



Regular Article

Increasing medical student awareness of pathology through a virtual, asynchronous pathology elective



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A B S T R A C T

Faculty from the University of Florida Department of Pathology, Immunology, and Laboratory Medicine developed an asynchronous, fully virtual pathology elective for medical students that emphasizes both foundational pathology concepts as well as the role of pathologists in the broader health system. The program includes ten core modules as well as several selective modules which allows students to tailor their coursework to better align with their desired specialty. After completing each module, students were required to concisely summarize the topic in the form of a 280-character tweet. Students were surveyed immediately after finishing the course and again one year after finishing the course to assess the effectiveness of the course in teaching students about pathology. Survey results showed significant improvement in student knowledge about the field of pathology and high levels of satisfaction with the course content and delivery. The tweet summaries required in the course provided a unique challenge for students. Although the course was initially developed in response to the COVID-19 pandemic, enrollment has continued steadily through 2023. Our study suggests that online pathology electives can be an effective way to increase medical student exposure to pathology and facilitate learning about the field of pathology, especially among students who may not ultimately pursue a career in pathology.

Keywords: COVID-19, Curriculum, Medical education, Pathology, Remote, Rotation, Virtual

Introduction

Pathology faculty at the University of Florida College of Medicine (UF COM) in Gainesville, Florida developed an asynchronous, fully virtual pathology elective for medical students which started in May 2020 in response to the AAMC recommendation to temporarily reduce or suspend in-person clinical rotations for medical students due to the COVID-19 pandemic.¹ The course was designed to be flexible, with both 2- and 4-week options available to accommodate students' rapidly changing clinical schedules. Additionally, the course was designed to be useful for students at any point in their training. In the course, learners used a variety of online resources to answer the key questions about fundamental pathology concepts as well as the role of pathologists in the broader healthcare system. We employed a novel approach to evaluate students' ability to concisely convey their understanding of pathology topics by requiring students to write a short tweet (280 characters or less) summarizing each concept. Students were not required to publish these to Twitter; instead, they uploaded them to the course website for review by course faculty.

In this article, we describe how we developed and evaluated the curriculum for our virtual, asynchronous pathology elective. We also

discuss the results of two surveys that we conducted after course completion to gather feedback from students about the content and delivery of the course.

Materials and methods

Curriculum development

The course was developed by two Pathology faculty at the University of Florida, one with a specialty in anatomic pathology and the other with a focus on clinical pathology. The course curriculum was derived from literature, faculty opinion, and guidelines from the 2017 Pathology Competencies for Medical Education.² The curriculum was reviewed and approved by the UF COM Curriculum Committee prior to enrolling students. The course was designed to provide medical students with a broad introduction to the subject of pathology as well as the role of pathologists in the broader health system.

The course was entirely online and asynchronous, allowing students to complete the work at their own pace. The decision to create a completely asynchronous course with no real-time contact was based in part on logistical issues caused by the COVID-19 pandemic. Pandemic-

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related disruptions, including limited access to childcare, school closures, and reduced business operating hours, created significant obstacles and time constraints for both faculty and students. Therefore, the curriculum for the online course was completely different from previous in-person pathology electives. We opted not to include “virtual sign-out” as this course was not intended to teach in-depth histopathology. Additionally, we felt that including “virtual sign-outs” would be a taxing way to teach clinical histopathology to medical students while simultaneously teaching pathology residents and fellows who were also in need of these experiences. Finally, the course’s asynchronicity was a way to avoid contributing to “Zoom fatigue”, which arose as a result of the drastically increased utilization of videoconferencing at the time.³ Due to the success of the asynchronous model, we opted to continue even as pandemic-related restrictions subsided; however, the curriculum was updated to inform students that they were welcome to join for an in-person experience (during or after their elective) if they wished.

The curriculum was designed on a free [Wix.com](https://www.wix.com) website by the course faculty. We opted to utilize Wix instead of platforms normally used by the UF COM mainly to give the course a more modern quality that would appeal to medical students. Additionally, the Wix platform offered an extremely flexible design. It is available anywhere with no login information required, making it easy for students to view, for example, on smartphones. Using Wix also offered portability and ease of access for other learners such as undergraduates and medical students from other schools, who have used the site in a limited fashion.

