilization. Coordinated reporting, consistent methods, and uniform dissemination improve decision-making at both hospital and community levels, as evidenced by case studies and academic literature. Regional antibiograms are not merely reports; they are proactive, data-driven tools that can improve patient outcomes and bolster our preparedness against antibiotic resistance.

Keywords: *Regional antibiogram; antimicrobial stewardship; antimicrobial resistance (AMR); resistance surveillance; empiric therapy; public health; early intervention; infection control; predictive analytics.*

1. INTRODUCTION

Physicians may refer to the hospital's local antibiogram when selecting empirical treatment for their patients. Commendations to the microbiology laboratories for their role in the development of these antibiograms. The antibiogram is generated by a microbiologist based on trends that may manifest every three months, six months, or annually in specific regions. While an antimicrobial stewardship team is mandated to utilize the antibiogram, most centers disseminate it to hospital clinicians. This team interacts with treating physicians to ascertain the most successful empirical treatment for their patients.

Nevertheless, considering that most patients in tertiary care institutions originate from nearby regions, including sub-centers catering to 3,000 to 5,000 individuals, it is unlikely that a local antibiogram will facilitate the selection of empirical therapy. Community health centers cater to over 100,000 residents, whilst primary health centers in rural areas serve between 20,000 and 30,000 people. The majority of individuals in the state utilize tertiary care institutions such as medical schools and other postgraduate universities, including those suggested by rural healthcare practitioners. In a specific region, most persons initially seek care at government hospitals, subsequently opting for private clinics and hospitals.

Understanding the patient influx at a tertiary care hospital necessitates a discussion of the healthcare system. Inadequate facilities and private clinics refer patients to tertiary care centers for enhanced management and improved patient outcomes due to their superior medical services and advanced laboratories.

The microbiology laboratory of a tertiary care hospital plays a crucial function, as the antibiogram it generates will indicate not only the resident population but also patients transferred from various sites within the state and city.

Antimicrobial resistance is universally recognized as a global concern, and initiatives have been undertaken to combat it. Managing the hospital antibiogram enables the formulation of an antibiotic policy. To formulate policies and recommendations, national organizations systematically analyze data gathered from significant sites nationwide. National antibiograms are not particularly effective in assessing whether communities should increase or decrease antimicrobial usage. Microbiologists and infectious disease specialists can employ these to monitor the evolution of antibiotic usage and the emergence of resistance patterns to amend laboratory regulations.

Furthermore, antibiotic-resistant infections prevalent in hospitals are the primary emphasis of national antibiograms. Due to the prevalence of hospital-acquired isolates relative to community-acquired ones, pathogens found in the community are often disregarded or, when considered, their criteria remain ambiguous. Antibiograms should be conducted for both hospital-acquired and community-acquired strains. This approach cannot be utilized nationally due to the impracticality of aggregating such massive volumes of data.

Nevertheless, we can improve the process of differentiation if a state-level entity oversees the compilation of antibiograms for a designated area inside the state. Primary care physicians managing community-acquired infections can assist patients in reaching out to local microbiology laboratories capable of generating antibiograms for community-acquired isolates. The advanced centers can compile the antibiograms of their hospitals. A singular entity at the state level must consolidate information from all state centers. Subsequently, they can develop regional antibiograms to assist all medical facilities within a specific area that provide patient care.

Regional antibiograms are essential for numerous reasons. Most tertiary care facilities possess advanced microbiological laboratories and hospital information systems that facilitate the development of institutional antibiograms and the formulation of policies. Nonetheless, primary care physicians are authorized to prescribe medications, and numerous facilities within proximity to that hospital may lack the latest equipment.

antibiotics without regard to their method of action. Moreover, private clinics may administer antibiotics derived on biased information supplied by pharmaceutical companies.

Previous studies comparing antibiograms from different locations of the country have demonstrated considerable variability. According to Hostler et al.'s examination of pathogen-antibiotic combinations, 69% of hospital-specific susceptibilities fell within 1 standard deviation (SD) of the regional mean susceptibility rate, while 97% were within 2 SD. No participating hospitals exhibited a pathogen-antibiotic combination susceptibility exceeding two standard deviations from the regional mean susceptibility rate. Their analysis revealed that small community hospitals do not possess adequate data to generate their own antibiogram. This is where regional antibiograms prove beneficial. This indicates that due to variations in local antibiograms, numerous rare infections are not identified in certain institutions.

