Pharmacology Education in North American Dental Schools: The Basic Science Survey Series

Medha Gautam, Ph.D.; David H. Shaw, Ph.D.; Ted D. Pate, Ph.D.; H. Wayne Lambert, Ph.D.

Abstract: As part of the Basic Science Survey Series (BSSS) for Dentistry, members of the American Dental Education Association (ADEA) Physiology, Pharmacology, and Therapeutics Section surveyed course directors of basic pharmacology courses in North American dental schools. The survey was designed to assess, among other things, faculty affiliation and experience of course directors, teaching methods, general course content and emphasis, extent of interdisciplinary (shared) instruction, and impact of recent curricular changes. Responses were received from forty-nine of sixty-seven (73.1 percent) U.S. and Canadian dental schools. The findings suggest the following: 1) substantial variation exists in instructional hours, faculty affiliation, placement within curriculum, class size, and interdisciplinary nature of pharmacology courses; 2) pharmacology course content emphasis is similar among schools; 3) the number of contact hours in pharmacology has remained stable over the past three decades; 4) recent curricular changes were often directed towards enhancing the integrative and clinically relevant aspects of pharmacology instruction; and 5) a trend toward innovative content delivery, such as use of computer-assisted instruction applications, is evident. Data, derived from this study, may be useful to pharmacology course directors, curriculum committees, and other dental educators with an interest in integrative and interprofessional education.

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The American Dental Education Association (ADEA) formed the Commission on Change and Innovation in Dental Education (ADEA CCI) in 2005 to provide leadership across dental education in the areas of curricular change and educational innovation.1 Over the past decade, repeated calls have been made for curricular reform and increased innovation in dental education.2–4 In fact, planned and implemented curricular changes have occurred at many dental schools, including the introduction of integrated and systems-based courses.5–7 As part of this interest in curricular change, the ADEA Physiology, Pharmacology, and Therapeutics Section designed and distributed two surveys to assess the state of pharmacology and physiology instruction in North American dental schools. Between October 2009 and September 2011, all U.S. and Canadian faculty members directing courses in basic pharmacology or human physiology for dental students were invited to complete the appropriate survey through the ADEA academic deans’ listserv. This article will focus on only the pharmacology survey. This Web-based survey was part of the Basic Science Survey Series (BSSS) for Dentistry, an educational research project that assesses how the basic sciences are taught to predoctoral dental students. The BSSS for Dentistry is supported by a grant from the ADEA Council of Sections Project Pool.

With many dental schools making or planning major basic science curricular changes,6,7 a survey of pharmacology instruction in dental schools is timely and important. The goals of this survey were to provide information about the effects of these curricular changes on pharmacology instruction and to enable dental educators to make informed decisions when future changes are being considered. The information gathered on course content and topics of instruction could also assist in the further development of curriculum guidelines, core competencies, and/or foundational knowledge requisites.8–10 Survey information
The survey was closed in September 2011, and the data were analyzed. Responses from three schools were submitted by two course directors and, unless indicated otherwise, are presented as combined data for each school. For example, if either course director replied positively to directing an integrated course, the school was counted as having course integration. The number of schools represented varies slightly in the results because some respondents did not answer every question.

Results and Discussion

When data collection ended, fifty-two course directors had responded to the survey, representing forty-nine of sixty-seven (73.1 percent) U.S. and Canadian dental schools. Therefore, the results presented here give a clear picture of basic pharmacology instruction in a majority of North American dental schools.

Faculty Affiliation and Experience of Course Directors

Out of fifty-two course directors responding to the survey, twenty-three (44.2 percent) individuals said they held their primary departmental affiliation within a dental school, twenty-five (48.1 percent) were affiliated with a medical school, and four (7.7 percent) held joint affiliations with both dental and medical schools (Figure 1). Because twenty-nine of fifty-two course directors (55.8 percent) reported holding primary or joint affiliations within a medical school, these data indicate dental schools rely heavily on medical school faculty members to teach basic pharmacology to dental students. This finding has also been documented in other basic science courses, particularly in the anatomical sciences (gross anatomy, neuroanatomy, histology, and embryology).14,15

Course directors of basic pharmacology courses reported their years of teaching experience in pharmacology ranged from zero to forty-five years, with a mean of 19.7 years and a median of twenty years (Figure 2 and Table 1). The years of experience teaching dental students ranged from two to forty-three years, with a mean of 17.7 years and a median of 16.5 years. Thirteen course directors from forty-nine schools (26.5 percent) have been teaching basic pharmacology courses for thirty to forty-five years, which suggests a need for recruitment of new course directors to replace faculty members approaching retirement.