The course consisted of three sections: core modules, part A selectives, and part B selectives (Fig. 1). All students were required to complete 10 core modules. Each core module consisted of a question (Table 1) and a variety of links to online resources for students to use to answer it. These resources included short videos, web articles, and podcasts. Students then answered the core question with a brief tweet response (280 characters or less). Core modules were chosen based on guidelines from the literature and by recommendation from subject matter experts.^{2,4}

Students could tailor the curriculum to be more relevant to their career goals and interests through the selective modules. For part A selective modules, students selected five webinars presented by the College of American Pathologists. The student then summarized the main topic of each webinar in a tweet. For the part B selective modules, students chose from a variety of short videos, articles, podcasts, and case reports and wrote tweet summaries of the most important features. Students completing the two-credit course chose 15 part B selectives while those completing the four-credit course chose 25. These modules included topics that are relevant to many fields of medicine, for example, a student

Table 1
Core module learning objectives.

Core Modules
Describe how a specimen goes from a patient’s body to a glass slide.
List the many aspects of pathologists’ jobs.
Describe the purpose and general process of frozen sections.
Describe the purpose and general features of autopsies.
Define cytopathology and give one example of a common use.
Briefly define/describe each of these terms: blood types, cross match, donor center, transfusion reaction, therapeutic apheresis.
Describe the most common techniques used in a clinical microbiology laboratory.
Describe the process going from a lab order to result in the electronic medical record.
Briefly describe what molecular pathology is and how it relates to personalized medicine.
Describe the normal histology of two organ systems.

interested in obstetrics had the option to choose a selective specifically relating to the pathology of uterine or ovarian tumors. All tweets were turned in as one document at the conclusion of the course, at which time the faculty would review and initiate further discussion by email as desired.

While some of the course resources were made by UF COM faculty, we also recognized that our pathology colleagues at other institutions have created many high-quality, publicly available resources for learners. We included links to many of these resources in our curriculum to allow students the option to learn from other excellent educators on various platforms. The full course curriculum can be viewed on the website.⁵

Survey design

Participants were asked to complete a course evaluation survey immediately following course completion, and another optional survey approximately one year after course completion. The purpose of the surveys was to assess students’ perceptions of the course, their perceptions of pathology, their career goals, and whether their career goals changed after completion of the course. See [Supplemental Tables 1 and 2](#) for a full list of survey questions. Most survey questions were short answer or radio button selections. Five questions utilized a 5-point Likert rating scale. Institutional Review Board approval (IRB 202100891) was obtained for this investigation.

The surveyed population included 64 medical students at the University of Florida who enrolled in either the 2- or 4-week online pathology elective rotation between May 2020 and March 2021.

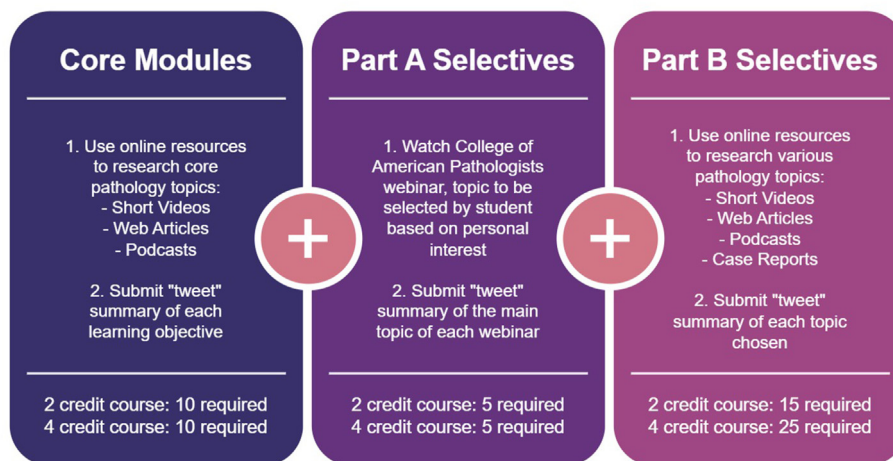


Fig. 1. Course layout.

Data analysis

Following survey completion, descriptive statistics were calculated for qualitative survey results. Short-answer survey results were analyzed by an independent researcher with training in qualitative research methods. This researcher was not involved with course development or course administration. Each short-answer was thematically coded to categorize common topics or themes within the responses. Data were completely de-identified prior to analysis.

