



## Regular Article

# The “Pathology Passport”: a redesign of the pathology elective experience to enhance medical student engagement and understanding of pathology as a clinical practice

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## ABSTRACT

Given the trend of condensed preclinical curricula in medical schools nationwide, creating meaningful pathology learning experiences within the clinical and post-clinical curricula is important to both enhance student understanding of how pathology integrates into daily healthcare delivery and spark potential career interest in the field. While pathology electives are a common modality for medical students to explore pathology, they frequently render students passive observers of daily clinical workflows (often in grossing and sign-out rooms of surgical pathology). This can have a negative impact on student engagement with their pathology clinical teams and on their satisfaction with the pathology elective experience. As such, we aim to describe our institutional experience in creating a new pathology elective structure, the “Pathology Passport,” which leverages intentional student engagement with existing pathology workflows and introduces a means of criterion-based grading. Data collected from student pre- and post-elective surveys demonstrate the elective's positive impact on students' perceived understanding of pathology and their overall learning experience. We hope that our resources can be leveraged at other institutions and even other non-pathology clerkship/elective rotations to promote active engagement of students in clinical workflows while providing clear expectations for grading.

**Keywords:** Active learning, Elective, Medical students, Passport, Pathology, Rotation

## Introduction

Medical student exposure to pathology in clinical curricula plays an important role in their recognition of pathology as a basis for clinical reasoning and management. Perhaps even more importantly, it can provide students with a functional understanding of how pathology laboratories operate. A lack of understanding regarding the workflow differences in anatomic and clinical pathology laboratories by practitioners can lead to confusion and, in the worst-case scenario, suboptimal patient management as they may fail to appropriately utilize laboratory services<sup>1,2</sup> (e.g. order inappropriate tests, send specimens to incorrect laboratories, etc.) or to recognize appropriate sources of contact and consultation within their pathology departments. As such, the identified problem affects current medical students, future healthcare professionals, and patients. While select medical schools across the country have integrated required pathology learning activities into clerkship curricula to address these learning gaps, these activities have historically been limited to single sessions (e.g. lectures, gross organ review, brain cutting) that occur on weekly to quarterly bases within a specified clerkship.<sup>3</sup> More recent curricular efforts have been devoted to integrating week-long pathology curricula within clerkship rotations.<sup>4</sup> However, the integration of pathology curricula into clerkship

curricula is not widespread. Most clinical exposure to pathology is often initiated by students who show interest in pursuing pathology electives.

Pathology electives have therefore been showcased for their capacity to enhance student understanding of pathology workflows and to optimize lab stewardship for students pursuing all fields of medicine. Pathology electives are also crucial in providing an accurate picture of pathologists' role in clinical care. Nemer highlighted that out of 254 medical student respondents to a survey eliciting their perceptions of pathology, 43.7% said they were unsure of or did not know the role of the pathologist in patient care.<sup>5</sup> Studies have also highlighted students' misconceptions about pathology. Journal articles by Holland et al. and Raphael et al. noted how students believe that pathologists have a limited impact on clinical decision-making.<sup>6,7</sup> However, the reality is that many patient management pathways are decided solely based on pathology results. This lack of insight and prevalent misconceptions of pathology not only become determinants in student selection of future career pathways<sup>8</sup> but also factors that can potentially negatively impact students' medical knowledge base and clinical skill sets. As a result, many pathology educators have highlighted the importance of the promotion of pathology electives in dispelling misconceptions and enhancing student interest in pathology for clinical skill building.

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Increased student exposure to pathology may also have the added benefit of increasing student interest in pursuing pathology as a career. Data from the National Residency Match Program (NRMP) have shown a concerning decrease in the number of US medical school graduates matriculating into pathology residency programs (see Fig. 1).<sup>9–15</sup> While matriculation into pathology was relatively stable from 2003 to 2010 (with an average of 61% of offered pathology residency positions filled by US seniors over this period<sup>9–11</sup>) there has been a subsequent steady decline in American medical school graduates matriculating into pathology.<sup>12,13</sup> By 2021, this had decreased to 212 graduating US seniors who applied to pathology, filling only 32.4% of available positions.<sup>14</sup> This represents a 40% decline in applicants and a 50% decrease in matched residents over an 11-year period, fueling growing concerns of a looming pathologist shortage.

