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Original Research

Virtual Anesthesiology Medical Student Learning Program Pilot Designed in Response to COVID-19

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Introduction

The Coronavirus disease 2019 (COVID-19) pandemic caused a series of unprecedented ripple effects throughout every aspect of society, including the state of medical education in the United States. The nature of the pandemic led the American Association of Medical Colleges (AAMC) Coalition for Physician Accountability to publish guidelines suggesting a suspension of clinical rotations for medical students.[1,2] Rotations were suspended for the 2020-2021 academic year and students were permitted 1 rotation out of their institution in the 2021-2022 academic year.[1] Approximately 80% of medical schools do not require an independent anesthesiology rotation,[3] leading many students interested in anesthesiology to rely on elective rotations to gain insight into the specialty, work with mentors, obtain letters of recommendation, and develop clinical skills. Rotations outside of one's home institution are important for students looking to evaluate whether a residency program's culture and environment align with their own personal and professional goals. Students who are at an intrinsic disadvantage in the process, such as international medical graduates or those without home anesthesiology residency programs, also benefit from completing rotations outside of their institution to explore programs they are interested in and form interpersonal relationships with residents and leadership at these programs.[4] During the onset of the COVID-19 pandemic in March 2020, anesthesiology residency applicants for the 2020-2021 Match season were at the forefront of applying for clinical rotations outside of their home institutions in preparation for the fourth year of clinical education in medical school. Many institutions participate in the AAMC Visiting Student Learning Opportunities (VSLO) program to review applications for visiting student rotations. The AAMC VSLO program applications open in March of each academic year for third-year medical students to apply for rotations to be completed in their fourth year of medical school, which put students applying for the Match 2021 in a difficult position to gain experience outside of their home institutions and stand out against other applicants at programs they were considering.[4] This is a critical time in the application timeline for students to explore programs they may be interested in and apply for rotations to increase face time with institutional leadership and residents. In the 2021-2022 academic season, AAMC VSLO also limited students to 1 visiting rotation, again limiting exposure to programs and institutional cultural experiences.[5]

With these challenges in mind, we designed the Virtual Preoperative Call to be a virtual asynchronous and synchronous problem-based curriculum for medical students interested in anesthesiology. The program aimed to provide experience designing preoperative anesthetic plans, as well as to interact with anesthesiologist preceptors. We sought to identify if the Virtual Preoperative Call program was a valuable educational tool and whether it provided medical students with a useful opportunity to gain experience about an institutional culture through discussion with program directors and future colleagues using a survey. This study was deemed exempt by the Institutional Review Board (IRB) at Partners Healthcare (Protocol #: 2020P002351) and the requirement for written informed consent was waived by the IRB.

Methods

Aim

The Virtual Preoperative Call program was designed to provide an interactive educational anesthesiology curriculum for interested medical students, as well as provide an opportunity to learn more about an institutional culture through a question and answer (Q&A) with a program's faculty. This program aimed to expose medical students in the 2020-2021 application cycle to a simulated, structured, virtual preoperative call that was designed in response to COVID-19 quarantine restrictions. Each session included a discussion of preoperative examination, independent creation of an anesthetic plan, and troubleshooting in the operating room.

Recruitment and Registration

Recruitment of participants and faculty preceptors to join a Virtual Preoperative Call session was done through social media platforms, such as Twitter, as well as the American Society of Anesthesiologists (ASA) Medical Student Component

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webpage and newsletter. For example, using Twitter, we posted a tweet describing the Virtual Preoperative Call Program. This tweet received more than 17 000 impressions (views) (Figure 1). To make sharing the program sign-up easier, we created a shortened custom uniform resource locator (URL) using Bitly Inc (New York, NY).

Participant recruitment was conducted in July 2020, following the shutdown of clinical rotations in March 2020 (Figure 2). Faculty were recruited through a sign-up form similar to the medical student recruitment method. Medical students entering their fourth year of medical school throughout the United States, as well as fourth-year international medical graduates, were recruited to participate in this program. Recruitment methods aligned with the National Resident Matching Program code of conduct for medical students and program directors.[6] This indicated that there were no violations between anesthesiology residency programs and applicants regarding inappropriate communication or recruitment during the 2020-2021 application season. Learning objectives included the following:

1. Facilitate active group collaboration among fourth-year medical students and teaching faculty, fellows, or residents, in working through preoperative cases.
2. Discuss important components of preoperative evaluation and clinical considerations contributing to anesthetic and perioperative plans.
3. Explore anesthetic management for a variety of surgeries.
4. Establish a better understanding of individual institutions or programs teaching methodology and overall culture.

