

Forensic Autopsy Experience and Core Entrustable Professional Activities: A Structured Introduction to Autopsy Pathology for Preclinical Student

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Abstract

The forensic and autopsy pathology service within the Department of Pathology at University of North Dakota School of Medicine provides an optional, structured autopsy experience for medical students during the second year of the curriculum. This experience reinforces forensic autopsy pathology as the practice of medicine and highlights the American Association of Medical Colleges Core Entrustable Professional Activities. Students self-select for this optional, noncredit autopsy observership. Prior to the experience, interested students participate in a session that reviews the professional and educational expectations of the autopsy experience, autopsy safety training, and logistics of call. Groups of up to 4 students are on call for an autopsy. Student groups observe and participate in an autopsy, ideally from scene through autopsy performance, slide review, and toxicology results. The student groups use a structured presentation format for summarizing their autopsy experience, forming a differential and final diagnosis, completing the death certificate, and discussing quality management or learning issues in the case. At the end of the semester, all students participating in the experience meet and each group presents a 10-minute, structured review of their case. At least 6 core entrustable professional activities were addressed in every autopsy review; some had more when advanced clinical questions or safety issues were identified. Additionally, one student presented his case at a national meeting with a resultant publication. The experience provided (1) a positive introduction to autopsy pathology, (2) reinforced the role of pathology in medicine, and (3) provided concrete examples of American Association of Medical Colleges Core Entrustable Professional Activities within pathology for students in preclinical years.

Keywords

autopsy, entrustable professional activities, forensic pathology, medical education, preclinical autopsy rotation

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Introduction

In May 2014, the American Association of Medical Colleges (AAMC) published new core guidelines, “Core Entrustable Professional Activities for Entering Residency” (Core-EPA’s) that all medical students should be able to perform upon entering residency training, regardless specialty practice (<https://www.aamc.org/initiatives/coreepas/>). As presented in Table 1, these 13 core competencies cover the basic skills and

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Table 1. American Association of Medical Colleges Core Entrustable Professional Activities (Core-EPA's).

EPA 1: Gather a history and perform a physical examination
EPA 2: Prioritize a differential diagnosis following a clinical encounter
EPA 3: Recommend and interpret common diagnostic and screening tests
EPA 4: Enter and discuss orders and prescriptions
EPA 5: Document a clinical encounter in the patient record
EPA 6: Provide an oral presentation of a clinical encounter
EPA 7: Form clinical questions and retrieve evidence to advance patient care
EPA 8: Give or receive a patient handover to transition care responsibility
EPA 9: Collaborate as a member of an interprofessional team
EPA 10: Recognize a patient requiring urgent or emergent care and initiate evaluation and management
EPA 11: Obtain informed consent for tests and/or procedures
EPA 12: Perform general procedures of a physician
EPA 13: Identify system failures and contribute to a culture of safety and improvement

knowledge base of a physician and provide a framework for assessment and learning across all specialties of medicine.

The University of North Dakota School of Medicine and Health Sciences (UNDSMHS) Pathology department provides an optional and structured autopsy experience for the second year medical students. The objective of this article is to describe this activity and processes for utilization by other pathology departments. Of the 13 AAMC Core EPA's, 7 are readily introduced through structuring of the autopsy experience. Depending on particular autopsy case features, all 13 Core EPA's may be relevant. An important component of the experience was a case presentation of the observed autopsy utilizing a structured presentation format. This required format maximized the opportunity to illustrate EPAs using the autopsy setting. Finally, the experience was designed to provide positive role models of active clinical practice of pathology and an introduction to professional activities in pathology outside of the traditional sophomore classroom. The structured autopsy experience provided (1) a positive introduction to autopsy pathology, (2) reinforced the central role of pathology in medicine, and (3) provided concrete examples of Core EPAs within pathology for students in preclinical years.

