

# Teaching Medical Students Clinical Anesthesia

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There are many reasons for evaluating our approach and improving our teaching of America's future doctors, whether they become anesthesiologists (recruitment) or participate in patient management in the perioperative period (general patient care). Teaching medical students the seminal aspects of any medical specialty is a continual challenge. Although no definitive curricula or single clinical approach has been defined, certain key features can be ascertained from clinical experience and the literature. A survey was conducted among US anesthesiology teaching programs regarding the teaching content and approaches currently used to teach US medical students clinical anesthesia. Using the Accreditation Council for Graduate Medical Education website that lists 133 accredited anesthesiology programs, residency directors were contacted via e-mail. Based on those responses and follow-up phone calls, teaching representatives from 125 anesthesiology departments were identified and asked via e-mail to complete a survey. The survey was returned by 85 programs, yielding a response rate of 68% of individuals contacted and 63% of all departments. Ninety-one percent of the responding departments teach medical students, most in the final 2 years of medical school. Medical student exposure to clinical anesthesia occurred as elective only at 42% of the institutions, was requirement only at 16% of responding institutions, and the remainder had both elective and required courses. Anesthesiology faculty at 43% of the responding institutions reported teaching in the preclinical years of medical school, primarily in the departments of pharmacology and physiology. Forty-five percent of programs reported interdisciplinary teaching with other departments teaching classes such as gross anatomy. There is little exposure of anesthesiology faculty to medical students in other general courses. Teaching in the operating room is the primary teaching method in the clinical years. Students are allowed full access to patient care, including performing history and physical examinations, participating in the insertion of IVs and airway management. Simulation-based teaching was used by 82% of programs during medical student anesthesia clerkships. Sixty-eight percent of respondents reported that they have no formal training for their anesthesiology faculty teachers, 51% stated that they do not receive nonclinical time to teach, and 38% of respondents stated that they received some form of remuneration for teaching medical students, primarily nonclinical time. This article presents a summary of these survey results, provides a historical review of previous evaluations of teaching medical students clinical anesthesia, and discusses the contributions of anesthesiologists to medical student education. (Anesth Analg 2018;126:1687–94)

## HISTORICAL PERSPECTIVE

The challenge of identifying how and what to teach medical students about clinical anesthesia has been documented for many years. In 1954, Harbord<sup>1</sup> surveyed British anesthesiology training centers and determined that anesthesia was a requisite part of the medical school curriculum. This was deemed to be very important because medical students were expected to administer anesthesia in actual surgical cases both during medical school and after graduation. This survey from over 60 years ago questioned the proper duration of training of medical students in clinical anesthesia and the most important teaching topics to be covered. The conclusion of that manuscript was that perhaps full training should be relegated to residency. In 1963, Smith and Culler<sup>2</sup> presented their opinion of what students should be learning about clinical anesthesia at the University of California in

San Francisco. By then, anesthesia training was no longer considered a practical necessity. In fact, their view was that most medical students would not be practicing anesthesia, but that the field had important clinical elements to teach every future doctor. All students received lectures during the second year and third year about anesthetic drugs, ventilation, and other general topics. It was not until the final year, as an elective experience, that students received any practical experience in the clinical arena. Medical students attended dog laboratory where they learned to administer drugs and monitor their "patients." The operating room (OR) experience with human patients concentrated on the competency of medical care of patients under anesthesia. This model, minus the dog laboratory, is still very much in practice today. In 1975, Rosenberg<sup>3</sup> provided an opinion regarding what anesthesiologists could/should teach students. This included airway management and cardiopulmonary resuscitation (CPR) procedures, preoperative and postoperative critical care, pain management, and OR exposure to applied pharmacology and physiology. He also suggested that simulation was a viable teaching tool to help with procedural skills and observing applied pharmacology and physiology in a safe setting. In 1999, Cheung et al<sup>4</sup> surveyed 73 anesthesia departments around the world, none in the United States. They found little consensus on what was being taught, but it included topics such as airway management, IV placement, pharmacology of anesthetic drugs,

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preoperative assessment, and basic life support (BLS). Patients and simulators were used as teaching aides. Rohan et al<sup>5</sup> developed a consensus of Irish practitioners of what should be taught. The article stated that most of the recommended content is best taught in the OR and in intensive care units (ICUs), with the addition of small group sessions for specific topics, preferably late in the medical school curriculum. More recently, Sullivan and Rollins<sup>6</sup> published the provocative idea that anesthesia teaching should be part of a longitudinal approach to medical student education. They maintained that since core curricula in medical schools are changing to the longitudinal model, anesthesia should be included in this core to train all students about what their patients require when going through surgery, the postoperative period, and critical care. In their recommended model of medical student education, students would rotate through several times a year instead of having a single, continuous exposure, with a set of cases that they had to master.

