Teaching ultrasound in osteopathic medical schools

https://doi.org/10.1515/jom-2023-0027
Received February 7, 2023; accepted October 19, 2023; published online December 7, 2023

Abstract

Context: An important diagnostic tool, ultrasound (US) has been incorporated into the curriculum of medical schools for more than 20 years. In the last decade, the interest in US educational research has experienced exponential growth but mostly from Medical Doctor (MD)-granted schools. The extent to which US is embedded in the curricula of the colleges of osteopathic medicine (COM) still requires a comprehensive evaluation.

Objectives: This survey is designed to evaluate the current status of US teaching in COMs with an emphasis on the inclusion of the US in osteopathic manipulative medicine (OMM) training.

Methods: An anonymous, voluntary, 22-question online survey was created and administered to all COMs to collect data about the current state of US teaching. A descriptive analysis was performed to describe and summarize the final data. Fisher's exact test was utilized for the comparison of study variables.

Results: We received responses from 36 of the 43 (83.7 %) COMs invited to participate in the survey, all of which had US training within their curriculum, most commonly integrated into the year 1 curriculum (86.1 %). Focused US training is incorporated into 83.3 % of these schools (30 of 36). Focused US training is covered in 83.3 % of schools (30 of 36). US is mostly taught in the anatomy course (38.8 %). US is incorporated in the OMM course in 12 of 36 schools (33.3 %). The majority of respondents feel that US training will make osteopathic students more competitive in the job market (88.9 %) and want more US in their curriculum (86.1 %). The idea that US is useful for a better understanding of the key OMM concepts is believed by 62.9 % of respondents. The major obstacle to the implementation of US in the curriculum is having appropriately trained faculty (86.1 %). The majority of the respondents did not feel that an adequate budget is a handicap to implementing US in the curriculum.

Conclusions: US is included within the curriculum of all respondents to our survey, a third of whom included US within their OMM curriculum. US is treated as a useful and important skill for future osteopathic physicians. The majority of COMs desire more US training in the curriculum. The main barrier to implementing US in the curriculum is the lack of appropriately trained faculty.

Keywords: curriculum; education; osteopathic medical school; osteopathic medical students; teaching; ultrasound

Ultrasound (US) is an effective first-line imaging technique that is easily portable, noninvasive, not harmful to patients, and relatively low cost. US is an innovative teaching tool that connects basic science with clinical application [1–3]. In clinical practice, US examination usually follows one of two standard protocols: a standard comprehensive approach or point-of-care-ultrasound (POCUS) [4]. In POCUS testing, the physician performs the US and interprets the results at the bedside, providing the opportunity for immediate diagnosis and expedited treatment [3, 4].

Starting in 2014, family medicine residency programs began to integrate POCUS into training programs. POCUS has become a core competency in many family medicine training programs. More than half (53 %) of family medicine residency program directors report establishing POCUS as part of their program’s core curriculum [5].

The American Institute of Ultrasound in Medicine (AIUM) defines two levels of US training [6, 7]. The first level of training is exposure to US, which is described as observational or passive learning, and can be provided by lectures, assigned readings, online modules, or observing someone else performing a US examination [7]. The second type of US training is described as focused training that occurs when the students are able to perform US themselves, in addition to being able to interpret normal anatomy and/or pathology on the scan [7].

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US has been incorporated into the curriculum of medical schools for more than 20 years [8]. Examples of US-integrated curricula developed by the AIUM [9] are the curricula at the University of California, Irvine [10] and University of South Carolina [11], as well as several other resources that contain great recommendations about teaching US for medical students [12–14]. In 2022, the international consensus conference provided the first comprehensive recommendations for teaching US in medical schools [3].