Materials and Methods

Autopsy Experience

The experience consisted of observing an autopsy from the combined consented (hospital and private autopsy) and forensic autopsy service within our department. Roughly 85% of cases were forensic autopsies; the remainder were equally split between private, family requested autopsies and hospital requested, family consented autopsies. A pre-experience orientation meeting was required for all students participating in this activity. This meeting reviewed the structure of the experience, the state privacy laws for autopsies and safety training related to autopsy. All medical students at UNDSMHS complete

privacy training meeting Health Insurance Portability and Accountability Act recommendations at matriculation orientation sessions. Students signed a memorandum of understanding that outlined the responsibilities, expected conduct, and professional expectations of this experience. Students could self-select groups or were placed in groups no larger than 4 students for an autopsy call period, generally one weekend day. The prosector texted the assigned students when a case was scheduled. Each group of students attended an autopsy and at the conclusion, completed a formatted review of the case. Ideally, the autopsy experience included a scene investigation, review of medical records, and other information relating to reason for an autopsy. Following the completion of gross prosection, students and faculty worked together on a particular case; faculty provided autopsy images, toxicology, and other results as needed. Students could review the histology from the case, independently or with faculty. Finally, each student group created and presented a summary of their autopsy experience to other students, including how each student would sign the death certificate. These summary meetings occurred at least 2 weeks after the last group rotated through the autopsy experience; 5 to 9 autopsy presentations occurred in a single session. The total time commitment from the students for this experience was 6 to 8 hours: 45 minutes of orientation; 2 to 3 hours of scene and autopsy observation; preparation of 1 to 2 hours, and a 1 to 2-hour summary conference.

Autopsy Presentation Format

The autopsy presentations followed a highly structured, 10-component format (Table 2) designed to succinctly demonstrate components and thinking in performance of an autopsy, to maximize exposure to AAMC Core EPA's and to direct learning objectives for the autopsy experience. The required order of slides, limitation of slide numbers, and requirement that the presentation be accomplished in 10 minutes all forced consideration of the goals of the autopsy, relevant findings, a salient differential diagnosis, and final interpretive summary. Students were required to comment on at least one unexpected finding. In many cases, the unexpected findings were trivial but in some autopsies, the unexpected findings provided a springboard for further discussion, error detection, safety, and response within a quality review environment (Core-EPA-13). One medical issue of the case was selected and discussed with correlation to clinical presentation and care. Finally, the students needed to formulate a death certificate based on case findings and provide a case summary, including reflection by the students of lessons learned. During group discussion, this often could be related to Core-EPA-9, team based and integrated care.

Survey

Students who completed the autopsy review received an anonymous, electronic poll about this experience. All students participating in the activity over the 2 years of enrollment received the initial survey; subsequently, each group of students received the survey following completion of the case presentation

Table 2. Format for Autopsy Presentations.

Content of PowerPoint Slide	# of Required/ Maximum Slides	Most/all Cases: Core-EPA Covered	Some Cases: Core-EPA
1 History and scene findings	1	1	
2 Medical review; justify decision to autopsy	1	2, 11	
3 External findings/diagrams: Must deidentify autopsy patients per state law	1-2	5, 6	
4 Findings consistent with history—usually one word slide; may have additional slide with microscopic findings	1-2	2	
5 Unexpected findings: MUST have at least one finding	1		13
6 Toxicology results (if done) and interpretation	0-1	3	
7 Medical issues (outline medical issues relevant to case; essentially the anatomic diagnosis)	1	5, 2	
8 Short presentation (1-2 slides) on one of the medical issues of case	1-2	6	7, 4, 10
9 Death certification (each student can have one slide or a group DC can be presented)	1	12	
10 Summary and lesson learned	1	6	8, 9

Abbreviations: DC, Death certificate.

Table 3. Evaluation Questions.

	% Agree	% Neutral	% Disagree	N
I would recommend this activity to other students	100	0	0	52
The activity was a good use of my time	100	0	0	
Giving the presentation at the end added to the educational benefit of observing an autopsy	94	4	2	52
I felt more capable of filling out a death certificate after this experience	90	10	0	52
I am more confident of knowing what deaths should be reported to the medical examiner or coroner	77	17	6	52
	Yes	No		
Did observing an autopsy give you a better perspective for the role of pathology in medicine?	100	0		52
Did observing an autopsy make you (even for a brief period) consider pathology as a career?	60	40		52
What suggestions would you make to improve the process?	40% with suggestions; no response or no suggestions: 60%			
Any other comments?	75% with responses; 25% no response			

sessions. There was no difference in the number of respondents between the 2 groups (immediate polling and polling several months after the experience). Table 3 contains the survey's questions and responses. Seventy-two students received the survey, including third year students who participated in their second year (35 students) and current second year students who had recently completed the autopsy experience (37 students). The survey was 9 questions and took 2 minutes to complete; 5 questions were agree/neutral/disagree type, 2 questions were yes/no type, and 2 questions were open text for free comments. Since the survey was anonymous, questions were on the evaluation of educational content and the faculty received only deidentified, aggregated results, the UND Institutional Review Board decided this did not fall under their review.