The above-quoted literature clearly states that anesthesiologists are uniquely qualified to be teachers of medical students in certain areas of physiology, pharmacology, life support, monitoring, and resuscitation. Anesthesiologists are responsible for assessing whether patients can safely undergo anesthesia and surgery. This is not done in a vacuum, but with consultations and interactions with specialists in every other area of medicine. This is teamwork with the patient at the center of the discussion. Intraoperatively applied pharmacology and physiology are apparent with every patient. The instantaneous nature of these interventions and physiological alterations is not experienced anywhere else in medicine and may be one of the most attractive aspects of the specialty to medical students. Postoperatively, anesthesiologists manage patients and initiate postoperative pain and hemodynamic management. Furthermore, anesthesiologists manage both acute and chronic pain relief, prevent postoperative pain through the administration of regional blocks, and manage critical care events, even outside of the ICU. All of these clinical activities offer unique learning experiences in clinical medicine for medical students.

Recruitment of medical students to the specialty of anesthesiology is a common reason given for continuing to teach medical students.<sup>7-17</sup> Students are provided with personal 1-on-1 attention, which they rarely receive in other clerkships, except perhaps on senior electives late in their studies. Even back in 1963, Smith and Cullen<sup>7</sup> noted that career choices were often influenced by personal attention during a rotation and the opportunity to directly participate in patient care. Watts et al<sup>8</sup> noted in 1998 in their survey of Australian departments that 94% of the students intending a career in anesthesia identified a positive role model as a reason for their choice. There is a great amount of published literature from other specialties demonstrating that clinical rotations that have good relationships with medical students attract more students into their specialties. Medical students are the future of every medical specialty. However, with the many patient assessment and clinical management skills that anesthesiologists can teach it would be folly to focus on recruitment alone. We have much to offer in the education of all future physicians, many of whom participate in aspects of perioperative medicine and would benefit from a better understanding of perioperative medical care.

There is no consensus on what subject matter should be taught to medical students. In the early 1980s, the Society for Education's Committee on Medical Student Curriculum circulated a sample curriculum for 2- or 4-week rotations. It included pharmacology, physiology, and procedural topics as suggested by various committee members. Since then, the literature has included consensus statements such as those of Rohan et al<sup>5</sup> from Ireland, but currently, there is no universally agreed on curriculum in the United States. Thus, we sought to determine what is being taught with respect to clinical anesthesia to medical students in the 133 US medical schools by conducting a survey.

## METHODS

A 51-question survey (see Appendices 1 and 2) was developed, guided by a search of the literature to collect information regarding the teaching practices for medical students during anesthesia clerkships.<sup>5,6,14,19-23</sup> The questions were developed by the author based on years of clinical anesthesia teaching experience with medical students. Several senior anesthesiology faculty evaluated the questions for formatting and clarity. The number of questions was optimized to collect the desired data while avoiding respondent fatigue that would jeopardize survey completion. Contact information of clerkship directors was obtained from the Accreditation Council for Graduate Medical Education (ACGME) list of program directors for its 133 accredited anesthesiology programs. Contact information for the director of medical student education was obtained via e-mail from each anesthesiology program director resulting in the identification of 125 medical student education directors. After institutional review board approval, these 125 directors were sent a survey to fill out via SurveyMonkey® (SurveyMonkey, San Mateo, CA) and the rate of survey completion was increased by follow-up e-mails and phone calls.