Methods

On October 1, 2009, the academic deans of the sixty-seven U.S. and Canadian dental schools were e-mailed an invitation to participate in the online survey and asked to forward that invitation to the course directors of their pharmacology courses. The survey, posted on SurveyMonkey, included questions on the following: 1) faculty affiliation and experience of course directors, 2) placement and content of basic pharmacology courses, 3) student contact hours, 4) class size and number of faculty members teaching, 5) inclusion of other professional students in the class, 6) topics and content areas of dental pharmacology courses, 7) effects of curricular changes on pharmacology instruction, and 8) use of computer-assisted instruction (CAI). Three reminder e-mails were sent to the academic deans of those schools that had not responded, requesting them to urge their faculty to participate.
retirement. Due to the existing shortage of faculty in dentistry and other allied health professionals and of pharmacology professionals in general, dental schools may have difficulties recruiting and retaining pharmacology educators in the near future. In fact, some schools have implemented innovative strategies to compensate for the faculty shortage in order to continue to maintain the quality of their educational programs.

**Contact Hours and Placement of Pharmacology Courses**

With forty-five dental schools reporting contact hours, basic pharmacology instruction ranged between twenty-nine and 114 hours, with a mean of 67.7 hours and a median of sixty-nine hours. When comparing these numbers to three previously published studies, we found that the contact hours for basic pharmacology instruction in the dental curriculum have remained relatively stable over the past thirty-five years (Table 2), despite the exponential growth in therapeutic options in health care and, more specific to dental medicine, the increase in pharmacotherapeutic agents for pain, caries, and patient management. In contrast, the 2008-09 survey of dental education by the American Dental Association (ADA) showed the clock hours of instruction in pharmacology and therapeutics together had a mean of 79.7 hours and a median of seventy-eight hours. However, the ADA survey includes instruction hours in therapeutics that may fall outside the basic pharmacology instruction surveyed in our study.

Concerning curricular placement, thirty-three out of forty-eight (68.8 percent) schools reported that basic pharmacology was taught in year two of the

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**Figure 1. Primary affiliation of course directors in basic pharmacology participating in study**

**Table 1. Years of experience of course directors in dental pharmacology courses**

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>Mean</th>
<th>Median</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching pharmacology</td>
<td>19.7</td>
<td>20</td>
<td>0-45</td>
</tr>
<tr>
<td>Teaching dental students</td>
<td>17.7</td>
<td>16.5</td>
<td>2-43</td>
</tr>
</tbody>
</table>

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**Figure 2. Respondents' overall teaching experience**

*Note: All survey participants were course directors (n=52) representing forty-nine U.S. and Canadian dental schools.*
dental curriculum (Table 3). Course directors from seven of forty-eight schools (14.6 percent) included comments indicating that they directed courses in which elements of basic pharmacology were taught over multiple years. In this group of responses, course directors reported having basic pharmacology modules distributed over two, three, or all four years of the dental curriculum. Interestingly, five of these seven (71.4 percent) respondents also acknowledged that their teaching was affected by curricular change within the five years prior to completing the survey or that they taught an integrated pharmacology course. In a related question, respondents from ten out of forty-seven schools (21.3 percent) indicated that contact hours in their pharmacology courses included between four and eighteen hours for small-group discussions in addition to traditional lectures. These data suggest a recent trend toward integration and adoption of systems-based courses with inclusion of small-group learning or problem-based learning (PBL).4-7

Class Size, Shared Instruction, and Faculty Number

To gain insight into basic pharmacology course organization, course directors were asked questions concerning shared instruction, the number of students taught, and the number of faculty members helping to teach the course. Course directors from ten out of forty-nine schools (20.4 percent) reported shared instruction with students from other health professions in their pharmacology courses. Interestingly, twenty out of twenty-nine course directors (69.0 percent) who possessed a medical or joint medical-dental type of school affiliation reported that their dental pharmacology courses excluded students from other disciplines. Therefore, a majority of survey respondents with medical school affiliations had pharmacology courses that were strictly for dental students.