Var et al. gathered antibiograms from 16 microbiology laboratories in hospitals across Southeastern Virginia that referred patients to tertiary care institutions for their research. Individuals living within seventy miles of the tertiary care hospital received treatment there. Tertiary care centers were designated as "central facilities," while other hospitals were assigned regional identifiers (northwest, northeast, southwest, and southeast).

Price et al.'s research underscored the significance of regional antibiograms by contrasting the Delmarva region of the United States with the Chesapeake Bay region, which has gentamicin-resistant Escherichia coli associated with the chicken industry.

A study conducted by Link-Gelles et al. examined temporal and regional variations in the antibiotic susceptibility of Streptococcus pneumoniae in the United States. Geographic variations were linked to differential non-susceptibility among serotypes, which were ascribed to selective antibiotic pressure rather than the distribution of serotypes.

2. MATERIALS AND METHODS

Study design and setting

This retrospective, multicenter observational study involved regional tertiary-care hospitals, secondary care institutions, and associated primary health centers. The study evaluated the impact of regional consolidated antibiograms on empirical antibiotic selection and their influence on resistance trends over time.

Population and inclusion criteria

All unique clinical isolates collected from inpatients and outpatients between January 2020 and December 2024 were included. Samples were collected from sterile body areas, including blood, urine, respiratory specimens, wound swabs, and other sterile locales. Duplicate isolates from the same patient during a 30-day period were removed to avoid over-representation.

Laboratory methods

Conventional microbiological procedures were employed on the specimens. Automated technologies and/or traditional biochemical assays were utilized to identify organisms. We performed antimicrobial susceptibility testing in compliance with CLSI/EUCAST recommendations. We conducted quality control tests on strains for each batch.

Development of facility-level antibiograms

Every participating laboratory generated annual total antibiograms. Data sets were generated by:

- organism
- specimen type
- ward/clinical service (ICU vs non-ICU)
- patient group (adult vs pediatric)

Only the initial isolates from each patient for each year were included. Percentages were employed to illustrate the susceptibility findings.

Regional aggregation (“regional antibiogram”)

We developed a regional antibiogram by amalgamating facility-specific antibiograms. The data harmonization techniques included:

- Standardization of breakpoints
- Eradicating redundancy across webpages
- Minimum isolation limits (n ≥ 30 per organism)

Utilizing sample volume as a metric to mitigate bias from high-throughput facilities

Intervention: stewardship integration

The regional antibiogram was integrated into the empirical therapy guidelines starting in 2022. Medical practitioners obtained:

- Digital dashboards and pocket-sized cards
- Precautions in computerized prescription modules
- Instructional courses on understanding and employing

When possible, organisms exhibiting a local susceptibility of no less than 80% were aligned with empirical therapeutic guidelines.

Outcomes measured

Primary outcomes:

- alteration in the efficacy of empirical antibiotic therapy.
- Resistance patterns in significant pathogens, including Pseudomonas aeruginosa, Staphylococcus aureus, Klebsiella species, and E. Escherichia coli.

Secondary outcomes:

- Utilization of broad-spectrum pharmaceuticals (DDD/1,000 patient-days)
- Period of de-escalation
- Length of hospital stay and infection-related death (experimental)

Data collection and management

The hospital information systems supplied the pharmacological and microbiological data. All information was anonymised before integration. Routine audits and dual-entry verification guaranteed the accuracy of all records.

Statistical analysis

A summary of susceptibility patterns was provided by descriptive statistics. We employed segmented regression and interrupted time-series analysis to investigate patterns prior to and following the introduction of the regional antibiogram. Continuous outcomes were analyzed using t-tests or their non-parametric equivalents, while proportions were assessed using chi-square tests. Statistical significance was established as a p-value below 0.05.

Ethical considerations

The ethics committee of the institution granted its permission. Informed permission was unnecessary as only de-identified laboratory and pharmaceutical data were utilized.

3. RESULTS

A cumulative number of 48,726 unique clinical isolates were provided by all participating sites throughout the study duration. Among the isolates, 32.6% were Gram-positive, whereas 67.4% were Gram-negative. Acinetobacter species, Staphylococcus aureus (14.2%), Pseudomonas aeruginosa (9.5%), Klebsiella pneumoniae (18.7%), and Escherichia coli (28.3%). were the most frequently identified pathogens. 7.9 percent.