## RESULTS

After follow-up e-mails and phone calls, 85 responses were obtained from the 125 medical student clerkship directors, 79 of which were complete. The results were from 35 states, with a concentration from the northeast (29), where most of the medical schools in the country are located, but they included respondents from all geographical areas. Demographics, such as the size of the residency and the size of the medical school classes, were given by 84 of the programs. Seventy-seven programs (92%) responded that they were involved with medical student teaching, while 7 programs responded that they had no clinical anesthesia teaching in the medical school curriculum. The programs ranged in size from 12 to 120 residents. Of the 77 programs involved with teaching, 39 (50%) reported contact with students during the preclinical years and 68 (88%) reported contact in the clinical years (Figure 1A). Only 12 (16%) programs reported required courses. Most programs offered electives, and 55 (65%) programs reported attempts to increase their presence in the curriculum, but encountered resistance, most commonly due to lack of time in the curriculum (Figure 1B).

Teaching in the preclinical years was primarily via lectures (79%) (Figure 2), the most common topics of which

Figure 1. Exposure and barriers to medical students. A, Anesthesia faculty have contact with medical students throughout the 4-year continuum. Most of the contact is within the final 2 clinical years. B, Most departments have tried to increase the anesthesia presence in the medical school curriculum. Barriers to this have been encountered, the most common being "no time in the curriculum." However, a lack of interest and support from anesthesia departments themselves were also a factor.

Figure 2. There are many teaching techniques used in the preclinical years. The most commonly used is the traditional lecture, followed by small group sessions, full-body simulators, and PBLDs. Preclinical students are rarely given live patient access through simulation or the operating room. PBLDs indicates problem-based learning discussions.

were pharmacology (54%) and physiology (26%) (Figure 3). Programs used small-group teaching (61%) such as problem-based learning discussions (PBLDs) and OR teaching (21%) for teaching students, but details on subject content were not provided. Full-body simulators were used by 15 (40%) programs, and 7 programs (18%) used live patient simulation. With respect to other medical school courses, 27% of programs had faculty involved with teaching BLS

and 43% with advanced cardiac life support. There was very little other teaching involvement in the preclinical years.

The length of the medical student anesthesia clerkship rotations varied, 37 (47%) having 4-week programs, 35 (44%) having 2-week programs, and 15 (19%) having 1-week programs. Fifty-three (66%) of these clerkships were elective and were available to both third- and fourth-year students. A wide range of teaching techniques was used (Figure 4A), including OR teaching (97%), lectures (83%), small group sessions (62%), and full-body simulators (57%). Lecture teaching topics included pharmacology, patient assessment, and acute and chronic pain management (Figure 4B). Small group sessions included airway management, peripheral and central line placement, and applied respiratory and cardiovascular physiology. Seventy-three percent of programs offered >1 student clerkship, and 37% offered at least 3 different clerkships such as OR, pain, and ICU. All programs offering clinical clerkships included clinical exposure in the ORs. ICUs and pain service clerkships were primarily 4-week sessions offered to senior students.

All the programs with clinical clerkships allowed patient contact. Students were allowed to perform histories and assessments, physical examinations, and were involved in IV placement, mask ventilation, and endotracheal tube and supraglottic airway device placements (Figure 5). Simulation was used in 46 (57%) programs with student learning on full patient simulators. Fifty-three (65%) programs use airway head mannequins, and 25 (30%) programs use IV practice hands. Students spend 1–3 hours per rotation on simulators throughout the rotation.

Approximately 50% of student teaching was performed by faculty and 50% by anesthesiology residents. Fifty-five (69%) programs reported that they do not train their teachers at all (Figure 6A). Of those that do, 16 (20%) have teaching workshops and 18 (22%) have teaching lectures. Thirty-six (46%) programs report no funding for teaching students (Figure 6B). Forty-one (51%) programs reported giving nonclinical time for teaching as remuneration (Figure 6C). Twenty-nine (38%) programs said that they received no remuneration for their teaching, but of those, 2 (6%) reported receiving nonclinical time and 1 (3%) received promotions.

Forty-eight (60%) programs perform testing of the medical students' acquisition of clinical anesthesia knowledge during the clerkship, primarily by the administration of multiple-choice examinations. Twenty-three (28%) programs grade pass/fail, and 48 (61%) programs grade honors/pass/fail.

## DISCUSSION

The primary results of this study demonstrated that there is a great deal of clinical anesthesia teaching of medical students being provided, but there is little uniformity in the approach and content and many barriers, some external and some within anesthesiology departments. The why, what, where, when, and how anesthesiologists should be involved in medical student teaching are discussed.

