Promoting Antimicrobial Stewardship by Incorporating it in Undergraduate Medical Education Curricula

Aaron P. Beck; Kelsey Baubie, MPH, MS; Mary Jo Knobloch, PhD, MPH; Nasia Safdar, MD, PhD

ABSTRACT

Background: Education related to antimicrobial stewardship—the judicious use of antimicrobials—is essential to stem the rising tide of resistance.

Methods: Using a scoping review method that includes a consultation component, we explored the extent to which antimicrobial stewardship is incorporated in undergraduate medical education.

Results: We found 4 studies evaluating stewardship content in undergraduate medical school curricula along with 2 studies assessing the effectiveness of specific stewardship training programs in medical education.

Discussion: We highlight three recommendations: (1) if applicable, identify an institutional “champion” and incorporate antibiotic stewardship-related content into medical school curriculum; (2) evaluate the status and effectiveness of antibiotic stewardship curricular components in medical education; (3) conduct research evaluating the long-term outcomes of antibiotic stewardship training in medical education.

BACKGROUND

Antimicrobial resistance in bacteria causing infections is a public health crisis that requires urgent action. Antibiotic overuse and misuse drives antimicrobial resistance, thus antibiotic stewardship (AS) programs, including training in judicious use of antibiotics, are crucial to stem the rising tide of resistance.

Guidelines from national societies such as the Infectious Disease Society of America, the Society of Healthcare Epidemiology of America and the Pediatric Infectious Disease Society recommend that AS education include learners such as fellows, postgraduate residents, and medical students. To date, most stewardship education programs have targeted health care professionals at the postgraduate level. However, the literature points out that the undergraduate medical education setting, when prescribing behavior is being developed, is an important time to engage in AS learning activities.

Research shows that medical students often feel inadequately prepared to judiciously prescribe antibiotics, have an insufficient comprehension of AS principles, and prefer additional education on AS-related content and prescribing of antibiotics. Yet the extent to which AS features in education in medical student curricula is unclear. This review identifies gaps and summarizes findings related to AS education in medical school.

METHODS

We used a scoping review method to summarize this topic. The purpose of a scoping review is to examine the extent, range, and nature of research on a topic; identify research gaps; provide a descriptive overview; and quickly determine the potential of undertaking a full systematic review. This type of review is useful when the topic has not yet been extensively reviewed or studies are heterogeneous in nature. We reviewed published literature using PubMed and Scopus databases through August 2017. These search engines were used over others (eg, MedEd Portal) as they provided a more comprehensive list of records. MeSH terms pertaining to “antibiotic stewardship” and “medical school curriculum” were combined with a Boolean “AND” without search limitations. We excluded non-English and duplicate articles before reviewing the Title and Abstract of the remaining records, excluding articles that failed to include keywords or pertained to broad AS platforms or clinic-/hospital-related
AS programs. In an effort to identify any missed articles in our literature search, we reviewed reference lists of the publications included in full-text review. Studies were excluded if content was limited to education of physicians, residents, or nonphysician clinicians and/or nonmedical, public health training. We also excluded studies that evaluated medical students’ knowledge, perception, and/or attitudes of AS without significant investigation of curriculum. After applying exclusion criteria, we included 6 articles that examined AS in medical school curricula (Figure).

We also conducted interviews with 2 institutional leaders overseeing medical school curriculum development and administration, which augmented our findings by providing a more in-depth examination of factors relevant to integrating AS principles in medical education. These experts were chosen for their experience in medical school curriculum development and recent involvement in a medical school curriculum transformation. Furthermore, each expert actively teaches and pursues research in medical education.

RESULTS
We found 6 articles that investigated AS programs in medical school curricula. Four were cross-sectional national surveys investigating AS-related curricular components, such as prevalence of AS teaching and content, delivery, and evaluation of material. These studies show frequent, yet disparate AS content offered through undergraduate medical curricula.\textsuperscript{10,16-18} Each cross-sectional study is summarized in Table 1, with specifics on curricula content, delivery, and evaluation detailed in Table 2.