Table 2. Number of contact hours in dental pharmacology courses over thirty-five years

<table>
<thead>
<tr>
<th>Survey Report</th>
<th>Average Student Contact Hours</th>
<th>Range (Hours)</th>
<th>Number of Schools Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976 report1</td>
<td>67</td>
<td>28-130</td>
<td>55</td>
</tr>
<tr>
<td>1986 report2</td>
<td>64</td>
<td>39-127</td>
<td>15</td>
</tr>
<tr>
<td>1996 report3</td>
<td>57</td>
<td>21-89</td>
<td>51</td>
</tr>
<tr>
<td>Current survey</td>
<td>67.7</td>
<td>29-114</td>
<td>45†</td>
</tr>
</tbody>
</table>

†Responses from four schools were not complete and therefore were not included.

Table 3. Placement of pharmacology in dental curricula

<table>
<thead>
<tr>
<th>Year for Teaching Basic Pharmacology</th>
<th>Number of Schools (n=48)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>First year</td>
<td>7</td>
<td>14.6%</td>
</tr>
<tr>
<td>Second year</td>
<td>33</td>
<td>68.8%</td>
</tr>
<tr>
<td>Third year</td>
<td>8</td>
<td>16.7%</td>
</tr>
</tbody>
</table>

Note: Seven out of forty-eight (14.6 percent) respondents indicated that basic pharmacology was taught over multiple years at their school. Those responses were classified according to the first year in which dental students received basic pharmacology instruction at their school.

Table 4. Class size and shared instruction

<table>
<thead>
<tr>
<th>Class Size (number of students)</th>
<th>Total (n=49)</th>
<th>Dental Students Only (N=39, 79.6%)</th>
<th>Dental + Other Students (N=10, 20.4%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-80</td>
<td>23 (46.9%)</td>
<td>18 (36.7%)</td>
<td>5 (10.2%)</td>
</tr>
<tr>
<td>81-120</td>
<td>18 (36.7%)</td>
<td>16 (32.7%)</td>
<td>2 (4.1%)</td>
</tr>
<tr>
<td>121-160</td>
<td>3 (6.1%)</td>
<td>1 (2.0%)</td>
<td>2 (4.1%)</td>
</tr>
<tr>
<td>161-350</td>
<td>5 (10.2%)</td>
<td>4 (8.2%)</td>
<td>1 (2.0%)</td>
</tr>
</tbody>
</table>
As shown in Figure 4, the range of hours spent discussing specific topics in pharmacology varied considerably. The majority (86-90 percent) of faculty members reported spending two hours or more on five topics, including general principles, autonomic drugs, cardiovascular drugs, antimicrobial agents, and central nervous system (CNS) drugs. Most of the respondents (75-100 percent) reported spending one hour or more on a second group of topics, which included opioid analgesics, nonopioid analgesics, local anesthetics, general anesthetics, drugs of abuse, and drugs affecting the respiratory, endocrine, and gastrointestinal systems.

Conversely, content areas with the least coverage included immunotherapy, dietary supplements, and toxicology in that faculty members predominantly reported less than one hour of coverage, no coverage, or coverage by another dental course within the curriculum. Only 56 percent of course directors responded that instruction in prescription writing lasted one hour or more in their basic pharmacology course.

Effects of Curricular Changes

Course directors from eighteen of forty-nine schools (36.7 percent) reported that their pharmacology instruction was affected by curricular changes in the five years prior to completing the survey. Some common themes emerged from these reported curricular changes. Direct separate basic pharmacology courses for dental students. Nevertheless, shared instruction may be a result of a national push toward increasing interprofessional education in the dental curriculum. Other health professions students reported being included in basic pharmacology courses for dental students were students in medical, physician assistant, dental hygiene, pharmacy, optometry, and biomedical graduate research programs. Of the schools where shared instruction was reported, only three out of ten (30.0 percent) had a class size of more than 120 students (Table 4).

Survey respondents were asked how many additional faculty members and teaching assistants were used in the delivery of their courses. As shown in Figure 3, basic pharmacology courses for dental students are taught by three or more faculty members in thirty-five out of forty-nine schools (71.4 percent). Teaching assistants were assigned to basic pharmacology courses in only three out of forty-nine schools (6.1 percent).

Topics and Content Areas

In 1990, Curriculum Guidelines for Pharmacology were published in the *Journal of Dental Education*; however, these guidelines did not indicate the core content or time spent on these topics within basic dental pharmacology courses. Therefore, a focus of our study was directed toward these areas.