Participants

For the 2020-2021 recruitment season, there were more than 200 students who signed up to participate. Ninety-seven students were assigned to a session on a first-come, first-served basis. Nineteen faculty preceptors from 14 different institutions staffed 16 sessions. Faculty preceptors were individuals who completed residency training in anesthesiology and who were currently practicing in an academic medical center or private practice. The medical students who signed up to participate represented more than 100 medical schools across the United States and internationally. We aimed to limit each preceptor to 3 to 4 medical students per session, with 3 to 4 faculty members per session, creating more of an intimate environment for students to get to know each other, as well as create a safe space to ask questions. The number of students and faculty varied each session based on availability and logistics around scheduling.

Program Preparation and Execution

To participate in this program, both medical students and faculty members needed the following:

1. A laptop or desktop with a webcam as well as audio and microphone capabilities
2. A Zoom Video Communications, Inc. (San Jose, CA) account
3. High-speed internet connection

Using the Zoom Video Communications, Inc. virtual platform, each session was composed of a short introduction to the program, 60 minutes of active case discussion in breakout rooms with a ratio of 3 students to 1 faculty member, and a 45-minute question-and-answer (Q&A) session with all faculty members and students to discuss the anesthetic case, residency programs, and career development. The Zoom Video Call logistics were provided to the students ahead of time, including the link and instructions for each session. Students were assigned manually to sessions based on a first-come, first-served sign-up system. Students were capped at 3 to 4 per preceptor, with 3 to 4 preceptors per session. The program was scheduled in 2-hour increments.

The case stem, a preoperative plan outline, and suggested resources were emailed to students before the call, to promote asynchronous learning through independent preparation of an anesthetic plan. The case was created by the faculty lead and reviewed by multiple preceptors who participated in the program (Appendix 1). Resources were sent out to medical students to help with the creation of their anesthetic plan (Appendix 2). In the breakout portion of the call, each student was encouraged to contribute their approach to various components of the anesthetic plan, including anesthetic type, monitors, lines, induction, maintenance, and emergence. Unanticipated intraoperative events were also presented to students to provide an additional scenario to apply their knowledge. Although each breakout room discussed the same case, each faculty member was encouraged to add their clinical expertise and approach. Faculty were given a discussion outline to help guide the student discussion of the case. This was aimed to mimic a preoperative call that one would participate in the evening before a case as a resident anesthesiologist. This part of the call lasted 1 hour.

The Q&A session followed the case discussions in 1 main meeting room, with all the student participants and faculty preceptors. We had an ASA Medical Student Component moderator who asked questions from the Zoom chat to the faculty. Most questions were related to the residency Match cycle, how to stand out as an anesthesiology applicant, and specific questions about the institutions the faculty represented. In addition, faculty members offered career development advice regarding research, fellowships, and leadership in the field. All faculty members were asked to introduce themselves, explain their journey and training in anesthesiology, as well as explain their role in their current anesthesiology department. Medical students were able to ask questions regarding specific advice on how to pursue subspecialties, inquired about program-specific questions, as well as ask about how to find mentors in anesthesiology, resources to get involved in research, and what was currently being done in the institutions represented by the faculty about diversity, equity, and inclusion in their departments. This part of the virtual experience allowed students without a home anesthesiology department to field questions related to setting oneself up for a successful career, as well as discover more information on how to match into anesthesiology.

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Evaluating Perceived Effect and Statistical Analysis

A short Likert-scale survey was sent to medical students before and after participation in a session using REDCap electronic data capture tool hosted at Partners Healthcare. Precall surveys were sent to participating students immediately before each virtual education call, and postcall surveys were sent immediately following the virtual session. We designed the survey to assess the program's self-reported effect on participants' anesthesiology knowledge, and whether the program design was successful in creating a collaborative experience while also providing a forum to explore residency programs. Data were collected between August 2020 and October 2020, during which 16 sessions were held. Change in precall expected benefits and postcall experienced benefits was quantified using repeated-measure multinomial ordinal logistics using SPSS version 26 (IBM, Armonk, NY), presented as the odds ratio (OR) of the postcall assessment exceeding precall expectations.

