The Microbiologist as an Active Member of the Antimicrobial Stewardship Team: A Value Proposition

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"Antimicrobial stewardship" has become a popular subject of discussion in hospitals. Your hospital may have an antibiotic stewardship program (ASP). But are you an active member of this team?

A working definition for antimicrobial stewardship (adapted from Dellit T, Owens RC, McGowan Jr. JE, et al. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship. *Clin Infect Dis*. 2007;44:159-177) may be restated as follows:

> ***Processes designed to optimize the appropriate use of antimicrobials by ensuring that every patient receives an antibiotic only when one is needed, with the right agent at the right dose by the right route and for the right duration, in order to improve patient care and optimize health care outcomes while minimizing unintended consequences***

Certainly, this definition of antimicrobial stewardship is tedious yet instructive. The point is that any effort to utilize antimicrobials judiciously via an informed process is beneficial to the patient. In some cases, that process begins with antimicrobial susceptibility testing and the cumulative antibiogram.

The microbiologist is a crucial executor of antimicrobial stewardship by identifying through *in vitro* susceptibility testing antimicrobials that provide the greatest chance of leading to clinical cure, assuming the agents are used appropriately in an adequate dose for the site of infection and patient hepatorenal function. Conversely, a report that an antimicrobial susceptibility result yields *in vitro* resistance suggests to the clinician that this agent should not be selected, or if currently used, it might need to be discontinued or changed to another agent. While this function is elementary to the everyday workload of the microbiologist, there are many additional activities that demonstrate the value of the microbiologist as an integral member of the ASP.

In vitro antimicrobial susceptibility test (AST) results are most often communicated in a single patient's pathology report. However, the microbiologist can provide additional information to support antimicrobial therapy decisions by analyzing all AST results generated over a given timeframe and

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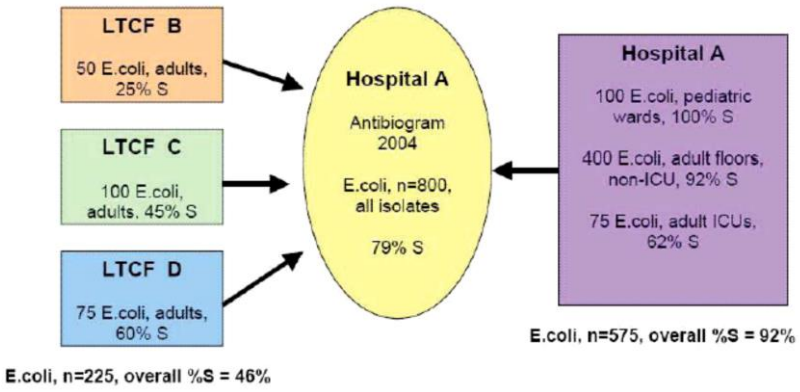
preparing cumulative antibiograms. These assist in identifying optimal therapy based on the experience of susceptibility results in preceding patients. For example, empiric therapy for suspected *Escherichia coli* bacteremia will be based on prior experience with AST results for this pathogen. Empiric therapy decisions derived from cumulative antibiogram data illustrate the value-added proposition for the microbiologist. Let's look at two examples.

In the first example (see illustration), susceptibilities to Drug A in 800 unique *E.coli* isolates was below 80%. Perceived as no longer a choice for empiric therapy, the microbiologist conducted an investigation into patient demographics to try to identify the unfavorable resistance rate (eg, low %S) for Drug A. The number of isolates contributed by a variety of health care settings at Hospital A consisted of pediatric patients, adult inpatients (non-intensive care unit [ICU]), and adult inpatients (ICU). When each source of inpatients was examined separately, the overall %S to Drug A was 92%, which contrasts sharply from the 79% S result generated from all 800 *E. coli* isolates tested. During the investigation, the microbiologist noted that *E. coli* isolates in patients from three local long-term care facilities (LTCFs) exhibited high resistance rates. Subsequently, it was determined that the 79% S result for the 800 *E. coli* isolates with Drug A was due primarily to the contribution of the patient's isolates from LTCFs and not from inpatients within Hospital A, except for the adult ICU (62% S). LTCF B appeared to be the "worst offender." As a result of identifying the primary sources for resistance, the ASP was able to focus efforts on how Drug A was being prescribed in that facility.