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consistent with recommendations from the ADEA CCI.\textsuperscript{1,2} The effect on contact hours produced as a result of the changes was variable and ranged from minimal change to a substantial increase to a decrease in contact hours. One respondent reported that there was better cross-communication among faculty, greater student buy-in, and improvement in first-year student comprehension as a result of the earlier introduction of clinically relevant material into the classroom.

Course directors who stated there had been no curricular changes were asked what the primary method of instruction was in their course/s. Overall, thirty-two out of forty-nine schools (63.3 percent) reported that their courses were primarily lecture-based. Four of these thirty-two schools (12.5 percent) reported a curricular change five years prior to completing this survey. Course directors from three out of forty-nine schools (6.1 percent) selected “other” than lecture-based to answer this question.
and fourteen out of forty-nine schools (28.6 percent) did not respond. Some course directors were directing both lecture-based and problem-based courses; others were using lectures and clinical cases as the primary methods of instruction in an individual course. Course directors from five out of thirty-two schools (15.6 percent) qualified their choice with comments, reporting their lecture-based courses included supplementation with case-based prescription writing, clinical case studies or case study collaborative homework, instruction on how to use a clinical drug database, online instruction, use of an audience response system, or small-group discussion. Together with the substantial number of course directors reporting that there were recent curricular changes affecting their course, the comments from course directors primarily using lecture-based teaching indicate that efforts are ongoing in many schools to include multiple modes of instruction and teaching tools in their basic dental pharmacology courses.

Survey participants were also asked whether their pharmacology instruction was taught as a stand-alone course, as part of another biomedical course, or in an integrated curriculum. Forty of forty-eight schools (83.3 percent) reported a stand-alone course. Only 6.3 percent of schools (three out of forty-eight) indicated that pharmacology was taught as part of another course, while 12.5 percent (six out of forty-eight) indicated that it was taught in an integrated curriculum. Course directors from four schools indicated that their pharmacology instruction consisted of courses that were a mix of stand-alone and integrated courses or part of another course. Therefore, course directors from only nine out of forty-eight schools (18.8 percent) indicated that pharmacology was taught as part of another course or in an integrated curriculum, despite eighteen out of forty-nine schools (36.7 percent) reporting a recent curricular change that affected their course.

Use of CAI Applications

The use of Web-based instruction in basic pharmacology has been reported by a few schools, but its long-term benefits have not been evaluated.\(^41\)\(^42\) This survey revealed that computer-assisted instruction (CAI) is gaining prominence in the teaching of pharmacology to dental students, with 53.1 percent schools (twenty-six out of forty-nine) reporting use of CAI applications (specialized software, websites, etc.) to engage the students in one or more pharmacology topics. Several respondents reported using commercially available software such as Blackboard and BlueLine or other secure online systems for online discussion boards, exam questions, and posting lectures and course materials. Several survey participants reported using commercially available, Web-based drug compendia, such as Epocrates, Micromedex, and Lexicomp. One respondent reported using human simulation monitors to teach autonomic and cardiovascular drugs, as well as for drugs used in the management of medical emergencies in the dental office. Another faculty member reported using Web-delivered spreadsheets to facilitate learning pharmacokinetics and patient management, as well as developing in-house learning packages for use of a drug database and patient counseling.

Conclusion

The results of this survey provide useful information about the trends in courses providing basic pharmacology instruction to dental students. The overall response rate of U.S. and Canadian dental schools participating in the survey was substantial (73.1 percent), and the majority of respondents indicated that basic pharmacology was taught as a stand-alone course in the second year of dental school. The average and range of student contact hours in basic pharmacology varied considerably, but have not changed substantially over the last thirty-five years. This rather stagnant curriculum commitment to pharmacology is surprising considering the expansion in therapeutic options that has occurred over these years. Only a few course directors reported that changes to the dental curriculum had resulted in reduced contact hours for pharmacology; rather, the majority reported that the number of contact hours had essentially stayed the same even after curricular changes. About half of the dental schools (twenty-four of forty-nine) in the study were utilizing faculty members with appointments outside of the dental school to direct basic pharmacology courses, and 20.4 percent of schools (ten of forty-nine) reported shared instruction with students from other health professions.

Even with the enormous variation in the instructional hours and the heterogeneity in terms of class size, faculty affiliation, and students from different programs of study, the vast majority of dental schools (~90 percent) agreed on an emphasis of specific content areas in pharmacology. The greatest emphasis was on general principles, autonomic drugs,
Acknowledgments
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REFERENCES