Results

The Virtual Preoperative Call educational opportunity was promoted to senior medical students. From 2020-2021, more than 200 medical students from more than 100 medical schools registered for the curriculum. Between August 2020 and October 2020, 97 medical students participated. There were more than 19 faculty preceptors from 14 residency programs across the United States who participated in the virtual preceptorship.

Survey Results

The reported sex of the 72 call participants who completed the precall survey was equal between men and women. All 72 survey respondents were fourth-year medical students. Of note, 76% participated in an anesthesiology elective despite only 46% having an anesthesiology program at their home institution (Table 1). Respondents predominantly responded positively (*agree* and *strongly agree*) to our statements regarding the expected benefits of the call (Table 2). In comparing the precall survey with the postcall survey, the highest OR was regarding the expected benefits of building anesthesiology knowledge (OR, 12.48; 95% confidence interval, 2.80–55.73; $P = .001$). All respondents found the call useful in building anesthesiology knowledge and networking, and 42 (86%) found the call helpful in deciding where to apply for residency. Overall, 100% of respondents found the call useful, collaborative, engaging, and important to define critical thinking skills (Table 3). Most (92%) did not find the call intimidating (*disagree* and *strongly disagree*), and of the 4 respondents finding the call intimidating, only 1 (2%) strongly felt this way.

Discussion

Program Effect

This pilot program provided an opportunity for fourth-year medical students interested in anesthesiology to create and discuss a preoperative plan, apply knowledge to intraoperative scenarios, and network with residency program faculty during a period of social distancing and cancelled rotations. Our survey data suggest participants perceived a positive effect on anesthesiology knowledge, networking skills with colleagues, and learning about residency programs before the application process. Through the program, students designed an anesthetic plan and discussed it with a faculty member. Because faculty represented 14 different programs throughout the United States, students were exposed to different institutional practices in anesthetic techniques and the rationale for approaches to a standard case. During the open Q&A period, participants received advice on the residency application season and beyond. Faculty preceptors shared experiences with their program in a more intimate setting, fielded questions from students, and provided advice regarding the interview selection process. One hundred percent of participants found this virtual education program to be useful, collaborative, and engaging, as well as helping to define important critical thinking skills, with minimal intimidation.

Although not objectively measured, a potential secondary benefit from this program was participants' experience with teleconferencing in a professional setting, which served as practice for the virtual interview format. Students at institutions without home anesthesiology departments gained exposure to anesthesiology faculty from across the country. As the COVID-19 pandemic continues to change how residency applications and interviews are structured, increasing opportunities for students to be exposed to different specialties, including anesthesiology, is desired. Virtual education may continue to supplement in-person clinical activities, skills labs, as well as problem-based learning discussions. As many residency programs move to more long-term use of virtual platforms for applicant recruitment, such as virtual meet-and-greet sessions with residents, and virtual interviews, our program may be beneficial for pursuing additional opportunities to learn about anesthesiology and residency programs. In addition, free, virtual programs provide more equitable options for students who are unable to afford to participate in multiple rotations outside of their institutions.

The COVID-19 pandemic forced medical educators and clinical faculty to design novel learning modalities. Other specialties, including urology, geriatric medicine, plastic surgery, ophthalmology, and pathology, as well as other surgical subspecialties, have created novel curricula catered toward medical students and residents in a time when educational gaps were created by pandemic restrictions.[7-11] For example, during the onset of the COVID-19 pandemic in 2020, urologists across the country adopted web-based platforms to develop a virtual lecture series to fill the gap in in-person education.[7] The American Urological Association (AUA) offers resources to students, residents, and practicing urologists to study a wide array of topics in the field, much like the ASA. In response to pandemic disruptions, the AUA developed alternative resident education activities, converted conferences to digital platforms by using telecommunication software, established virtual grand rounds, and created other novel collaborative online didactics.[7] Similar to our virtual curricula, the novel virtual education initiatives within the AUA promoted networking and provided opportunities for participants to actively communicate in discussions at the end of each lecture, fostering a sense of community and camaraderie. With the

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cancellation of several national conferences, the virtual education series allowed trainees to gain new exposure to faculty outside of their home institutions and tailor their educational experience to their interests, making lectures and discussions more engaging.