In the last decade, research in educational US has experienced substantial growth, reaching more than 3,500 publications in 2020 [3]. Most US interest has originated from Medical Doctor (MD)-granting schools. In 2014, the results of a national survey of curricula at MD medical schools found that 62.2% of respondents reported that US training was integrated into their curriculum [15]. US was most commonly taught in the third year of the curriculum, and the purpose of training varied by curricular year. The majority of the schools that taught US in the first or second year of medical school indicated that it was utilized as a tool for teaching basic science (87.1%) or medicine topics (69.0%). The third and fourth years of training was mostly concentrated to teach students how to perform US scans and how to interpret them. Only 5.9% of respondents reported teaching students procedural guidance utilizing US [15]. In 2016, a National Survey of US integration in Medical Education was performed [16]. The authors contacted both allopathic and osteopathic schools to participate in the survey. Only schools with an advanced, integrated US curriculum were permitted to complete the survey (36 of 48 schools responded). The average years of US in the curriculum was 2.8 years, and most US was incorporated into years 1 and 2 of the training program. Difficulties with implementation of US were most commonly due to shortage of funding for faculty/equipment (52.9%), and lack of time in the curriculum (50.0%).

In 2021, Nicholas et al. [17] published a study about the implementation of US in accredited medical schools in the United States. Two hundred schools (both allopathic and osteopathic) were invited to participate in the study. The survey was completed by 55 (35.3%) allopathic schools and 24 (54.5%) osteopathic schools. The majority of schools (83.5%) reported that a mandatory US curriculum was most commonly integrated into the basic science course (73.8%). US was also noted to be incorporated into the clinical skills course 66.2% of the time and during clinical rotations 35.4% of the time. Osteopathic schools reported that US is integrated into “other” courses 87.5% of the time and taught as a separate course only 12.5% of the time. This study is limited by the relatively low response rate from osteopathic schools, and the role of US teaching in osteopathic manipulative medicine (OMM) was not specifically assessed.

Additional publications exploring the status of US teaching in COMs assessed US implementation specifically in anatomy courses [18–21], in OMM [22–25], in clinical skills [26, 27], or in obstetrics [28].

Several reviews address the variety of different types of US curricula in many different medical schools worldwide [1, 2, 29]. Many German-speaking medical schools offer access to either compulsory or elective US courses in their medical education curricula [30]. Surprisingly, the United Kingdom and the Republic of Ireland exhibit limited US in their medical education curriculum [31].

Our study evaluates the current status of US teaching in COMs with an emphasis on US in OMM training. We focused on OMM specifically because this is the modality that separates COMs from their MD counterparts. We explored the opinions of administrators and educators on the delivery of US training in COMs. We hypothesized that US is widely implemented in COMs, but the level of utilization and implementation varies vastly on the curricula.

Methods

The study design, informed consent form, cover letter, and survey questions were reviewed and approved by the Ohio University Institutional Review Board (IRB). This study was deemed exempt (IRB number: 22-E-227). The authors disclose neither any financial support nor any conflict of interest for this study. No compensation was provided to the participants of the study.

Participants

In the fall of 2022, there were 44 COMs listed on the American Association of Colleges of Osteopathic Medicine (AACOM) website [32]. One newly established COM (Montana COM) was excluded from the study. A total of 43 COMs were included in the study. We identified Deans, Associate Deans, and Assistant Deans of Education and Curriculum (or equivalent level), as well as US champions from the schools’ individual websites. We obtained the contact emails from their respective school websites. In early October of 2022, we sent initial emails to the 43 COMs and their chosen participants. The email contained the cover letter with a link to the online informed consent form and survey. We sent follow-up emails to nonresponders over the next 2–3 weeks. Survey collection closed in late November 2022.

Survey design

An anonymous, voluntary 22-question online survey was created and administered via Qualtrics (Qualtrics XM Platform, Provo, UT) to collect data about the current state of US teaching in COMs (Appendix A).