Timing Within the Curriculum

The medical curriculum schedule at UNDSMHS consists of 4 blocks of 10-week periods ("blocks") during each of the first 2 years. An educational block consists of 8 weeks of education, followed by 1 week of assessment and 1 week for either a break

or remediation if needed. The autopsy experience generally occurred during the week off or initial 5 weeks of the 8 educational weeks within a block to allow for sufficient study time and lack of conflicts with formal assessment activities. The autopsy review sessions, with presentations from autopsies during the previous block, occurred in the first 2 weeks of a block. Practically, a delay of at least 3 weeks following the gross completion of the autopsy was needed to allow completion of all testing, including toxicology and histology. Students required time to review findings with faculty and their group and prepare a presentation. Departments desiring to implement this program should coordinate with timing within the medical curriculum as well as anticipated turn-around-times for various autopsy components at their respective institutions.

Faculty Training

All physician pathology faculty at the University of North Dakota are forensic pathologists and clinical practice is dedicated to autopsy and forensic pathology. Although all physicians agreed to utilize the case presentation points and formulation of a death

Table 4. Class Participation Demographics:

Students in each class (class size 79) participating in autopsy experience:
Sophomores in 2016-2017: 44%;
Sophomores in 2017-2018: 47%
Response to survey: 52/72 = 72% return
Total autopsies and presentations: 34

certificate, initially, each physician guided the students and discussion during the autopsy and review without specific guidelines. After surveys of the students, some variation of learning issues was noted and the faculty agreed that in addition to the presentation format, each group would have a discussion of forensic versus medical autopsies, reporting and duties within a medicolegal system, and issues in error reporting in medicine. If other departments utilized faculty who are not primarily involved in autopsy pathology, additional goals and discussion points may be appropriate.

Feedback and Review

Core-EPA's need feedback and assessment of students to maximize growth and performance. Although this limited and voluntary activity was not structured for formal formative evaluation, the presentation and feedback to every student group guided students toward achievement of goals. Faculty provided students feedback as presentations were developed and again at the time of formal presentation. There was peer-feedback with the group presentation and allotted discussion. Finally, at the end of each presentation session, faculty identified how activities related to entrustable activities and how a case presentation for an autopsy was similar to a clinical presentation expected in the clinical rotations and beyond.

Results

The autopsy experience was popular with students (Table 4), despite the relatively high time expectation (6 to 10 hours) for this elective, noncredit activity. Nearly half of each class participated in the autopsy experience. All the students (Table 3) responded that it was a good use of their time and would recommend the activity to others. No student withdrew from the activity or failed to complete the group presentation. The presentation requirement drew high praise from the students with 94% feeling it added to the educational benefit of observing an autopsy. The positive response to the summary presentation and the free text from students on clinical rotations reinforced Core EPAs such as documenting a clinical encounter (Core-EPA-5) and oral presentation of a clinical encounter (Core-EPA-6) as illustrated by this student comment:

The presentation was a very important piece of the experience. Though I didn't realize it at the time, it was really good practice for third year, being able to present a case from start to finish and give the pertinent information.

One of the requirements in the presentation was filling out a mock death certificate on the case the students observed. Each student was encouraged to do this independently then the group decided on the best (or modified) death certificate as part of their autopsy presentation. Students had to defend their choice for certification. Students rated this activity also highly with 90% stating they felt more capable of filling out a death certificate following this activity (Table 3).

One goal for this experience was to give students more knowledge and information on what cases to report to the Coroner or Medical Examiner. However, when queried, only 77% responded affirmatively, 17% were neutral, and 6% had a negative response. One of the 4 faculty sharing this training was not reviewing this with the students, likely accounting for the lower number than other aspects of the survey. This led to incorporation of faculty training and standardization of expectations. All students felt the autopsy experience provided a better perspective for the role of pathology in medicine (Table 3) and 60% responded they considered pathology as a career because of this experience.