This trend is likely exacerbated by recent nationwide trends to shorten pre-clinical curricula, during which medical students have traditionally had most of their exposure to pathology content and pathologists. The etiology of this decline has been evaluated in prior studies. McCloskey et al. conducted a national survey of medical students to evaluate factors that impact their specialty choice.<sup>16</sup> Their work revealed that personality fit within a specialty and available clinical rotations during medical school were the two highest-ranked factors in decision-making regarding career choice. With specific regard to students who considered but did not pursue pathology residency training, respondents endorsed a lower understanding of pathologist job activities and were less likely to have participated in electives and/or been actively recruited to the field by pathology faculty. They concluded that to increase the number of graduates pursuing pathology, it is essential to improve medical student exposure to pathology during the clinical years and to improve the quality of interactions between pathology attendings and residents with medical students.

As such, high-quality pathology elective rotations are an important mechanism for pathology recruitment. Unfortunately, studies have reported that medical students are often disappointed with pathology elective experiences due to their lack of emphasis on skill building. An editorial published by Minhas et al.<sup>17</sup> called on pathologists to improve their clinical learning environments stating, “Pathology departments

must focus on making the pathology elective experience more exciting and beneficial to attract potential rotators.” Many institutions’ pathology electives place elective students in a passive observer role in sign-out and grossing activities. However, as Minhas and colleagues note, this low ratio of active to passive learning and infrequent opportunity for students to autonomously engage with active clinical cases can contribute to a lack of student satisfaction with the pathology elective experience. While the authors proposed several ideas to redesign pathology electives, including a potential “passport case logbook,” there were no descriptions/details within this editorial or subsequent literature outlining the logistical frameworks and detailed curricula required to implement them.

University of Michigan Medical School (UMMS) post-clerkship medical students have traditionally been able to participate in a General Pathology Elective, which consisted of a short tour/orientation on the first day of the elective followed by a daily schedule of hour-long resident-directed didactic sessions, passive observation of sign-out activities, optional participation in departmental conferences, and “independent time” for study (which often occurs at home). The rotation grade was based on faculty feedback, when available, an end-of-rotation reflective essay, and optional case write-ups. During the COVID-19 pandemic, however, all in-person learning activities were placed on an institutional pause. While other institutions had success in creating engaging virtual electives during this period,<sup>18–20</sup> we endeavored to restructure our pathology elective rotation utilizing the scaffold proposed by Minhas and developed an operationalized “Pathology Passport” for implementation after reinstatement of in-person learning.

Here, we present our experience in the creation of our “Pathology Passport.” We aim to illustrate the curriculum design process with the set goals of creating an elective experience that: (1) promoted active student integration into clinical workflows to create more meaningful hands-on learning experiences, (2) encouraged student participation in creating their own learning goals/plans, (3) was criterion-based, allowing for a transparent grading framework, and (4) was sustainable for the busy clinical workflows of the departmental learning environment. We also sought to measure and highlight the revamped elective’s impact on students’ perceived understanding of pathology and their overall learning experience.