In addition, other advancements in e-learning also prevailed during the COVID-19 pandemic. The University of Pennsylvania created a 2-week virtual geriatrics elective for clerkship students to meet the increased demand for both online learning and geriatric education.[8] Specific teaching modalities used in this program included virtual case-based learning, multimedia, such as articles, podcasts, review material supported by discussion posts, small group assignments, large group meetings, and phone interviewing clinical skills work. A 5-point Likert-scale survey via Qualtrics was completed to assess this program's effectiveness. Of the total number of students (n = 34), 67.6% of students responded (n = 23), with 95.6% of respondents agreeing that the course was well organized, and the program objectives were clear.[8] They also used a designated Canvas discussion board for real-time feedback throughout the course, including any technical difficulties, which were overall positive comments about the virtual elective. Overall, this virtual course made students feel more prepared to care for older adults by increasing their appreciation of geriatric principles. Although our program did not include direct student feedback, this could be done in the future to gather intentional changes or adaptations students would want to see for future iterations of our program.

When the AAMC announced the strong recommendation to pause in-person rotations, the American Council of Academic Plastic Surgeons issued statements recommending the cessation of all rotations and interviews for the foreseeable future.[12] This afforded them the opportunity to create a virtual subinternship to bridge the gap between programs and applicants during this crucial time in their training.[9] The educational framework consisted of modules, videos, standardized anatomic atlases, and surgical preparation tools, followed by standardized journal article discussions, quizzes, and finalized clinical scenarios. This virtual rotation provided clinical and operative learning, didactics, the opportunity for faculty mentorship and professional development, as well as assessing a mutual personality fit between the program and student rotator.[9] To their knowledge, this was the first creation of a virtual subinternship for rising fourth-year medical students interested in this surgical subspecialty.

Program Feasibility and Adaptation

Although the COVID-19 pandemic disrupted the traditional structure of medical education, it offered an opportunity to design and implement unique virtual learning opportunities for medical students and residents. Our virtual education program provides exposure to anesthesiology and could supplement current medical school curricula that typically lack formal rotations in the specialty. The format of our program also could be adopted for use by other specialties interested in providing a virtual learning experience for students. The most significant limitations to the program's widespread feasibility and adaptation were maintenance of faculty volunteers to run each session and the creation of clinically relevant cases for discussion. With the widespread use of virtual videoconferencing platforms, such as Zoom, virtual education programs, such as ours, can be implemented easily. The use of new educational technologies and the reevaluation of traditional learning mechanisms have provided opportunities for medical schools to enhance and supplement their current education models.

Limitations

A total of 72 of the 97 participants (74% response rate) responded to the precall survey, and 49 of the 72 (68% response rate) precall survey respondents also completed the postcall survey. Only individuals who completed the precall survey received the postcall survey. Results do not include an objective measure of educational value. Our results may have been influenced by selection bias based on the survey tool and how the questions were written. Respondents who were satisfied with the program were more likely to respond to the survey. In addition, these results may have been affected by response bias, as the survey tool used was not validated and created to evaluate this program. Other limitations of this program included the bandwidth to accommodate every medical student who signed up for a specific session. With a limited number of faculty preceptors, not every medical student was able to participate in a preoperative call. More than 200 medical students signed up, with only 97 being accommodated to a session. Increasing the pool of available faculty is one improvement that could accommodate more students. Faculty preceptors also brought a variety of clinical experiences and perspectives to each clinical case. For some, this may be a limitation regarding the specific education that was provided during each preceptor session. However, faculty preceptors were given a clinical guide to each case to structure the educational aspects around key points encountered throughout the discussion of the case.

Conclusions

The Virtual Anesthesiology Medical Student Learning Program was piloted during the COVID-19 pandemic and designed to give fourth-year medical students interested in a career in anesthesiology the opportunity to design and create patient-specific anesthetic plans, while also engaging in discussions with anesthesiology residency program faculty for advice on the residency application season. We hope to continue this program during future anesthesiology residency recruitment seasons and aim to expand the program in the upcoming years by increasing the number of participating faculty, the number of available sessions, and the variability of discussed cases. Future iterations of this program could also be hosted by other programs with shared central resources or modified and performed in other medical specialties.