The free text entries generally fell into 3 categories. Some, as expected, merely provided operational and administrative improvements with notification, timing, access or other internal aspect of the program. A second group of comments identified educational lessons within the experience. Many of the free text comments acknowledged the value of this experience for normal anatomy review, appreciation of anatomy variants, and fully appreciating what traumatic injury does to the body. A few comments identified inconsistencies in faculty interactions with the student groups, for example, the lack of review by one faculty member regarding permit requirements and referral to the medical-legal system. The third group of comments were self-reflections on the experience and were generally positive. Many of these reinforced the core lessons within specific EPA as was cited with the usefulness in preparation of oral clinical summaries. Some comments were indicative of deeper reflections by the students:

I found myself thinking about the life this person had and made me empathize with the family and loved ones who just lost someone important to them. I believe that incorporating autopsy observations into a medical curriculum fully embodies the patient-centered care that is so highly revered. As future healthcare providers, we need to acknowledge that people are our patients not only till death; rather, patients will continue under our care even after death.

Discussion

The structured format of the autopsy provided a framework for assessment of several AAMC Core-EPA's (Table 5). Core-EPAs 1, 2, 5, 6, 7, and 12 are common activities within autopsy practice and with structuring of the experience, emphasis of these Core-EPA's is straightforward. The autopsy can demonstrate correlation with traditional physical diagnosis findings, such as

Table 5. Application of AAMC Core EPAs Within a Structured Autopsy Pathology Experience.

AAMC Core EPA	Autopsy Activities Relative to EPA	Frequency Found
1 Gather a history and perform a physical examination	History: Obtained from scene, police and EMS reports, interviews of family, witnesses, recent contacts; medical, social history, and social medial presence. Physical: Autopsy performance; any supplemental imaging; may have correlation with some physical diagnosis finding.	Common
2 Prioritize a differential following a clinical encounter	<ul style="list-style-type: none"> Goals of autopsy reviewed with faculty prior to start Observed forensic/autopsy pathologists form differentials and evaluation during autopsy—observed change of technique and exam as appropriate during gross examination with new differentials identified. Differential diagnosis based on gross findings and history—Formation of PAD and preliminary cause of death; use of PAD and communication postautopsy. Steps to narrow a differential <ol style="list-style-type: none"> Seeking additional history and scene findings Microscopic confirmation and/or delineation Role of toxicology, microbiology, or other testing Final autopsy findings and diagnosis Differential was part of autopsy presentation requirement 	Common
3 Recommend and interpret common diagnostic and screening tests	<ul style="list-style-type: none"> Role of toxicology in forensic autopsy Postmortem toxicology interpretation Use of additional testing, ie, microbiology, clinical chemistry testing, hazardous gas detection, genetic, and other testing as appropriate Screening and communication to family, ie, unexpected atherosclerotic disease, thrombotic events, other potential genetic risks. 	Occasional
4 Enter and discuss orders and prescriptions	<ul style="list-style-type: none"> Use of Prescription Drug Monitoring Program—becoming standard with patient prescription practice in many states Use of medication for likely medical history or confirmation/rebuttal of history obtained by family. Uncommon medication errors, side effects, adverse interactions; rare but powerful clinical lesson. 	Occasional—Rare
5 Document a clinical encounter in the patient record	Students must prepare presentation of the case within a specified format and time limitation <ul style="list-style-type: none"> Strict limit of slides and time forces decisions on important aspects of presentations Oral communication and defense to group and faculty regarding case Structure of slides “forced” consideration of EPA’s without labeling them as such. 	Common; Positive unsolicited response from students
6 Provide an oral presentation of a clinical encounter	<ul style="list-style-type: none"> Student teams present their patient within a 10-minute time frame Scripted PowerPoint® presentation on areas to be covered; Structured to maximize exposure to EPA’s Question period after presentation for clarification and assessment of knowledge learned Oral defense of death certification wording 	Common; Positive unsolicited response from students
7 Form clinical questions and retrieve evidence to advance patient care	<ul style="list-style-type: none"> Clinical findings listed as part of presentation Students formulate medical issues and must explore one finding from autopsy as part of presentation Some autopsies had findings suitable for case report or presentation Students who desired working on case report or presentation (especially those interested in pathology) provided examples from these or other autopsy cases. Funding for national meeting if accepted and manuscript drafted. 	Common; Enhanced opportunities for interested students