Results

First survey

Sixty-four medical students completed the first survey immediately after course completion. 75% (n = 48) had completed 1 or fewer clinical clerkships prior to taking the elective, 25% (n = 16) had completed 10 or more clinical clerkships prior to taking the elective. 81% (n = 52) of the medical students who took the course reported that they were “not at all” or “slightly” familiar with the practice of pathology prior to taking the course while none reported that they were “very” or “extremely” familiar with the practice of pathology. At the conclusion of the course, no students remained “not at all” or “slightly” familiar and 61% (n = 39) reported that they were “very” or “extremely” familiar with the practice of pathology (Fig. 2). On average, students reported that their likelihood of applying to a pathology residency was 14% prior to taking the course, compared with 24% after completion (Fig. 3). Internal medicine had the highest level of career interest at 39% (n = 25) followed by general surgery at 22% (n = 14; Table 2). Only 9% (n = 6) of students indicated a specific career interest in pathology (n = 6). Students reported that they spent an average of 10.8 h per week on course activities.

Participants were asked to describe the most surprising thing they learned about the field of pathology. Responses revealed several common themes, including the broad range of activities pathologists are involved in, including not just anatomic pathology (eg. histopathology and autopsies), but clinical pathology (eg. laboratory medicine and transfusion medicine). Participants were also surprised to learn about the close collaboration between pathologists and surgeons. Another theme that emerged was surprise about the breadth of knowledge required by

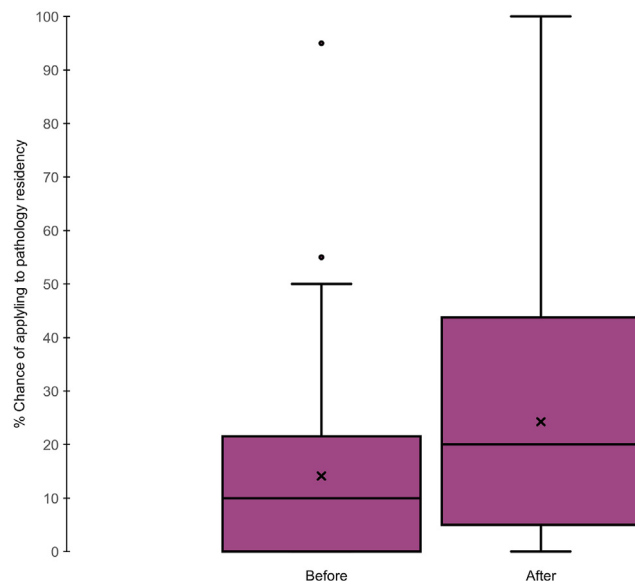


Fig. 3. Likelihood of applying to pathology residency before and after course completion. Box-and-whisker plot showing mean (x symbol), median (horizontal bar), 1st and 3rd quartiles with inter-quartile range (IQR, box), “minimum” and “maximum” distributions (1st quartile minus 1.5 IQR; 3rd quartile plus 1.5 IQR, whiskers) and outliers (dots) for student responses before and after the course. “Before” represents n = 64 student responses; “After” represents n = 64 student responses. Although the median is increased after course completion, the difference is not statistically significant.

pathologists, including a wide variety of stains, tumor types, and laboratory tests.

When asked what they liked best about the course, many students commented on the flexibility and variety of resources that were available in the course, the ability to tailor the course to their specific interests, and the breadth of the material covered. Six students commented that they enjoyed the challenge of concisely summarizing information with the tweet assignments.