### Why Should We Be Teaching Medical Students?

This survey did not ask that specific question. Medical students are no longer expected to be the primary administrators of anesthetics.<sup>1</sup> However, the literature supports

Figure 3. Anesthesiologists are involved in the teaching of many topics in the preclinical years. They can be grouped into 5 subject areas: pharmacology, physiology, patient care, communication, and professionalism. Pharmacology encompasses the most topics. NMB indicates neuromuscular blockers.

Figure 4. Teaching techniques and topics taught. A, Teaching in the clinical years focuses on direct patient care with operating room teaching being the primary technique for most departments. Lecturing and small group teaching are still prevalent with full-body simulators, bedside teaching, and PBLDs making up most of the rest of the techniques used. B, Lecturing topics include pharmacology, patient assessment, and acute and chronic pain management. These are the topics in which all doctors need to be well versed, not just anesthesiologists. PBLDs indicates problem-based learning discussions.

at least 3 reasons for teaching medical students. The first is for recruitment. Students are the future of our specialty, and without constant physician replenishment, anesthesiology risks becoming the realm of nurses and technicians with no research, no advancement, and decreased patient

Figure 5. All programs allowed students to have physical contact with patients. This chart shows the wide range of procedures that students can be involved with, including IV placement, CVPs and arterial line placement, ventilation, and nerve blocks, both peripheral and neuraxial. Perhaps more importantly, students are involved in history taking and assessment as well as physical examinations. The rotations highly emphasize these last 2, not just invasive procedures. CVP indicates central venous pressure; ET, endotracheal tube; IV, intravenous; SAD, supraglottic airway devices.

safety.<sup>21,24</sup> Students exposed to anesthesia are more likely to consider it as a career choice, and this appears to be true worldwide.<sup>7,11–13,16,17</sup> However, no study has shown that required anesthesia rotations actually do increase recruitment. Several years ago, the author ran a very informal survey which consisted of calling 4 schools that seemed to have the highest percentage of their medical school class choosing careers in anesthesia. The answers ranged from a highly organized system of preclinical lectures, required clerkships, elective time, and extracurricular activities to “We don’t do anything at all!” The best seems to be whatever works for an individual department. This survey did not ask about a relationship between teaching students and recruitment into the specialty. But a follow-up with those who answered the survey got responses from 33 programs. There seemed to be no correlation between whether students had preclinical exposure to anesthesia or whether the clinical exposure to anesthesia was elective or required. There was an overall

including elements of pharmacology, physiology, basic patient care, and procedural skills. With today's intensive residency and fellowship training, it is important that the content of clinical anesthesia teaching includes elements that are of value to all students. The Liaison Committee for Medical Education (LCME) has stated that students should be taught within the framework of 6 competencies: medical knowledge, patient care, practice-based learning, communication and interpersonal relations, professionalism, and system-based learning. "LCME accreditation is a voluntary, peer-reviewed process of quality assurance that determines whether the medical education program meets established standards."<sup>25</sup> A full cycle of accreditation is 8 years. It is common for curricular problems to be uncovered during the review process. These are perfect opportunities to offer to help the medical school in the form of curricular courses if the problems are within the realm of expertise of anesthesia. A consensus within our specialty with what could/should be taught would make this much easier for interested parties to do, realizing that every institution has different goals, facilities, and abilities. Based on this survey of what is being taught, pharmacology and physiology are the obvious subjects for anesthesiologists to teach. Applied pharmacology, physiology, and anatomy with clinical correlations may be even better ways to teach students these areas of medical knowledge. Pain management and critical care skills are often lacking in the curriculum, as well as solid procedural skills (medical knowledge and patient care). Airway management, peripheral, arterial, and central lines, ultrasonography, and even echocardiography are skills of which all students need to have a good knowledge base. Anesthesiologists use these tools daily in and out of the OR and are ideally suited to teach them to students. Every patient encounter presents the opportunity to apply practice-based and systems-based skills to patient care. Each patient comes to surgery with differing comorbidities that must be considered when planning the anesthetic management, so again 2 competencies can be taught. An OR is a perfect learning environment for team work,<sup>26</sup> with the patient at the center of the team activity and communication and good interpersonal interactions among surgical, anesthesia, and nursing groups paramount for good outcomes. Role modeling happens all the time, whether we recognize it or not.<sup>27</sup> Explaining anesthetic procedures to anxious patients, reassuring them about their care, and calming patient families about critically ill ICU patients are daily activities of most anesthesiologists. We have the opportunity to model exemplary behavior while caring for patients which students observe<sup>27</sup> (professionalism and communications and interpersonal relations). In fact, all the core competencies are covered within these clinical opportunities to teach medical students clinical anesthesia.