The survey consisted of three groups of questions to cover the following areas:
(1) Status of US teaching in the COMs (questions 1–10). We asked about integration of US into the curriculum, during what years of training were students exposed to US, and whether there were opportunities to receive focused training in US. We also asked the responders’ opinion about the benefits of US teaching for better understanding of basic sciences and clinical concepts, and the usefulness for future medical professionals.

(2) Role of US in OMM training (questions 11–16). We evaluated the opinion of the responders regarding US use in the OMM course, whether US is useful for a better understanding of key osteopathic concepts, if US should be a required skill for DO practitioners, and what should be the level of US knowledge of faculty that are training osteopathic medical students.

(3) Potential difficulties of US implementation in the COM curriculum (questions 17–22). We asked about the availability of trained faculty, US equipment, COM budget, and perceived student interest in US training.

The survey questions were either multiple-choice or Likert scale type. The survey concluded with an open comment section.

Before distribution, the survey was critically reviewed by two faculty members (a DO with expertise in US and an MD/PhD with no US experience. Both reviewers are experienced in survey design).

An online informed consent form preceded the survey. The survey was distributed by email with a cover letter that included a brief description of the project and an invitation to complete the survey (Appendix B). The link to the survey was embedded in the email. Participants could skip a question or stop the survey at any point. The cover letter, online informed consent form, and survey are provided in the Supplemental Materials (Appendices A and B).

Data analysis

Descriptive analysis was performed to describe and summarize the final data with Fisher’s exact test utilized for the comparison of study variables, given the small sample size [33]. The corresponding frequencies and percentages were reported. Statistical significance was determined at a value of $p<0.05$. Data were analyzed with SAS® v9.4 (SAS Institute, Cary, NC).

Results

We received responses from 36 of the 43 (83.7 %) COMs that we solicited for participation in our study. The distribution of the respondents are presented in Table 1. In total, 75 % of responders were described as administrative positions, and 25 % were experts in US.

US training was initially reported by 35 of the 36 respondents (97.2 %) as part of the curriculum. One responder provided a “No” answer, but later mentioned that US is part of their anatomy and physiology courses, thus 100 % of respondents to this survey indicated that US is included within their COM curriculum.

From the responses provided, US is most commonly integrated in only year 1 curriculum (30/35, 86.1 %). It should be noted that US is also provided only in the year 2 curriculum (29/35, 83.3 %), year 3 curriculum (16/35, 44.4 %), and year 4 curriculum (11/35, 30.5 %). US was included in both years 1 and 2 (28/35, 80 % of the time) and in all four years of training (7/35, 20 % of the time).

Perception of US teaching in COM

Exposure and focused training to US data is presented in Table 2. The most exposure to US was demonstrated in anatomy (25/36, 69.4 %), and less commonly in OMM (11/36, 30.6 %), and family medicine (9/36, 25 %). An option to indicate that nongraded and extracurricular US options were available to students. Taking this information into account, we conclude that 100 % of respondents provide exposure to US in COMs.

Focused required US training is provided in 83.3 % of schools who responded (30 of 36), again mostly taught in
anatomy (14/36, 38.8 %), followed by OMM (9/36, 25 %) and then family medicine (5/36, 13.9 %). “Other” types of US-focused training were reported by most respondents (25/36, 69.4 %), described as POCUS courses and different clinical activities.

Optional extracurricular US training is available at 77.8 % of COMs. Three respondents (8.3 %) were not sure about such option in their schools.

US is incorporated in the OMM course in 12 of 36 schools (33.3 %) and not included in 21/36 (58.3 %). Two respondents (5.6 %) were not sure.