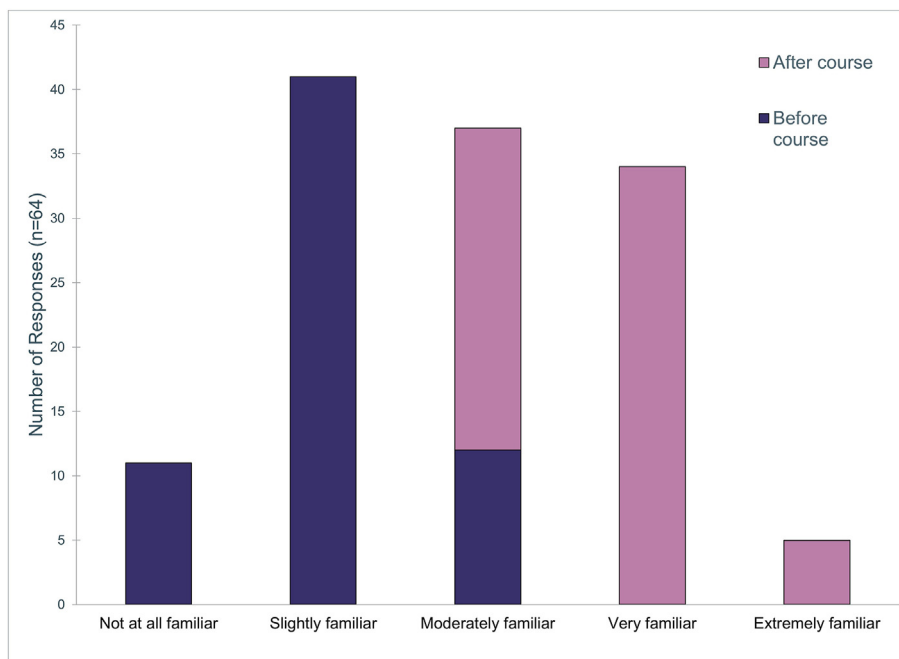


Fig. 2. Reported familiarity with pathology before and after course completion.

Table 2

Specialties that participants (n = 64) were considering for residency. Participants could select more than one specialty.

What specialties are you considering for residency?	Number of responses
Anesthesiology	7
Dermatology	2
Emergency Medicine	6
Family Medicine	7
Internal Medicine	25
Neurology	3
Neurosurgery	4
OB/Gyn	7
Ophthalmology	4
Orthopedic Surgery	4
Otolaryngology	5
Pathology	6
Pediatrics	9
Plastic Surgery	1
PM&R	2
Psychiatry	4
Radiology	6
General Surgery	14
Undecided	5
Urology	2

When asked what could be improved about the course, a few themes emerged. Nine students commented on the difficulty of condensing information down for the tweet assignments, and several suggested increasing the character limit or allowing for alternatives. Several students suggested including more self-assessment tools so they could evaluate their understanding and test themselves throughout the course. Some students felt that some of the material was above their learning level and requested more basic core modules that would prepare them for the more complex material that was available in the selectives. A few students suggested having more opportunities to interact with real pathologists, either through face-to-face discussions or via teleconferencing.

Second survey

Eighteen medical students completed the second survey approximately one year after course completion and after the participants had completed all of their core clinical clerkships. The goal of this survey was to evaluate the role that the pathology elective played in their other clinical rotations and in board exam preparation. Participants were asked about their intended specialty, when they took the course, the number of completed clinical rotations, and the usefulness of the course for their clinical rotations and board exams. Participants were also asked about the interaction with pathology and the laboratory during their clinical rotations, and the usefulness of the course for their preparation for Step 2 and their chosen specialty.

The majority of participants took the pathology elective before completing any in-person clinical rotations. Only 16% (n = 3) of participants took it after completing clinical rotations, which is likely because students who took the elective after clinical rotations had already graduated at the time this survey was administered. 67% (n = 12) stated that they felt the knowledge they gained during the pathology elective was moderately, very, or extremely useful for their other clinical rotations, with no students saying that it was not useful. Most students stated that the elective was only slightly useful in preparing them for the Step 2 exam. The clinical clerkships that allowed students to interact the most with pathology or the laboratory were Internal Medicine (n = 11), Surgery (n = 10), and OB-Gyn (n = 8). These interactions included dropping off samples at the lab, viewing frozen sections or slides with a pathologist, looking at blood smears, and calling the lab with clinical questions. Only one participant did not interact with pathology or the laboratory during their clerkships. 16% of students (n = 3) participated in an in-person pathology rotation after completing the online elective.

Discussion

This report describes our process of developing an online, asynchronous pathology elective.