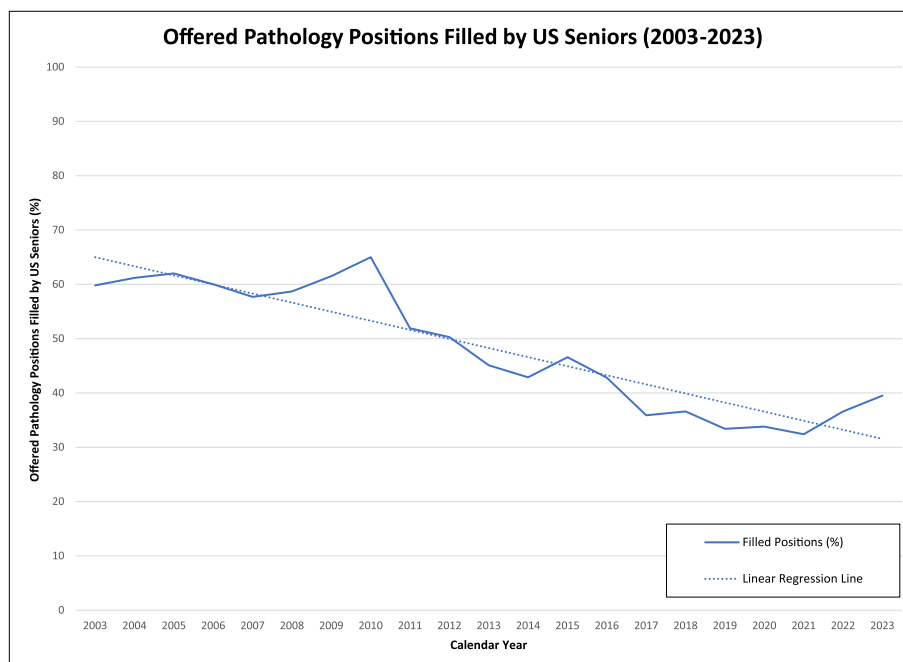


Fig. 1. Percentage of offered pathology positions filled by US Seniors (2000–2023).

## Materials and methods

### Curriculum design

As an introduction to the UMMS curricular structure, medical students progress through a one-year preclinical curriculum. In their second year, they rotate through core clinical rotations. In their subsequent third and fourth years, they participate in various elective and research experiences tailored to their professional and personal interests. As such, this curricular design would impact third- and fourth-year UMMS students.

A workgroup focused on undertaking the pathology elective redesign was created in January 2021. The working members were composed of a resident and two faculty members with vested interests in medical education programs. After a review of the current state of the General Pathology Elective, we focused on problem identification and a targeted needs assessment. We noted that major concerns in the pre-existing elective were three-fold: (1) a lack of clearly defined educational objectives that could be applicable to a diverse learner population, (2) lack of student engagement in the clinical workflows of the department, and (3) a poorly defined metric for translating clinical performance into resultant grades.

We focused initial efforts on our anatomic pathology subspecialty services, particularly on ways to enhance medical student engagement in clinical workflows. Through subsequent meetings between workgroup members, we collated a list of high-priority learning objectives for pathology elective students in anatomic pathology (Table 1). Potential educational methods that could be used to fulfill each learning objective were discussed, highlighting activities that would engage students with their own learning process. The workgroup then sought insights and feedback from other stakeholders who would be impacted by any curricular changes. In our pre-existing pathology elective layout, residents spent the most time with pathology elective students and would be the most impacted by curricular changes. An electronic survey was distributed to pathology residents to obtain their thoughts about the appropriate levels for student engagement in clinical workflows and potential obstacles to implementation. The results of our survey would ultimately help establish acceptable specimen numbers and types for medical students to preview, as well as identify important logistical concerns that would need to be mitigated. For example, although medical students have access to our electronic medical record (EMR), they do not have access to the pathology laboratory information system (LIS). If previewing cases, medical students would be unable to see the gross description or format reports without assistance from residents. Additionally, other stakeholders who could be involved in supervising/guiding elective students (such as pathology assistants) were identified as potential educator groups. Keeping these suggestions and concerns in mind, we then began the process of developing the final format for our new elective.