(continued)

Table 5. (continued)

AAMC Core EPA	Autopsy Activities Relative to EPA	Frequency Found
8 Give or receive a patient handover to transition care responsibility	<ul style="list-style-type: none"> • Direct observation of case handoff between faculty and between investigators and faculty • Death information summaries reinforced succinct and relevant summary needed 	Uncommon; less directly applicable
9 Collaborate as a member of an interprofessional team	<ul style="list-style-type: none"> • Postautopsy tasks of PAD, calling family/agencies/others. • Autopsy and forensic pathology is a team sport. • Investigators, police, EMS, medical records (from multiple sites), PDMP, scene investigation—all needed • Some worked with FAA, NTSB, other agencies 	Common but needs pointed out.
10 Recognize a patient requiring urgent or emergent care and initiate evaluation and management	<ul style="list-style-type: none"> • Cases occurred where emergent care not recognized or the care plan not successful or not implemented with adverse outcomes • Decisions in emergent care often documented in trauma cases and effects seen at autopsy 	Uncommon but powerful examples
11 Obtain informed consent for tests/procedures	<ul style="list-style-type: none"> • Discussion of forensic vs consented autopsy • Religious and cultural objections discussion in forensic autopsies; importance of cultural awareness and sensitivity • Components of valid autopsy permit 	Discussion point; rare re-consent of autopsy needed
12 Perform general procedures of a physician	<ul style="list-style-type: none"> • Death certification • Family communication and cultural sensitivity • Recognition and referral of appropriate cases to medicolegal system 	Common
13 Identify system failures and contribute to a culture of safety and improvement	<ul style="list-style-type: none"> • All groups had to document at least ONE unexpected finding at every autopsy; most were diagnostically trivial but usually provided learning opportunity. • Expected findings in any autopsy: 40% with unexpected finding; 104 significant finding • Cases with significant diagnostic findings at autopsy: <ul style="list-style-type: none"> ○ Reporting mechanisms/peer-review/QA review in health systems ○ Internal discussion of what might have altered course • Routine exposure to other quality review agencies, ie, FAA/NTSB, accident reconstruction, OSHA, Consumer Product review, etc in many forensic autopsies. Experienced focus for improvements and safety. 	Common discussion; powerful but uncommon examples

Abbreviations: AAMC, American Association of Medical Colleges; EPA, entrustable professional activity; EMS, emergency medical services; FAA, Federal Aviation Administration; NTSB, National Transportation Safety Board; OSHA, Occupational Safety and Health Administration; PAD, preliminary autopsy diagnosis; PDMA, prescription drug monitoring program; QA, quality management.

documenting ascites from a cirrhotic liver or appreciation of different physical examination and auscultation findings in the thoracic examination in cases of asthma, interstitial fibrosis, empyema, or bronchopneumonia. Students consistently commented on the autopsy experience reinforcing basic anatomy, anatomic variation, and seeing the rationale particular findings of clinical physical examination. The presentation also required formulating medical issues of each case and discussion of at least one aspect of medical care. Obviously, some autopsies raised more significant questions than others did; however, in all cases there was an opportunity for learning.

Forensic pathology, and to a lesser extent autopsy pathology, is a team activity. Students saw information obtained from scenes; police; medical records from multiple sites; and family, friend, and witness statements coalesce into an assessment and medical diagnosis. Some cases involved further discussions with police, prosecutors, child services, Federal Aviation

Administration (FAA), National Transportation Safety Board (NTSB), Occupational Safety and Health Administration (OSHA), or other agencies. Pointing out the teamwork involved enlightened the students to the role of autopsy and forensic pathologists within family health, community health, public health and safety, thus illustrating collaborating as a member of a professional team. The students also participated in the daily discussions and handoffs between faculty, investigators, and agency representatives in forensic pathology, illustrating handover to transition care responsibility. The importance of communication and teamwork is readily highlighted on most autopsy and forensic practices.