The course aimed to increase understanding of what a pathologist does and how pathology and laboratory medicine fit into the broader healthcare system. These important concepts will help physicians in all specialties to improve patient care and better utilize their pathology and laboratory medicine colleagues. This goal appears to have been achieved as students reporting that they were “very” or “extremely” familiar with the practice of pathology went from 0% pre-course to 61% post-course completion. Additionally, 94% of students who completed the course and the second survey reported that they interfaced with pathologists during their clerkships after taking the elective. While we do not have a comparison for how many students who did not complete the elective interfaced with pathology, we posit that students who completed the elective interfaced with pathology more often and more effectively.

The fact that 81% of students reported that they were minimally familiar with the practice of pathology prior to taking the course raises questions regarding the effectiveness of early teaching of pathology concepts in undergraduate medical education. Students in pre-clinical years are exposed to several important aspects of pathology, including didactics relating to histology and laboratory medicine. However, there is very limited discussion of the role of pathologists in patient diagnosis and the function of pathologists in clinical care teams. Emphasizing the clinical relevance of pathology concepts, such as incorporating patient scenarios into didactic lectures or describing the role of pathologists in specific clinical cases, may be a potential solution to enhance pre-clinical awareness amongst medical students. Unfortunately, we do not have a comparator to assess familiarity of pathology vs familiarity with other fields of medicine, for example, how many students would describe themselves as familiar with the practice of internal medicine prior to completing clerkships? Additionally, since both surveys were taken after completion of the course, we acknowledge that there may be some degree of recall bias influencing the students’ self-reported pre-course understanding of pathology.

Is there still a role for this online, asynchronous course without any in-person requirements? While the course was initially developed to address the challenges posed by the COVID-19 pandemic, it still serves as an effective tool for encouraging self-study and exploration among students. The low commitment required to participate in the course makes it accessible (and perhaps desirable) to students who may not have had a prior interest in pathology. There is certainly a need for flexibility amongst fourth-year students who need time to do residency interviews (even if virtual) and to prepare for an upcoming move. This elective may also be helpful for students who require flexibility for other reasons, including supplementing parental leave. The survey results indicated that students do benefit from the course, even those who do not ultimately pursue a career in pathology. In 2022–2023, 24 students out of a class of approximately 135 (17%) registered for this class. Usually only 1–2 medical students match into pathology each year from UF COM, so we are extremely happy to be sharing the field of pathology with students who will ultimately pursue other fields. Finally, students who desire more in-person interaction are encouraged to spend time with our faculty at their convenience after course completion, though we have not documented how often this has occurred.

One opportunity for improvement mentioned in student feedback was the limited role of the course in USMLE Step 2 preparation. Faculty have determined that this is not a major goal of the course, especially considering many students will have already completed Step 2 prior to taking the course. It is an ongoing goal to increase the exposure that medical students have to pathology during their core clinical clerkships. This has proven difficult as clerkship directors are understandably hesitant to cede any of their already limited rotation time to other specialties. Many schools have incorporated integrated or interdisciplinary curricula in their core

clerkships, increasing exposure to pathology, radiology, genetics, and other “non-core” specialties, so we will continue to advocate for integration of pathology into the core clinical curriculum at UF COM.^{6,7,8}

To our knowledge, the concept of writing tweets as an assignment has not been previously published in undergraduate medical literature. However, there have been numerous studies on the use of social media platforms, including Twitter, as a means of sharing medical knowledge and promoting professional development in the medical community.^{9,10,11} By incorporating a tweet assignment into our course curriculum, we aimed to challenge and engage medical students while also providing them with valuable experience in presenting complex information in a concise and accessible manner. This format requires careful synthesis of the material and the ability to distill key concepts into short, engaging messages that are easily shared and understood by a wider audience. We believe that this approach not only helps students to develop important communication skills but also prepares them to effectively leverage social media in their future professional endeavors.

Conclusion

Overall, our online, asynchronous pathology elective course was effective in increasing students’ familiarity with the practice of pathology. Given the limited opportunities medical students have to learn about the field of pathology during their preclinical and clinical years, our course provided a flexible and accessible way for students to gain knowledge about the role of pathology in medicine. The knowledge gained through this course is valuable for all future physicians as it enables them to improve patient care and effectively collaborate with pathology colleagues, regardless of their chosen specialty.

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Declaration of competing interest

The authors declare that there are no competing interests with respect to the research, authorship, and/or publication of this article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.acpath.2023.100093>.

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