Taking inspiration from the “passport case logbook” proposed by Minhas, we created our own “Pathology Passport”. The month-long pathology elective would be split into four one-week rotations, each focusing on a different anatomic pathology subspecialty. Leveraging

stakeholders’ feedback about sustainable and meaningful ways in which elective students could be integrated into clinical workflows, we identified learning activities for each subspecialty rotation. Each activity was assigned a relative difficulty level (easy, moderate, difficult) and estimated time required for completion. These aspects were then used to assign a maximum point value to each activity. Completion of the activity would be signed off by a pathologist assistant, resident, fellow, and/or faculty member, who would also allocate the number of points earned. If the student performed the activity at a satisfactory level, a maximum point value would be assigned by the assessor. However, if the assessor felt that there were key elements missing for adequate completion, they could assign partial point values with detailed verbal and written feedback on areas to improve on. Assigned point values would accumulate for final grade assignments, with pre-defined point cut-offs for grades of pass, high pass, and honors. After this, activities were stratified into required and optional activities. Required activities were deemed essential for students to understand pathology workflows (i.e. observing grossing, previewing a case, and presenting relevant clinical history). Optional activities could be chosen by the learner in accordance with their personal interests and goals. Also leveraging feedback from stakeholders, we set limits on the number of times each student could perform an activity to minimize workflow disruptions in busy clinical services. For example, we limited the number of cases for grossing observation to 5 cases per week. Acknowledging the higher degree of supervision and increased time required for students to take part in the technical aspects of grossing, we limited active student participation in grossing to two cases per week. In the same vein, additional resident time and support would be required to facilitate elective student efforts to preview cases by helping them obtain adequate clinical and grossing information from the pathology LIS and providing them with educational resources. As such, a maximum of 5 cases per week was set as a limit for “independent” student previewing of cases. Figs. 2–6 show pages from the “Pathology Passport” for students rotating through the Gastrointestinal Pathology subspecialty service and highlight the specimen/case number limits.

Once created, the “Pathology Passport” was then presented to faculty division directors and residents for additional input. Most feedback was positive, especially for setting limits for participation in certain activities to mitigate the negative impact on workflow efficiency and trainee education. Additional suggestions included emphasizing the importance of proactive communication from the medical students to the faculty/residents about which activities they were interested in completing that week to facilitate educational and clinical workflows. These changes were then incorporated into the final version of the “Pathology Passport” and orientation materials were created to introduce trainees to the format of the course (Supplemental Material 1). The elements of the “Pathology Passport” as well as its grading schematics were reviewed with faculty and residents at departmental faculty and resident meetings leading up to the initial launch of the new General Pathology Elective layout. The elective redesign workgroup members would also be available as references for subsequent questions posed by residents and faculty.

In the new elective layout, each student receives an introductory email from the medical student coordinator which would provide access to a pre-recorded presentation that introduces the “Pathology Passport” components. Additionally, the e-mail solicits information on elective students’ career interests and requests for specific rotations within their General Pathology Elective (which includes options for breast pathology, gynecologic pathology, genitourinary pathology, gastrointestinal pathology, autopsy, frozen section, “Room 1” (a combination of head and neck, bone and soft tissue, thoracic, and endocrine pathology), and hematopathology). Subsequently, schedules are tailored to best fit student learning goals with available resources. These schedules are provided along with contact information for the service residents and faculty a week before the elective start date. On the first-day orientation, students are provided with additional information (i.e. tumor board schedules, building maps, etc.) to facilitate their learning experiences.

**Table 1**  
High-priority learning objectives for pathology elective students.

General Pathology Elective Learning Objectives
Summarize the diverse roles of pathologists in medical practice and how they interact with other clinical specialties.
Outline the process by which a surgical specimen becomes a slide, including the process of grossing, histology processing, and staining.
Explain the role of frozen section evaluation and its limitations.
Describe the indications for an autopsy and compose a preliminary gross pathologic diagnosis and clinical pathologic correlation for an autopsy case.
Recall the key concepts of organ histology and apply them to the interpretation of patient samples.

