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Curbing Antimicrobial Resistance: Do Physicians Receive Adequate Education about Antibigrams?

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To the Editor

To combat the worldwide crisis of antimicrobial resistance, the World Health Organization (WHO) has developed its Global Action Plan on Antimicrobial Resistance.¹ This plan outlines several objectives including: increasing education about appropriate antimicrobial use and promoting antimicrobial stewardship. To help achieve these goals, the WHO urges health care institutions to produce and distribute locally derived antibigrams to clinicians. The expectation is that antibiogram use will improve empiric antimicrobial prescribing and decrease inappropriate antimicrobial use. However, whether physicians are receiving sufficient education about antibigrams is not known.

In this study, we evaluated medical trainees' knowledge and education regarding antibigrams. A 20-item survey (<https://www.surveymonkey.com>) was sent electronically to house staff in US training programs. The survey contained five test-of-knowledge questions: Two questions involved recognizing the definitions of “antibiogram” and “breakpoint” and three questions required respondents to interpret specific components of sample antibigrams (sections of sample antibigrams were highlighted and respondents were asked to interpret what the sections represented). The Institutional Review Board at the University of California, Davis Medical Center, approved this study.

All data were analyzed using SAS(r) version 9.3. (SAS Institute, Inc. Cary, NC). A non-parametric analysis of variance (the NPAR1WAY procedure) was used to compare antibiogram interpretation question scores between different groups. All questions were

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weighted equally and mean percent correct scores were calculated based on number correct per participant. P-values of less than 0.05 were considered significant.

A total of 692/4211 invited house staff participated; 74.4% were residents and 25.6% were interns. Most respondents had graduated from US medical schools (88.7%) and were training at academic institutions (87.7%). Internal medicine trainees comprised 41.8% of respondents, followed by emergency medicine (20.9%), pediatrics (11.9%), family medicine (9.0%), surgery (8.7%), and obstetrics-gynecology (6.8%). Overall, 327 (49.0%) had completed an infectious diseases (ID) clinical rotation.

Table 1 shows the survey question responses. Almost all respondents were familiar with what an antibiogram is and correctly identified the definition of “antibiogram”. However, only 62.2% correctly identified the definition of “breakpoint”. Only 77.9% of respondents knew how to obtain their institution's antibiogram. For the antibiogram interpretation questions, 90.9% (549/604) of respondents correctly identified that a highlighted number in a sample antibiogram represented the percent of *Escherichia coli* isolates that were susceptible to ceftriaxone, and 85.8% (507/591) identified that a highlighted number represented the percent of methicillin-resistant *Staphylococcus aureus* isolates that were susceptible to levofloxacin. Only 68.0% (404/594) identified that a highlighted section represented the breakpoint for trimethoprim/sulfamethoxazole. Table 2 summarizes the mean percent correct scores for respondents (n=554) who completed all three antibiogram interpretation questions. Mean percent correct scores were significantly higher for residents than those for interns and for respondents who had completed an ID rotation. Differences were not observed among the various medical specialties.

Sources of education about antibiograms (respondents could choose more than one answer) included the following: 69.6% of respondents were taught about antibiograms during internship or residency, 45.4% in a medical school course, 19.0% by an ID physician, and 14.8% by a pharmacist. Notably, 15.1% did not receive any formal training in antibiograms. Of those who had completed an ID rotation, only 33.0% received antibiogram education during the rotation. Overall, 73.7% of respondents expressed an interest in receiving more training in antibiogram interpretation. Preferred settings for future training were “lectures during internship and residency” (88.3%), “during clinical rounds” (53.8%), “during medical school lectures” (46.0%), and “online courses” (34.7%).

The present study illustrates that medical trainees are not receiving adequate education about antibiograms. More than half of our respondents were not taught about antibiograms in medical school and many had not received any antibiogram education. Although we found that most house staff had some familiarity with antibiograms and correctly answered basic antibiogram questions, over one third did not correctly answer more challenging questions, such as the definition or interpretation of a breakpoint.

Notably, two-thirds of respondents who had spent time on an ID service had not been taught about antibiograms during the rotation. Perhaps ID physicians assume that house staff receive such education elsewhere or they place more emphasis on implementing institutional antimicrobial stewardship programs. It has been reported that passive educational programs

(e.g.; didactic lectures) do not curtail antimicrobial prescribing as effectively as do stewardship programs that incorporate active interventions (e.g.; recommendations for antimicrobial selection or de-escalation).² However, such active interventions may be more successful when prescribers are knowledgeable about their local antibiogram.

Several other factors may negatively impact antibiogram education. For example, physicians often seek guidance about antimicrobial prescribing from pharmacists or non-ID physicians, yet these persons may have insufficient antibiogram knowledge.³⁻⁵ As a result, medical trainees may be learning prescribing practices from sources who do not emphasize the value of antibiograms. Another factor may be that clinicians lack of accessibility to timely and accurate institutional antibiograms. Despite recommendations that hospitals provide antibiograms to clinicians on an annual basis, a number of studies have revealed that laboratory and hospital compliance with antibiogram preparation and distribution is suboptimal.⁶⁻⁸ Along with our finding that 22% of survey respondents did not know how to obtain their institution's antibiogram, the results of these studies suggest that another barrier to antibiogram education is poor availability of antibiograms. Finally, effective antibiogram education may be hindered by the lack of clarity about how best to use antibiograms to guide antimicrobial therapy. For over a decade, the US Centers for Disease Control and Prevention has instructed clinicians to “use local data, know your antibiogram”.^{9,10} Yet, practical recommendations for their use are scarce; the paucity of outcomes data has impeded progress in this area. Further assessment of each of these factors may identify targets for antibiogram education improvement.