Further opinions on the role of the US training in COMs are presented in Table 3. The majority of respondents support the teaching of US and feel that it is useful for gaining a better understanding of both key basic science concepts and clinical case understanding (both 34/36, 94.4 %). The respondents also felt that US training will make osteopathic medical students more competitive in the job market (32/36, 88.9 %). The majority of schools would like more US in their curriculum (31/36, 86.1 %), and only 5 of 36 (13.9 %) were neutral. Respondents feel that US is useful for gaining a better understanding of the key OMM concepts 22/35 (62.9 %) of the time, and 13/35 (37.1 %) were neutral. None of the respondents felt that US was not a useful tool for better understanding of key OMM concepts. US as a required skill for OMM practitioners is supported by 18/35 (51.4 %) respondents, while 13/35 (37.1 %) were neutral and 4/35 (11.5 %) disagreed and felt that US was not an important skill.

Among the respondents, 42.9 % (15/35) felt that the requirement of basic US training for OMM faculty was important, while 15/35 (42.9 %) were neutral and 5/35 (14.2 %) disagreed with this concept.

Almost half of the respondents (16/35, 45.7 %) did not feel that US in the anatomy lab is enough to gain a better understanding of basic OMM concepts, 12 of 35 (34.3 %) were neutral about this, and only 7/35 (20 %) agreed with such a statement.

Most respondents agree that basic US training should be a required skill for anatomy faculty (21/35, 60 %), and 11/35 (31.4 %) were neutral.

<table>
<thead>
<tr>
<th>N</th>
<th>Question (no of responses)</th>
<th>Disagree or strongly disagree, no, %</th>
<th>Neutral, no, %</th>
<th>Agree or strongly agree, no, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>US is useful for better understanding of the key basic sciences (anatomy, physiology, etc.) concepts (n=36)</td>
<td>0 (0.0)</td>
<td>2 (5.6)</td>
<td>34 (94.4)</td>
</tr>
<tr>
<td>2</td>
<td>US is useful for better understanding of clinical cases (n=36)</td>
<td>0 (0.0)</td>
<td>2 (5.6)</td>
<td>34 (94.4)</td>
</tr>
<tr>
<td>3</td>
<td>Experience with US will make our students more competitive in the job market (n=36)</td>
<td>1 (2.8)</td>
<td>3 (8.3)</td>
<td>32 (88.9)</td>
</tr>
<tr>
<td>4</td>
<td>Would you like more US in your curriculum? (n=36)</td>
<td>0 (0.0)</td>
<td>5 (13.9)</td>
<td>31 (86.1)</td>
</tr>
<tr>
<td>5</td>
<td>I believe US is useful for the future of the DO profession (n=36)</td>
<td>0 (0.0)</td>
<td>2 (5.6)</td>
<td>34 (94.4)</td>
</tr>
<tr>
<td>6</td>
<td>US is useful for better understanding of key osteopathic manipulative medicine concepts (n=35)</td>
<td>0 (0.0)</td>
<td>13 (37.1)</td>
<td>22 (62.9)</td>
</tr>
<tr>
<td>7</td>
<td>Basic US training should be a required skill for OMM practitioners (n=35)</td>
<td>4 (11.5)</td>
<td>13 (37.1)</td>
<td>18 (51.4)</td>
</tr>
<tr>
<td>8</td>
<td>Basic US training should be a required skill for OMM faculty (n=35)</td>
<td>5 (14.2)</td>
<td>15 (42.9)</td>
<td>15 (42.9)</td>
</tr>
<tr>
<td>9</td>
<td>US in the anatomy lab is enough for better understanding of OMM key concepts (n=35)</td>
<td>16 (45.7)</td>
<td>12 (34.3)</td>
<td>7 (20.0)</td>
</tr>
<tr>
<td>10</td>
<td>Basic US training should be a required skill for anatomy faculty (n=35)</td>
<td>3 (8.6)</td>
<td>11 (31.4)</td>
<td>21 (60.0)</td>
</tr>
</tbody>
</table>

Table 3: Opinions on the role of US education in OMSs.

DO, doctor of osteopathy; OMM, osteopathic manipulative medicine; OMS, osteopathic medical school; US, ultrasound.