The role and use of prescription drug monitoring programs (PDMP) is common in forensic pathology. Prescriptions and drugs found at scenes provide confirmation of medical history, assessment of compliance, or overuse of prescriptions. Students see PDMP used in daily practice, a skill applicable to

many specialties. Although uncommon, medication errors that result in death, adverse reactions, and side effects of medications provide a powerful clinical lesson at autopsy.

The mixture of consented autopsies and medicolegal, forensic autopsies provided an excellent opportunity to discuss informed consent. Ideally, discussion with faculty stimulated learning about consent process, why and when consent was not required for most medicolegal autopsies, dealing with religious and cultural objections to an autopsy and other consent related issues. For consented autopsies, a mandatory task was to review the consent for validity and restrictions. Occasionally, nonvalid permits occurred and the pathologists and/or the particular care team initiated a new consent process for the autopsy from the family. Observation of an autopsy while in medical school also validates the consent process for autopsies in future patients. The students have a better understanding of what the autopsy entails and the benefits that may result, thus they are better equipped to obtain informed consents from families in the future.

The autopsy is a premier example of quality assurance within medicine and pathology, consistently uncovering unexpected findings. The Agency of Healthcare Research and Quality recognized autopsy as an important and underutilized quality assessment tool and opportunity for improvement of health-care systems.¹ A 1994 Q-Probes study by the College of American Pathologists examined the performance of 2459 autopsies in 248 institutions, excluding all stillbirths and forensic cases.² In this multi-institutional survey representing a broad cross-section of North American pathology practices, 40% of autopsies had at least one major clinically unexpected finding contributing to the patient's death, 17% had a minor finding contributing to death, and 32% a minor finding not contributing to death. Several other studies within selected institutions throughout the world confirm these rates, in pediatric, adult, and intensive care unit populations.³⁻⁶ The frequency of unexpected findings discovered at autopsy has remained relatively constant over several decades even with the advent of modern imaging and diagnostic techniques.^{7,8} This provides a rich experience for the students with the autopsy. The presentation format for autopsies required students to document at least one unexpected finding. Often, these findings were diagnostically trivial or an anatomic variant. Other autopsies had significant unexpected diagnostic findings in line with expectations from the literature. This was a learning experience for students in several ways. The revelation of discordant findings at autopsy was impactful to the students who generally felt confident in preautopsy assessments. Some cases identified missed diagnostic opportunities. In cases where a system failure was suspected, students saw the effects and realized how reporting was done to quality management or peer review within the health system. The contribution to system improvement and public health was reinforced when the other quality review agencies, such as the Consumer Product Safety Commission (CPSC), FAA, NTSB, OSHA or others were involved in a case. Observation and reporting of cases to local, state, or national reviews, such as patterns of drug deaths, details of surveillance studies such as national violent

death reporting system, sudden death in the young, or similar studies emphasized the population-based use of forensic autopsy data and the public health component of medicine.

This focused and structured autopsy experience for preclinical medical students provided constructive exposure to autopsy pathology and a positive role model for autopsy practice and pathology within a clinical setting. Students directly observed how forensic pathologists formed differentials and evaluation during an autopsy. Occasionally, a change of technique or different examination occurred during the gross autopsy examination based on findings and evolving diagnostic assessment. This dynamic interplay of forming and revising differential diagnosis was common during most autopsies and appreciated by the students. This refinement of autopsy differentials continued as histology, toxicology, and other testing was obtained resulting in the final autopsy diagnosis. Other physician activities relating to autopsy included family communication regarding autopsy findings as well as recognition and referral of appropriate cases to the medicolegal system for the area. Mentoring of students with a grieving family, explaining findings, and medical implications was a powerful lesson for students delivered by pathology faculty in the practice of medicine. A few highly interested students pursued additional learning opportunities for case reports and posters based on autopsy material. Students learned about the autopsy, saw pathologists contributing to patient quality care, family health, public health, quality, and systems improvement as part of a larger team. Most students reflected positively on the opportunities to interact with families and communities, review anatomy, appreciate variations in anatomy, and effects of trauma and/or disease in multiple body systems. Students saw real examples of faculty pathologists actively involved in medical practice and teams and discovered concrete examples of physician professional activities during preclinical years within autopsy pathology. The framing of autopsy activities in the context of Core-EPA provided an excellent preclinical base for these activities and further involved pathology faculty in clinical assessment. Finally, preclinical students observed pathologist faculty providing positive role models for the specialty.

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