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Abstract

Background: This learning opportunity was designed to provide an interactive, virtual, educational anesthesiology program for interested medical students and to offer an opportunity to learn more about an institutional culture through a question and answer (Q&A) with program faculty preceptors for the 2020-2021 anesthesiology residency application cycle. We sought to identify if this virtual learning program was a valuable educational tool through a survey.

Methods: A short Likert-scale survey was sent to medical students before and after participation in a session using REDCap electronic data capture tool. We designed the survey to assess the program's self-reported effect on participants' anesthesiology knowledge, and whether the program design was successful in creating a collaborative experience while also providing a forum to explore residency programs.

Results: All respondents found the call useful in building anesthesiology knowledge and networking, and 42 (86%) found the call helpful in deciding where to apply for residency. Overall, 100% of respondents found the call useful, collaborative, engaging, and important to define critical thinking skills.

Conclusions: The framework used for this program—virtual asynchronous and synchronous problem-based learning—can be applied broadly with potential benefit to medical student participants challenged by the cancellation of clinical rotations.

Keywords: Medical education, virtual learning, anesthesiology, residency

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Figures

Figure 1. *Tweet recruiting participants for the virtual learning program.*

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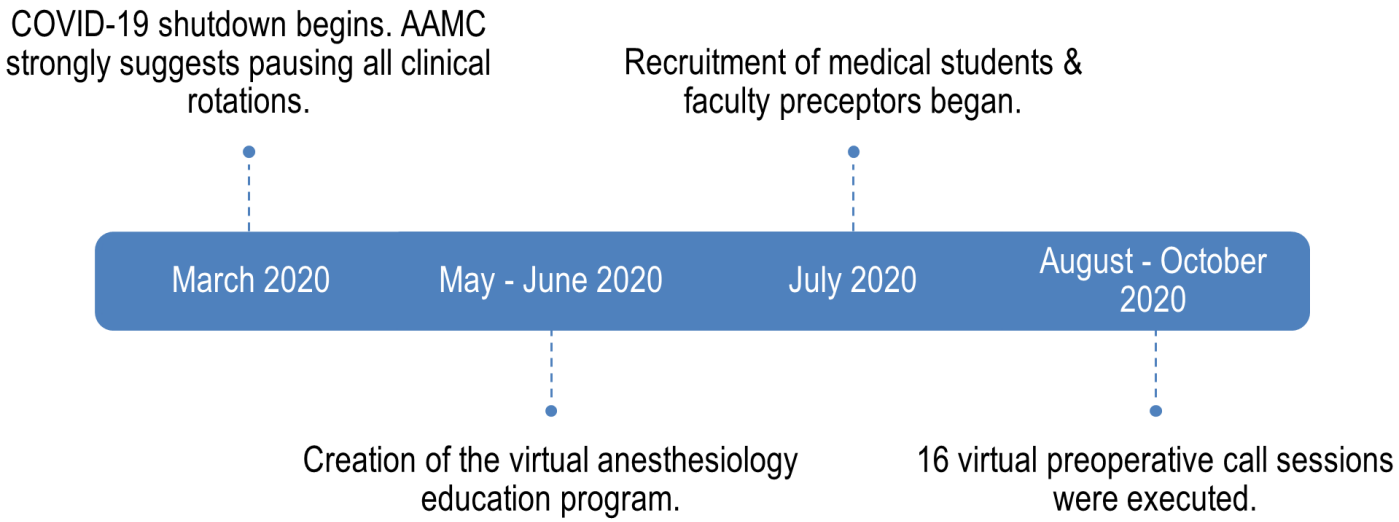
Figures *continued*

Figure 2. *Virtual learning recruitment and program timeline.*



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Tables

Table 1. *Program Participant Characteristics Before and After Program*

	Before Program (n = 72)	After Program (n = 49)
	No. (%)	No. (%)
Sex		
Men	36 (50)	28 (57)
Women	36 (50)	21 (43)
Home Anesthesiology Program		
Yes	33 (46)	21 (43)
No	39 (54)	28 (57)
Participated in Anesthesiology Elective		
Yes	55 (76)	39 (80)
No	17 (24)	10 (20)