Sample of Gastrointestinal Pathology Rotation from "Pathology Passport" (Page 1/5)										
GI – Gastrointestinal Pathology (Dates of Rotation: _____)										
Task	Required for passing (if yes, # of times)	Max Points Per Attempt	Difficulty	Time Required for:		Sign-off by:	Points	Signature	Notes For: Evaluators	Notes For: Students
				Preparation	Performance					
<i>Present clinical history for a case at sign-out (max: 5x/week). Place case numbers below.</i>	Yes (2)	2		5-10 minutes	1-2 minutes	Faculty, Fellow, or Resident			Please designate sources of strength & areas for improvement when signing off/point allocation.	Ask service resident for MRN of the associated case and utilize MiChart for history gathering.
1										
2										
3										
4										
5										
<i>Observe grossing/macroscopic evaluation of a large resection case (max: 5x/week). Place case numbers below.</i>	Yes (2)	2		N/A	15-60 minutes	Resident or Pathologist Assistant (PA)			Please highlight key aspects of specified organ grossing (differential, staging, etc.)	
1										
2										
3										
4										
5										

Fig. 2. A sample of the "Pathology Passport:" Page 1 (of 5) for the clinical activities elective students can participate in during their Gastrointestinal Pathology rotation. Required elements and the number of times they are expected to be performed are indicated in the text and designated by a grey background. The relative difficulty of each element is designated by green (easy), yellow (moderate), and red (difficult) colors. In this case, two activities are shown - presenting a clinical history for a case at sign out and observing the grossing/macroscopic evaluation of a large resection. Both can be performed up to 5 times for a credit of up to 2 points for each attempt, and both tasks are of easy difficulty (green). As indicated by the grey background, each activity is required to be performed twice to obtain a grade of Pass. Additional information, including estimated times for adequate preparation and performance of each activity, appropriate supervisory roles to sign off on the activity, and associated points for each element is also included.

Sample of Gastrointestinal Pathology Rotation from "Pathology Passport" (Page 2/5)										
Task	Required for passing (if yes, # of times)	Max Points per attempt	Difficulty	Time Required for:		Sign-off by:	Points	Signature	Notes For: Evaluators	Notes For: Students
				Preparation	Performance					
<i>Preview a biopsy (1-3 slides) independently and present history and differential/leading diagnosis at sign-out (max: 5x/week). Place case numbers, your differential/leading diagnosis, and final diagnosis below.</i>	Yes (1)	7		30-60 minutes	10-15 minutes	Faculty (preferred), Fellow, or Resident			Please designate sources of strength & areas for improvement when signing off/providing point allocation.	Ask service resident for MRN of associated case and utilize MiChart for history gathering. Utilize textbooks provided as references in sign-out rooms to evaluate microscopy.
1										
2										
3										
4										
5										

Fig. 3. A sample of the "Pathology Passport:" Page 2 (of 5) for the clinical activities elective students can participate in during their Gastrointestinal Pathology rotation. In this case, the activity shown is previewing a biopsy and providing the relevant clinical history and differential diagnosis. This activity is more involved and is therefore considered to be of moderate difficulty (yellow) and can be performed up to five times for a credit of up to 7 points per attempt. It is required to be completed at least once for a grade of Pass.

Sample of Gastrointestinal Pathology Rotation from "Pathology Passport" (Page 3/5)										
Task	Required for passing (if yes, # of times)	Max Points Per Attempt	Difficulty	Time Required for:		Sign-off by:	Points	Signature	Notes For: Evaluators	Notes For: Students
				Preparation	Performance					
Participate in the grossing of a resection specimen with the supervision of a resident (i.e. take measurements, ink, take representative sections, etc. (max: 2x/week). Place case numbers below.	No	4		N/A	15-60 minutes	Resident			Please highlight key aspects of clinicopathologic correlation of specified organ resection (differential diagnoses, key macroscopic considerations such as margins, lymph node, etc.)	The degree of participation or involvement will vary based on the experience and comfort levels of both you and your resident. This can include a combination of providing measurements, taking photographs, representative sections, inking, etc.)
1										
2										