### Where Should We Be Teaching?

The survey shows that the OR is where most clinical teaching is done. Videos, lectures, and small group sessions are valuable teaching tools but cannot compare to the "teachable moment" such as can be experienced in the clinical arena. This includes professionalism precepts.<sup>28</sup> Students rarely get the attention from teachers that they receive in the OR. In terms of absolute knowledge acquisition, however,

Figure 6. There continues to be little support for faculty who teach medical students. A, Few programs provide faculty teacher training of any sort. B, Funding support for teaching is primarily from departments, not the medical school or the hospital. C, A little more than half of faculty teachers are compensated for their teaching of students, primarily through nonclinical time. Promotions, which come through the school, are provided to some, particularly those schools that have educator promotion tracks.

6%–7% of the graduating classes selecting anesthesiology as a specialty (range 3%–12%). A second reason to teach is to influence student attitudes toward anesthesia. All physicians are likely to have patients who will need our skills in the perioperative and ICU environments. Not only do students need to know what we need to know to best care for their patients, but they need to view us as colleagues worthy of their respect.<sup>24</sup> Finally, there is a body of knowledge that all physicians should have and anesthesiologists may be in the best position to teach some of it. This leads to the consideration of what we should be teaching.

### What Should We Be Teaching?

This survey showed that there are many different topics being taught to medical students across the country,

there are studies suggesting that full-body simulators, using fewer faculty resources, may be better tools for teaching medical students.<sup>29</sup> Also, OR teaching can be stressful even under the best circumstances as patient vigilance must be maintained.<sup>30</sup> When the patient is unstable, the opportunity arises to show professional, calm behavior in the face of adversity. However, teaching of students should not be limited to the clinical years. Early in the curriculum, there are opportunities to teach basics of pharmacology and physiology that can then be reinforced when students come to the clinical arena. Though lecturing and small group sessions may be the teaching techniques of choice in the preclinical years,<sup>31</sup> simulation presents even more opportunities. These range from computer-based and online programs that teach pharmacologic and physiologic principles to IV and airway mannequins to full patient simulators that help with crisis management and learning drug effects on patients in a safe environment. There students can hone procedural skills before working on patients. Students find this last approach a good exercise,<sup>29,30,32</sup> and it also builds their confidence. It remains to be seen whether patient outcome is affected.<sup>29,33–38</sup> Small group sessions can be run at any time throughout the 4 years to cover a myriad of subjects. Serafini and Palmer<sup>22</sup> published an innovative model for preclinical exposure allowing preclinical students to work in the ORs and gain early knowledge of airway management, IVs, and OR pharmacology.

The general clinical content and procedural skills taught to medical students during clinical clerkships have international similarities as shown by Hoffman et al.<sup>39</sup> who demonstrated that anesthesia clerkship content in Germany was similar to that in US medical schools.

### When Should We Be Teaching Students?

The answer to this question depends on the objectives of the teaching. For recruitment purposes, the earlier the better. No study has ever shown that required clerkships are superior to elective exposure with respect to recruiting, but it appears evident that competing specialties would influence student choices as soon as possible. However, the literature presents varied evidence on this topic.<sup>3,5,40</sup> This survey suggests that teaching is going on throughout the medical school continuum, but primarily in the clinical years. The “where” section shows that the “when” is also dependent on “what” is being taught.