Difficulties in the implementation of US in the curriculum

The major obstacle with implementation of US in the curriculum is having appropriately trained faculty in 31/36 (86.1 % of the time) schools. Only 2/36 (5.6 %) were neutral and 3/36 (8.3 %) expressed disagreement with this statement (Table 4). A lack of adequate US equipment was felt to be a hindrance to US implementation by 11 of 36 (30.6 %) respondents; 21/36 (58.3 %) respondents disagreed or strongly disagreed with this. Only 10 (27.8 %) of respondents felt that an overloaded curriculum precludes the COM from employing US in the curriculum; 22 (61.1 %) disagreed or strongly disagreed with this. The majority of the respondents did not feel that adequate budget is a handicap to US in the curriculum. At the same time, 8/36 (22.2 %) were neutral and 6/36 (16.7 %) agreed or strongly agreed with this. Lack of student interest is not a problem, 94.4 % respondents disagree or strongly disagree with this statement (Table 4).

We next explored the relationship between both the inclusion and exclusion of US in OMM courses at COMs. Among COMs that incorporated US into their OMM courses,
Table 4: Existing difficulties of US implementation in the curriculum of OMS (n=36).

<table>
<thead>
<tr>
<th>N</th>
<th>Question</th>
<th>Disagree or strongly disagree, no, %</th>
<th>Neutral, no, %</th>
<th>Agree or strongly agree, no, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>We do not have enough trained faculty</td>
<td>3 (8.3)</td>
<td>2 (5.6)</td>
<td>31 (86.1)</td>
</tr>
<tr>
<td>2</td>
<td>Students are not interested in US</td>
<td>34 (94.4)</td>
<td>2 (5.6)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>3</td>
<td>We do not have enough US equipment</td>
<td>21 (58.3)</td>
<td>4 (11.1)</td>
<td>11 (30.6)</td>
</tr>
<tr>
<td>4</td>
<td>We do not have enough budget to cover US equipment</td>
<td>22 (61.1)</td>
<td>8 (22.2)</td>
<td>6 (16.7)</td>
</tr>
<tr>
<td>5</td>
<td>Due to an overloaded curriculum, US cannot be included</td>
<td>22 (61.1)</td>
<td>4 (11.1)</td>
<td>10 (27.8)</td>
</tr>
</tbody>
</table>

OMS, osteopathic medical school; US, ultrasound.

Discussion

US is a great educational tool and plays an important role in the curricula of both allopathic and osteopathic medical schools. There is overwhelming consensus that teaching US should be part of medical education [2, 6, 15]. Over the years, the number of medical schools with US as part of the curriculum is growing in the United States. In 2014, Bahner et al. [15] reported that US training was included in the curricula of 62.2% of Allopathic Medical Schools. Later, in 2021, Nicholas et al. [17] reported that 72.6% of both allopathic and osteopathic medical schools have mandatory US in their curriculum. Our study report that 100% responders of COMs possess US teaching in their curricula.

The accuracy of US research responses obtained depend on the clarity of the questions being asked. In 2021, Nicholas et al. [17] administered a research study regarding the use of US in medical school curriculum, and found that the study criteria was not explained and resulted in individual respondent interpretation. In 2021, Bahner et al. [16] administered a research study regarding US in medical school curriculum, and they provided very clear detailed requirements for the respondents. In 2016, Dinh et al. [16] reported that only 27.7% of the schools (both allopathic and osteopathic) had formal US curriculum.

Our study shows that US is most frequently taught in years 1 and 2, which is consistent with data obtained by other researchers [16, 17]. In contrast, Bahner et al. [15] reported that US was most taught in the third year in MD medical schools [15].