**Fig. 4.** A sample of the "Pathology Passport:" Page 3 (of 5) for the clinical activities elective students can participate in during their Gastrointestinal Pathology rotation. For High Pass and Honors grades, the student must complete at least one of the optional learning activities designated by a purple background per week in addition to acquiring a designated point value cut-off. In this case, the activity shown is participation in the grossing of a specimen. As indicated by the purple background, this activity would be an option to complete for a student attempting to receive a grade of High Pass or Honors. As this activity may require a significant amount of extra time on the part of the resident working with the medical student, it is capped at two attempts per week.

Sample of Gastrointestinal Pathology Rotation from "Pathology Passport" (Page 4/5)										
Task	Required for passing (if yes, # of times)	Max Points Per Attempt	Difficulty	Time Required for:		Sign-off by:	Points	Signature	Notes For: Evaluators	Notes For: Students
				Preparation	Performance					
Present key findings or summary of an article relevant to the work-up of a disease entity seen in sign-out (max: 5x/week). Place reference of article(s) discussed below.	No	5		30-60 minutes	5 minutes	Faculty, Fellow, or Resident			Please help identify appropriate topic for discussion related to the evaluation or work-up of a case.	It will help to notify the faculty that you are interested in delving into a literature search on a disease entity identified/discussed in sign-out and present results of a related article the following day.
1										
2										
3										
4										
5										

**Fig. 5.** A sample of the "Pathology Passport:" Page 4 (of 5) for the clinical activities elective students can participate in during their Gastrointestinal Pathology rotation. This shows another example of an activity would be eligible for credit toward receiving a grade of High Pass or Honors. In this case, the activity involves preforming some literature review and presenting the key findings of a relevant disease entity. As this would require time in sign out, there are notes which advise the rotator to discuss in advance with the faculty member so that time can be appropriately coordinated. This also gives the faculty member an opportunity to suggest specific areas for the medical student to focus on, if applicable.

**Program evaluation**

In order to assess: (1) the level of student satisfaction with the new pathology elective layout and (2) the degree to which the new pathology layout met the original goals and expectations, pre- and post-rotation surveys were created for all elective students to complete at the beginning and end of their rotation experience, respectively. Questions in the surveys were designed to explore multiple aspects. The pre-elective survey was designed to assess the perceived overall understanding of broad pathology concepts and explore students' career interests (Table 2). In addition to these questions, the post-elective survey included questions to investigate the rotation's impact on student learning (Table 3). Responses were collected either as free text or on one of two 5-point Likert scales – Excellent (5), Very Good (4), Good (3), Fair

(2), Poor (1); or Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), Strong Disagree (1). Further feedback was solicited directly from learners via end-of-elective interviews with the clerkship director. Key points from student responses were recorded and consolidated.

**Results**

The new pathology elective curriculum was implemented in March of 2022, and 22 students completed the four-week elective between then and the end of July 2023. 21 (95%) completed both the pre- and post-elective surveys. These students consisted of 9 third-year medical students and 12 fourth-year medical students. The students expressed initial interest in a diverse range of residency training programs on their pre-elective survey, including internal medicine (1), general surgery (2),

Sample of Gastrointestinal Pathology Rotation from "Pathology Passport" (Page 5/5)										
Task	Required for passing (if yes, # of times)	Max Points Per Attempt	Difficulty	Time Required for:		Sign-off by:	Points	Signature	Notes For: Evaluators	Notes For: Students
				Preparation	Performance					
For a case that requires special stains or immunohistochemical work-up, explain the differential diagnoses and how the ancillary testing would be helpful in narrowing the differential (max: 5x/week). Place case numbers below.	No	5		30-60 minutes	5 minutes	Faculty, Fellow, or Resident			Please help identify an appropriate case where student can review references and on-line material to discuss the differential and utility of an ancillary test work-up.	It will help to notify the faculty that you are interested in reading more about ancillary testing for presentation the following day.
1										
2										
3										
4										
5										

Fig. 6. A sample of the "Pathology Passport:" Page 5 (of 5) for the clinical activities elective students can participate in during their Gastrointestinal Pathology rotation. This represents the final set of activities available to students during their GI rotation week. In this case, it is presenting how immunohistochemical and special stain work-up impacts the differential diagnosis for a case. Again, this is an activity which would be eligible for credit toward a grade of High Pass or Honors.