Illustration. The Antibiogram and Patient Demographics



In a similar case, susceptibility of Drug A had decreased 10% against *Pseudomonas aeruginosa* isolates over a two-year period. This was alarming to members of the ASP and resulted in a change in empiric therapy recommendations from Drug A to Drug B when *P. aeruginosa* was suspected in causing adult infections. Drug B, however, was associated with more adverse drug events. In investigative fashion similar to that in the first example, the microbiologist determined that this rise in resistance was confined to pediatric patients with cystic fibrosis (CF) who were cared for on a special unit (see table). *P. aeruginosa* isolates from pediatric patients without CF and all adult patients retained 100% susceptibility to Drug A! As a result of this query, Drug A was reinstituted as an empiric therapeutic choice in patients other than those with CF. The finding also prompted the hospital epidemiologist to assess hand-washing and respiratory equipment cleaning in the CF unit. Interestingly, the focus on patients with CF with subsequent improvement in hygiene and environmental control led to a decline in resistance of *P. aeruginosa* to Drug A over the following two years.

TABLE. Antibiotic Susceptibility of Non-Urinary Isolates of *Pseudomonas aeruginosa* to Drug A

All patients (adults + pediatrics)	100	80% S (Δ ⬇10%)
Adult patients only	60	100% S
Pediatric isolates only	40	50% S
Pediatric cystic fibrosis only	30	33% S
Non-CF pediatric patients	10	100% S

For illustration purposes only. In this example, 100% of *P.aeruginosa* isolates remained susceptible to DRUG A in adults and NON-cystic fibrosis pediatric patients. Therefore, resistance was confined to pediatric cystic fibrosis patients.

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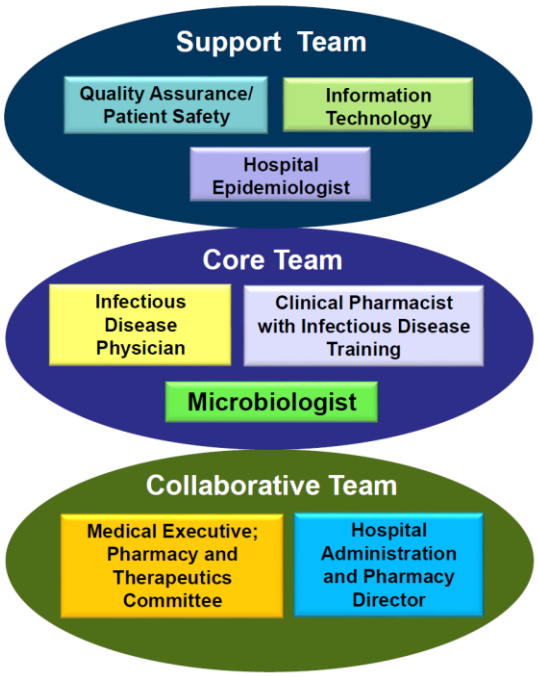
The above investigations conducted by the microbiologist, which were not intuitive, nor part of the daily AST routine, revealed the following:

- Rates of susceptibility or resistance derived by analyzing cumulative antimicrobial susceptibility data using specific sort criteria can be revealing.
- Patient demographic factors, such as differences in age, co-morbidities, hospital exposure, and prior antibiotic exposure, can significantly impact cumulative antibiogram reports.
- The assistance provided to the ASP (see diagram) such as in the above examples merits inclusion of the microbiologist as a Core Team Member of the ASP.
- Data provided by the engaged microbiologist can be used to support empiric drug selection in specific patient populations.
- The decision tree analysis used to determine which antimicrobials to prescribe empirically, based on patient demographics, can help clinicians to prescribe antimicrobials wisely.

Diagram. Structure of Antimicrobial Stewardship Program



The microbiologist plays a key role in identifying and conducting these investigations on behalf of antimicrobial stewardship efforts. Rather than viewing construction of the cumulative antibiogram as a burden, microbiologists can simply ask the question, “What is driving this resistance pattern?” The answer to this question will lead the team in choosing the most appropriate antimicrobial, leading to improved treatment of the patient. The clinical microbiologist will also have a sense of accomplishment and ongoing commitment in being included in this integral part of the ASP’s health care team.

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