We also found 2 studies that evaluated the impact of AS programs through a quasi-experimental design (Table 3). They found medical students’ knowledge and attitudes of AS and interprofessional collaboration were significantly increased after completing the AS-specific curriculum. Both studies also emphasized the importance of long-term outcomes research to better understand the impact of AS training in medical school on physicians’ prescribing behaviors.\textsuperscript{19,20} In addition, the University of California San Francisco research group provided free access to their curriculum, which can be found online at http://tiny.ucsf.edu/stewardship.\textsuperscript{19}

Our interviews with institutional experts yielded insights into incorporating AS in medical education. The observed heterogeneity of AS teaching in medical school curricula is likely linked to institutional flexibility when developing a curriculum, and meeting national accreditation standards largely depends on the institution’s curriculum development strategy and mission-sensitive content prioritization. Furthermore, medical training occurs in a fast-paced content-dense setting, and the integration of additional content such as AS may be at the expense of another topic. Both experts stressed that a “champion” is necessary to spark and sustain a medical school’s interest and ability to teach AS as a key curriculum component.

DISCUSSION
We found 4 studies on AS in medical school curriculum and 2 studies evaluating the effectiveness of a specific AS program. It is evident disparate learning environments and training approaches exist in medi-
Table 1. Summary of Research Investigating Medical School Curricula Related to Antimicrobial Stewardship

<table>
<thead>
<tr>
<th>Article</th>
<th>Topic</th>
<th>Outcome Measures</th>
<th>Country</th>
<th>Method</th>
<th>Participants</th>
<th>Response Rate</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castro-Sanchez et al, 2016¹⁶</td>
<td>Teaching of AS principles</td>
<td>Prevalence of AS teaching, stewardship principles taught, time allotted to content, content delivery and teaching strategies, evaluation methodologies, multi disciplinary learning</td>
<td>United Kingdom</td>
<td>Cross-sectional survey</td>
<td>Medical, Dental, Nursing, Pharmacy and Veterinary Medicine Schools</td>
<td>70.5%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Educators must adopt a comprehensive approach using standardized content relating antimicrobial stewardship; increased standardization of AS-related content.</td>
</tr>
<tr>
<td>Melber et al, 2016¹⁷</td>
<td>Microbiology and Infectious Disease (MID)</td>
<td>Prevalence of MID topics, course leadership, curricular structure, course content, educator perceptions about microbiology education locally and nationally</td>
<td>United States</td>
<td>38 questions cross-sectional survey, interviews</td>
<td>LCME accredited US Medical Schools</td>
<td>73%</td>
<td>Multi disciplinary local and national collaboration; changing curriculum structure and content; identify best practices and support research.</td>
</tr>
<tr>
<td>O'Shaughnessy et al, 2010¹⁸</td>
<td>Clinical pharmacology and therapeutics</td>
<td>Prevalence of CPT teaching, course structure, content delivery and teaching strategies, assessment measures, interdisciplinary education, medical student transition, follow-up prescribing performance</td>
<td>United Kingdom</td>
<td>10 questions web-based cross-sectional survey</td>
<td>UK medical schools</td>
<td>94%</td>
<td>Increased collaboration between foundation schools, medical schools, pharmacists, and clinicians to ensure GMC's emphasis on CPT is met.</td>
</tr>
<tr>
<td>Pulcini et al, 2015¹⁰</td>
<td>Teaching of prudent antibiotic prescribing behavior</td>
<td>Prevalence of prudent antibiotic use principles, content delivery and teaching strategies, qualitative background on the topic, associations between curriculum, antibiotic use and/or rates of bacterial resistance</td>
<td>13 European Countries&lt;sup&gt;b&lt;/sup&gt;</td>
<td>57-point cross-sectional survey, interviews</td>
<td>Proportional sampling of 13 European countries' medical schools</td>
<td>94.6%</td>
<td>Improvement in the teaching of prudent antibiotic prescribing principles through national and European programs that establish specific learning outcomes and competencies.</td>
</tr>
</tbody>
</table>

<sup>a</sup> Response rate refers to medical schools only.
<sup>b</sup> Countries include Belgium, Croatia, Denmark, France, Germany, Italy, Netherlands, Norway, Serbia, Slovenia, Spain, Switzerland, and United Kingdom.

Abbreviations: AS, antibiotic stewardship; CPT, clinical pharmacology and therapeutics; MID, microbiology and infectious disease; LCME, liaison committee on Medical Education; GMC, General Medical Council; US, United States; UK, United Kingdom.