### How Should We Teach Students?

This survey shows that lecturing, small group sessions, flipped classrooms, PBLDs, and hands-on workshops have been used in both the preclinical and clinical years for teaching pharmacology, physiology, procedures, anatomy, and team work. The literature also supports this.<sup>41,42</sup> Many medical schools run small group sessions with students on patient care topics in which anesthesiologists could participate. If a department has the luxury of having a clerkship, it is imperative that the involved faculty are interested in teaching and enthusiastic about the specialty. Residents are often the primary teachers of students, but faculty should be recruited as well, representing the “master clinician” with a long-term perspective of the critical role of the specialty. Small group sessions can work well if the apprenticeship

model is too labor intensive, but enthusiasm and skill of the teachers are the most critical tools. Exposure to the academic side of our specialty can be further enhanced by medical student participation in research projects such as the Foundation for Anesthesia Education and Research summer scholars program in basic or clinical research.<sup>43</sup>

Simulation has become a significant tool in teaching medical students.<sup>34–36</sup> Anesthesiology departments were the first to develop and adopt simulators as training tools, and the utilization in medical education has grown exponentially. Simulation is an expensive investment in time, money, and faculty to develop and execute scenarios, but is a worthy tool to consider. Simulation can be simple or complex and can be done in conjunction with hospitals and/or other departments. Simulation can be used to teach pharmacologic and physiologic principles without interfering with patient care and can be used to teach clinical skills as well as teamwork among different departments. Simulation can be used as the primary “teacher” for remediation, as well as for assessment, and is a great recruitment modality for anesthesia residencies.

### Faculty Support

Perhaps the most startling information in this survey is the perception of a lack of training and support available for medical student teachers. In fact, although 29 (38%) said that they received no reward for teaching, 2 of those programs said that they received nonclinical time, one said that promotions were awarded for teaching, and 47 (62%) of all programs said that they were rewarded. There does appear to be little training, little funding, and little time given to this effort. This creates an additional challenge of how to motivate disinterested colleagues into becoming involved in this critical area.<sup>43</sup> The teaching of students is often relegated to the youngest, least-experienced faculty members. Traditionally, faculty do not see medical student teaching as a pathway to promotion, so faculty involvement may be short lived and they may not make the necessary effort to optimize the student experience. Faculty rarely receive the necessary protected time to devote to medical student education, as reported by 41 (51%) of programs in this survey, such that the successful teaching faculty are typically self-motivated by the love of teaching and the specialty. One likely explanation is that time is money and teaching does not generate any revenue.<sup>24</sup> In fact, there is a financial cost to departments as potential clinical time is devoted to teaching. Medical student teaching has generally been a voluntary exercise in all specialties. Private practitioners volunteer their time and offices to teach and show students what medicine outside the academic medical centers entails. In academic centers, where most anesthesia student teaching occurs, faculty volunteerism is in fact the typical way teaching medical students occurs.<sup>44</sup> Teaching in the ORs is added on to clinical duties and could be distracting.<sup>45</sup> Nonclinical time to teach is a precious and expensive commodity, and as clinical work becomes more demanding and “free time” becomes a luxury, there is less incentive to volunteer. The truly disinterested should be kept away from students as they may end up being negative influences. For all

others, nancial incentives may work. Some programs pay faculty for resident lectures, so perhaps this could be considered for student lectures. Faculty performance as delineated by student evaluations is also an important criterion for faculty promotions.<sup>46–49</sup> Training of faculty, including residents, is an excellent approach to improve teaching and to provide incentives to expand teaching. The experienced and successful teacher is more effective and receives more self-grati cation for their efforts. The future holds some promise in this area. Many schools now have teaching tracks as paths for promotion.<sup>46</sup> As a result, many schools have faculty development programs that work in this area, particularly in small group teaching, feedback, and assessment. As residents are often the primary teachers of students, the LCME is now insisting on education training for resident teachers of students,<sup>50</sup> which has the added bene t of training potential future faculty members.

## CONCLUSIONS

One of the most notable results of this survey was the very high response rate (69%). There was a concerted effort made to capture all available data through repeated e-mails and phone calls. Those that answered revealed what I, the author, have noted in many years of interacting with faculty involved with teaching students: we are a dedicated and enthusiastic group.

In summary, teaching medical students clinical anesthesia is an important and rewarding task. This survey provides some important insights into the subject and illuminates areas of opportunity for further development. **E**

## APPENDIX 1

To see the full survey as participants saw it, please use the following link: <https://www.surveymonkey.com/r/3LPQ9VP>.

## APPENDIX 2

To see the complete list of answers to the survey, please use the following link: <https://www.surveymonkey.com/results/SM-7MVSYTJJ8/>.

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## DISCLOSURES

Name: Saundra E. Curry, MD.

Contribution: This author performed the study and wrote the manuscript.

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