Prior studies have raised awareness that medical trainees are not receiving adequate education about antimicrobial resistance and antimicrobial prescribing.^{3,4} This study adds to these concerns by highlighting that antibiogram education is deficient.

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References

1. World Health Organization. [Accessed 20 Aug 2015] Drug resistance: Global action plan on antimicrobial resistance. 2014. Available at: http://www.who.int/drugresistance/global_action_plan/en/
2. Dellit TH, Owens RC, McGowan JE Jr, et al. Infectious Diseases Society of America; Society for Healthcare Epidemiology of America. 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(2):159–77. [PubMed: 17173212]
3. Abbo LM, Cosgrove SE, Pottinger PS, et al. Medical students' perceptions and knowledge about antimicrobial stewardship: how are we educating our future prescribers? *Clin Infect Dis.* 2013; 57(5):631–8. [PubMed: 23728148]
4. Srinivasan A, Song X, Richards A, Sinkowitz-Cochran R, Cardo D, Rand C. A survey of knowledge, attitudes, and beliefs of house staff physicians from various specialties concerning antimicrobial use and resistance. *Arch Intern Med.* 2004; 164(13):1451–6. [PubMed: 15249355]

5. Justo JA, Gauthier TP, Scheetz MH, et al. Knowledge and attitudes of doctor of pharmacy students regarding the appropriate use of antimicrobials. *Clin Infect Dis*. 2014; 59 Suppl 3:S162–9. [PubMed: 25261543]
6. Lautenbach E, Nachamkin I. Analysis and presentation of cumulative antimicrobial susceptibility data (antibiograms): substantial variability across medical centers in the United States. *Infect Control Hosp Epidemiol*. 2006; 27(4):409–12. [PubMed: 16622821]
7. Boehme MS, Somsel PA, Downes FP. Systematic review of antibiograms: A National Laboratory System approach for improving antimicrobial susceptibility testing practices in Michigan. *Public Health Rep*. 2010; 125 Suppl 2:63–72. [PubMed: 20518446]
8. Moehring RW, Hazen KC, Hawkins MR, Drew RH, Sexton DJ, Anderson DJ. Challenges in Preparation of Cumulative Antibiogram Reports for Community Hospitals. *J Clin Microbiol*. 2015; 53(9):2977–82. [PubMed: 26179303]
9. Zapantis A, Lacy MK, Horvat RT, et al. Nationwide antibiogram analysis using NCCLS M39-A guidelines. *J Clin Microbiol*. 2005; 43(6):2629–34. [PubMed: 15956376]
10. Hindler, JA.; Barton, M.; Erdman, SM., et al. [Accessed 25 July 2015] Analysis and presentation of cumulative antimicrobial susceptibility test data; Approved guideline-Fourth edition. Clinical and Laboratory Standards Institute document M39-A4. 2014. Available at: http://shop.clsi.org/c.1253739/site/Sample_pdf/M39A4_sample.pdf

Highlights

- Antibiotic overuse is driving the worldwide crisis of antimicrobial resistance.
- All health care workers must become skilled in appropriate antimicrobial prescribing.
- The WHO recommends the use of antibiograms to guide antimicrobial prescribing.
- Physicians are not receiving adequate education about antibiograms.

Table 1
House Staff Responses to Questions about Antibigrams

Question	%
I am familiar with what an antibiogram is:	
Yes	93.4
No	6.6
I know how to obtain the antibiogram for my institution:	
Yes	77.9
No	22.1
I know how to interpret an antibiogram:	
Strongly agree	19.8
Agree	49.5
Neutral/unsure	21.3
Disagree	7.5
Strongly disagree	1.9
Identified the definition of “antibiogram”	
Correct	92.5
Incorrect	7.5
Identified the definition of “breakpoint”	
Correct	62.2
Incorrect	37.8

Table 2
Mean Percent Correct Scores for Antibigram Interpretation Questions

Variable	Mean Percent Correct Score, %	P-value *
Training level		0.004
Resident (n=407)	84.1%	
Intern (n=147)	76.2	
Completed infectious diseases rotation		0.024
Yes (n=279)	84.7	
No (n=275)	79.2	
I know how to interpret an antibiogram		<0.0001
Strongly agree (n=105)	94.3	
Agree (n=282)	87.9	
Neutral (n=114)	70.2	
Disagree (n=43)	52.7	
Strongly disagree (n=10)	46.7	
Medical specialty		0.390
Internal medicine (n=236)	81.9	
Emergency medicine (n=122)	79.5	
Family medicine/obstetrics-gynecology (n=83)	86.0	
Pediatrics (n=69)	80.0	
Surgery (n=44)	78.0	

* Non-parametric analysis of variance