Table 2. *Expected and Experienced Benefits of the Program*

	Strongly Disagree, No. (%)	*Disagree*, No. (%)	*Agree*, No. (%)	*Strongly Agree*, No. (%)	Increased Score OR	*P* Value
This program will be/was beneficial for building my anesthesiology knowledge.						
Before	0 (0)	0 (0)	17 (35)	32 (65)	12.48 [2.80-55.73]	0.001
After	0 (0)	0 (0)	2 (4)	47 (96)		
This program will be/was helpful for networking.						
Before	0 (0)	2 (4)	19 (39)	28 (57)	1.96 [1.02-3.75]	0.042
After	0 (0)	0 (0)	14 (29)	35 (71)		
This program will be/helped decide where to apply for residency.						
Before	1 (2)	7 (14)	26 (53)	15 (31)	1.72 [1.07-2.76]	0.025
After	1 (2)	6 (12)	19 (39)	23 (47)		

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Tables *continued*

Table 3. *Qualitative Assessment of the Program*

	***Strongly Disagree*, No. (%)**	***Disagree*, No. (%)**	***Agree*, No. (%)**	***Strongly Agree*, No. (%)**
I felt intimidated by the simulated call.	21 (43)	24 (48)	3 (6)	1 (2)
I felt engaged during the simulated call.	0 (0)	0 (0)	4 (8)	45 (92)
This session stimulated critical thinking.	0 (0)	0 (0)	5 (10)	44 (90)
This was a collaborative experience.	0 (0)	0 (0)	10 (20)	39 (80)
I will use this experience in my future practice of anesthesiology.	0 (0)	0 (0)	8 (16)	41 (84)

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Appendices

Appendix 1. General Surgery

A 25-year-old, 90 kg, 5'2" woman is scheduled for an elective laparoscopic cholecystectomy with Dr. Smith in OR 37. She is a current smoker. She has had an appendectomy in the past and notes that she had profound nausea after the procedure. She had a rash from penicillin as a child. Otherwise, on review of systems, she admits to frequent use of antacids for heartburn. When formulating your plan, ensure you have ideas for the following items:

- Anesthetic technique
- Monitors
- Lines
- Induction
- Maintenance
- Emergence
- Intraoperative considerations/complications based on surgical approach

Hints:

- What testing would you ensure is ordered for the day of surgery?
- What will you do to address her trouble with nausea?

Stanford Preop Assessment Template: http://ether.stanford.edu/ca1_new/Preop-template.pdf

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Appendices *continued*

Appendix 2. Resources for Student Anesthetic Plans

Virtual Pre Op Call

Resources for Designing an Anesthetic Plan

Goals

1. To practice researching an appropriate anesthetic plan
2. To practice identifying potential adverse events associated with a procedure

Free Online Resources

Stanford Pre Op Assessment Template: A cheat sheet to record a patient's relevant history and jot down an anesthetic plan.

Stanford CA-1 Anesthesia Handbook: A broad overview of many subjects relevant to anesthetic practice (designed for 1st year anesthesia residents).

Countbackwardsfrom10.com: Educational videos from MGH Critical Care Fellow, Dr. David Convissar.

OpenAnesthesia: A site sponsored by the International Anesthesia Research Society and dedicated to free/ open-access anesthesia resources.

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Appendices *continued*

Textbook Resources*

*Amazon affiliate links

Pocket Anesthesia (Pocket Notebook Series): Text designed by BWH which has quick evidence-based references to many anesthetic topics.

Clinical Anesthesia Procedures of the MGH: Text designed by MGH which has quick protocols for how cases are done.

Morgan and Mikhail Clinical Anesthesiology: Considered to be one of the fundamental anesthesia textbooks.

Miller Basics of Anesthesia: Considered to be one of the fundamental anesthesia textbooks.

Anesthesiologist's Manual of Surgical Procedures: A textbook focusing more on specific surgical steps and anesthetic management.

Essential Anesthesia: From Science to Practice by Euliano & Gravenstein: A lighter read than most traditional textbooks, providing understanding of anesthesiology to medical students and early learners.

Potential Medical School Resource

AccessAnesthesiology: many library and hospital system libraries provide institutional access to this resource which has many anesthesiology textbooks, including Morgan & Mikhail and Longnecker (another comprehensive anesthesia textbook)