The main interest of our study was US training in the OMM curriculum of COMs. Nicholas et al. [17] reported that US is rarely taught as a separate module (12.5%) but is instead integrated within other courses or rotations (87.5%). Dinh et al. [16] specifically only surveyed schools with formal US curriculum, finding that only three COMs reported the presence of such a formal program. In another study, a US curriculum was present in 24 (75%) COMs but the survey was completed by only 54.5% of them. US was a part of basic science (76.2%), in medical specialties/clinical skills (66.7%) and clinical rotations (23.8%) schools [17]. The authors reported that the number of faculty involved in teaching US was 1–5 in 45.5% and 5–10 in 50% of COMs. Most faculty were compensated (monetarily) for their teaching. Of the schools that have US machines, 25.8% have cart-based machines, 11.3% have hand-held machines, and 62.9% have a combination of the 2 forms [17]. Neither survey provided any information about the role of US in OMM teaching and its relevance to the DO profession, which was our main focus. In our study, respondents reported that US is part of the OMM curriculum in one-third of the schools surveyed (12/36, 33.3%). All of the COMs reported exposure to US at least once during their 4-year training program, and some of the respondents reported focused training in US (9/36, 25%). The majority of the respondents support the idea that US
is important for training of osteopathic medical students and is useful for gaining a better understanding by students of the key concepts of OMM. The majority of osteopathic medical schools want more US training in their curriculum (31/36, 86.1 %). These results are in agreement with a general trend in medical student training in the United States and worldwide [1–3].

Our study also explored difficulties identified by respondents with implementing US in the curriculum of COMs. The major problem identified was the lack of trained faculty (86.1 %). According to our data, a lack of US equipment and overloaded curricula (30.6 % and 27.8 % respectively) were not the major obstacles for implementing US into the curriculum. The budget was not identified as a problem for the majority of the COMs. In contrast, a lack of funding and time in the curriculum were the most significant barriers identified by both Nicholas et al. [17] and Bahner et al. [15] The respondents who mentioned a lack of US equipment also indicated that the budget was insufficient to acquire the US equipment, and they showed a preference for incorporating more US content into the curriculum. Although we have a good number of US training curricula for medical schools [9–11] and consensus statements from national and international societies [1–3], and along with great implementation of US teaching in a number of osteopathic schools [22–25], the implementation of national standards of US teaching in medical schools may substantially change the situation, with the teaching of US moving everybody (MD and DO schools) to the same standards of US training. Also, a consensus among the osteopathic community on US teaching in OMM courses would be a great advantage for the future training of DOs.

Limitations

Although we obtained a favorable response rate from the osteopathic medical schools, a natural limitation of the study is the small number of COMs in the United States. Owing to this limitation, some of the results that were not statistically significant have still been reported because they are relevant from the research question standpoint. It is also possible that the respondents were not aware of all of the US teaching opportunities available at their institutions. While many of the responses to the survey were descriptive in their nature and were followed with great comments, numerical quantification of varied qualitative experiences is always a challenge. Some of the responses are just the opinion of the person who completed the survey. This is also a limitation of our study.

Conclusions

COM curricula demonstrates a high degree of US training. One-third of responded COMs include US in their OMM curriculum. US is considered a useful and important skill for future osteopathic physicians. The majority of COMs desire more US training in the curriculum. The main barrier identified for implementing US in the curriculum is the lack of appropriately trained faculty, with a lack of funding and busy curricula being relevant but less critical barriers. Overall, teaching US in the OMM course provides another useful skill for well-rounded osteopathic physicians.

Acknowledgments: The authors would like to thank Bhakti B. Chavan (Biostatistician, Office of Research and Grants, Ohio University) for help with the data analysis.

Research ethics: The local Institutional Review Board deemed the study exempt from review.

Informed consent: Informed consent was obtained from all individuals included in this study.

Author contributions: Both authors provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; both authors drafted the article or revised it critically for important intellectual content; both authors gave final approval of the version of the article to be published; and both authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Competing interests: None declared.

Research funding: None declared.

Data availability: The raw data can be obtained on request from the corresponding author.

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**Supplementary Material:** The online version of this article offers supplementary material (https://doi.org/10.1515/jom-2023-0027).