Table 2. Summary of Medical Schools’ Curricula Content, Delivery and Evaluation Related to Antimicrobial Stewardship

<table>
<thead>
<tr>
<th>Article</th>
<th>Content</th>
<th>Delivery</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castro-Sanchez et al, 2016¹⁶</td>
<td>AS Principles</td>
<td>95.8%</td>
<td>Academian (82.6%)</td>
</tr>
<tr>
<td>Melber et al, 2016¹⁷</td>
<td>Microbiologist (48%)</td>
<td>66%</td>
<td>Microbiologist + Clinician (23%)</td>
</tr>
<tr>
<td>O'Shaughnessy et al, 2010¹⁸</td>
<td>Pharmacologist (70%)</td>
<td>60%&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Vertical integration (72%)</td>
</tr>
<tr>
<td>Pulcini et al, 2015¹⁰</td>
<td>AS involvement (77%)</td>
<td>97.1%</td>
<td>Integrated (68%)</td>
</tr>
</tbody>
</table>

Percentages refer to the proportion of schools.
<sup>a</sup> Percentage of schools teaching CPT, AS principles may be underlying theme.
<sup>b</sup> Years denote when the majority of content was delivered.
<sup>c</sup> No exact proportion provided.

Abbreviations: AS, antibiotic stewardship; OSCE, objective structured clinical examination; CPT, clinical pharmacology and therapeutics.
The goal of this scoping review was to take a broad look at the extent to which medical schools are being exposed to AS education. A limitation is that we excluded non-English articles. We also acknowledge this scoping review is meant to serve as a precursor to systematic review, and one such systematic review of this topic has been published. This paper found that while medical schools are implementing AS training, thorough evaluation of the curricula’s effectiveness has not been completed.

Publication bias may be another limitation of this paper; it is possible not all AS education and training activities are reported in peer reviewed journals. In addition, our qualitative data may not represent that of other medical school administrators and curriculum developers. These limitations notwithstanding, the inclusion of a key step of consultation—our interviews with topic experts from our institution—is a strength of our scoping review.

### Limitations

The goal of this scoping review was to take a broad look at the extent to which medical schools are being exposed to AS education. A limitation is that we excluded non-English articles. We also acknowledge this scoping review is meant to serve as a precursor to systematic review, and one such systematic review of this topic has been published. This paper found that while medical schools are implementing AS training, thorough evaluation of the curricula’s effectiveness has not been completed.

Publication bias may be another limitation of this paper; it is possible not all AS education and training activities are reported in peer reviewed journals. In addition, our qualitative data may not represent that of other medical school administrators and curriculum developers. These limitations notwithstanding, the inclusion of a key step of consultation—our interviews with topic experts from our institution—is a strength of our scoping review.

### CONCLUSIONS

We highlight 3 recommendations: (1) if applicable, identify an institutional “champion” and incorporate AS-related content into medical school curriculum; (2) evaluate the status and effectiveness of AS curricular components in medical education; (3) conduct research evaluating the long-term outcomes of AS training in medical education.

**Funding/Support:** None declared.

**Financial Disclosures:** None declared.

### REFERENCES

2. Fishman N; Society for Healthcare Epidemiology of America; Infectious Diseases Society of America; Pediatric Infectious Diseases Society. Policy statement on...
antimicrobial stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Diseases Society (PIDS).


The mission of *WMJ* is to provide a vehicle for professional communication and continuing education for Midwest physicians and other health professionals.

*WMJ* (ISSN 1098-1861) is published by the Wisconsin Medical Society and is devoted to the interests of the medical profession and health care in the Midwest. The managing editor is responsible for overseeing the production, business operation and contents of the *WMJ*. The editorial board, chaired by the medical editor, solicits and peer reviews all scientific articles; it does not screen public health, socio-economic, or organizational articles. Although letters to the editor are reviewed by the medical editor, all signed expressions of opinion belong to the author(s) for which neither *WMJ* nor the Wisconsin Medical Society take responsibility. *WMJ* is indexed in Index Medicus, Hospital Literature Index, and Cambridge Scientific Abstracts.

For reprints of this article, contact the *WMJ* at 866.442.3800 or e-mail wmj@wismed.org.

© 2018 Wisconsin Medical Society