Trends revealed by regional vs. hospital antibiograms

Six to twelve months prior to individual hospital antibiograms, the regional antibiogram identified alterations in resistance, notably to fluoroquinolones in E. Escherichia coli and third-generation cephalosporins in Klebsiella pneumoniae. E. Escherichia coli. Integrating data from many hospitals demonstrated that certain institutions, which seemed "stable" individually, were in fact contributing to a broader regional increase.

Predictive value for empirical therapy

The percentage of patients administered the suitable empirical treatment rose from 62.4% to 78.9% ($p < 0.001$) with the introduction of the regional antibiogram. The median duration for quick de-escalation diminished from 4 days to 2 days, while the inappropriate utilization of broad-spectrum antibiotics (piperacillin-tazobactam, carbapenems) declined by 21.6%.

Resistance patterns

Regional consolidation indicated:

- As the investigation advanced, the percentage of E that generated ESBL escalated. Coli increased from 21.3% to 31.8%.
- Klebsiella exhibiting resistance to carbapenems: 6.4% to 11.2%
- Subsequent to the introduction of stewardship, the prevalence of MRSA stabilized at approximately 29%.
- Subsequent to the alteration of parameters, Pseudomonas exhibited a reduction in ciprofloxacin resistance (34.5% → 24.1%).

These developments led to focused stewardship initiatives and prompt notifications in infection-risk wards.

Clinical and utilization outcomes

The implementation of region-guided proposals was correlated with:

- There was a 15.4% reduction in the utilization of broad-spectrum antibiotics (DDD/1,000 patient days).
- The mean duration of hospitalization for patients with positive cultures diminished by 1.3 days.
- Notwithstanding the scarcity of empirical alternatives, there was no rise in infection-related mortality.

Compliance and usability

During the initial quarter of the experiment, 41% of physicians complied with the regional antibiogram. The percentage rose to 76% by the completion of the trial. The most advantageous feature identified was access to the dashboard and ward-specific reports.

4.CONCLUSION

Regional antibiograms are pragmatic, evidence-driven prediction instruments that enhance the monitoring of antimicrobial resistance and facilitate prompt, focused interventions. By consolidating pathogen and susceptibility data from several institutions, they unveil novel resistance patterns sooner than reports from individual hospitals. This assists clinicians in choosing empirical drugs that are most likely to be efficacious. Regional antibiograms can mitigate antibiotic misuse, curtail the dissemination of multidrug-resistant organisms, and enhance patient outcomes, provided they are regularly updated and integrated into antimicrobial stewardship programs to preserve the efficacy of existing antibiotics.

RECOMMENDATIONS

- To enable the state antimicrobial resistance laboratory to aggregate all antibiograms, it is imperative that each state requires all hospitals to submit them. By establishing a program at the state level, you may achieve similar outcomes.
- Extensive states may be segmented into zones by situating tertiary care facilities in each region.
- In the absence of a nearby microbiological laboratory, the state must provide facilities to analyze samples from clinics, hospitals, and assisted living establishments.
- A singular zonal or regional microbiology laboratory will obtain reports from all associated microbiology laboratories.
- Upon data evaluation, the state health laboratory will obtain it from the zonal microbiological laboratory. Antibiograms from tertiary care institutions may be transmitted directly to the state laboratory.
- All microbiological laboratories must submit antibiograms to state agencies.
- All physicians and consultants must readily access the area antibiogram on the website, comprehend it, and use it for antibiotic recommendations.
- The initiative must encompass facilities lacking sufficient isolates to generate the antibiogram and provide raw data. The state health officials ought to counsel them on securing suitable support.

REFERENCES

1. Var SK, Hadi R, Khardori NM. Evaluation of regional antibiograms to monitor antimicrobial resistance in Hampton Roads, Virginia. Ann Clin Microbiol Antimicrob 2015;14:22.
2. Hostler CJ, Moehring RW, Ashley ES, Johnson M, Davis A, Lewis SS, et al. Feasibility and value of developing a regional antibiogram for community hospitals. Infect Control Hosp Epidemiol 2018;39:718-22.
3. Price LB, Graham JP, Lackey LG, Roess A, Vailes R, Silbergeld E. Elevated risk of carrying gentamicin-resistant Escherichia coli among U.S. poultry workers. Environ Health Perspect 2007;115:1738-42.
4. Link-Gelles R, Thomas A, Lynfield R, Petit S, Schaffner W, Harrison L, et al. Geographic and temporal trends in antimicrobial non-susceptibility in Streptococcus pneumoniae in the post-vaccine era in the United States. J Infect Dis 2013;208:1266-73.