**Table 2**  
Pre-elective survey questions.

I have a(n) (excellent/very good/good/fair/poor) understanding of the daily practice and responsibilities of a pathologist.
I have a(n) (excellent/very good/good/fair/poor) understanding of the grossing process/macroscopic evaluation of surgical pathology specimens.
I have a(n) (excellent/very good/good/fair/poor) understanding of how pathology integrates into daily patient care.
I understand the difference between anatomic and clinical pathology. (Strongly agree/agree/neutral/disagree/strongly disagree)
I am interested in applying to pathology residency. (Strongly agree/agree/neutral/disagree/strongly disagree)
I am currently planning on applying to a residency in _____. (Free text)

neurosurgery (1), obstetrics and gynecology (1), ophthalmology (1), otolaryngology (1), plastic surgery (1), and radiation oncology (1). Some students expressed uncertainty in future career trajectories and listed multiple fields including internal medicine or pathology (1), obstetrics and gynecology or family medicine (1), and radiology or pathology (2). The 8 remaining students were interested in pathology only.

Data from paired pre- and post-elective survey questions was reviewed, and comparisons were made using the Wilcoxon matched-pairs signed rank test. Results showed that students endorsed significant improvement ( $p < 0.0001$ ) in the understanding of daily practice and responsibilities of a pathologist, the grossing process/macroscopic evaluation, how pathology integrates into daily patient care, and the difference between anatomic and clinical pathology (Table 4). There was no significant change in student interest in applying to pathology residency.

Additional feedback showed a generally positive impact of the elective on student learning and understanding of pathology. All students agreed or strongly agreed the elective enhanced their understanding of clinicopathologic correlations and clinical decision-making skills, that they felt engaged in the clinical activities of the pathology services, and that faculty and residents facilitated active participation. Most students agreed (24%) or strongly agreed (67%) that the elective improved their understanding of lab testing (including indications and limitations), although some felt neutral (5%) or disagreed (5%). All students agreed or strongly agreed that the elective had a positive impact on perspectives about pathology and rated the overall quality of the elective as very good

**Table 3**  
Post-elective survey questions.

I have a(n) (excellent/very good/good/fair/poor) understanding of the daily practice and responsibilities of a pathologist.
I have a(n) (excellent/very good/good/fair/poor) understanding of the grossing process/macroscopic evaluation of surgical pathology specimens.
I have a(n) (excellent/very good/good/fair/poor) understanding of how pathology integrates into daily patient care.
I understand the difference between anatomic and clinical pathology. (Strongly agree/agree/neutral/disagree/strongly disagree)
I am interested in applying to pathology residency. (Strongly agree/agree/neutral/disagree/strongly disagree)
I am currently planning on applying to a residency in _____. (free text)
I am currently an _____. (Possible responses – M3 or M4).
Using the information gained from this rotation, I have a better understanding of the appropriate utilization of laboratory testing, including both testing indications and limitations. (Strongly agree/agree/neutral/disagree/strongly disagree)
This elective has made a positive impact on how I view pathology. (Strongly agree/agree/neutral/disagree/strongly disagree)
I felt engaged in the clinical activities of the pathology services I rotated on. (Strongly agree/agree/neutral/disagree/strongly disagree)
I felt residents facilitated my active participation in the clinical activities and completion of passport required and optional elements. (Strongly agree/agree/neutral/disagree/strongly disagree)
I felt faculty facilitated my active participation in the clinical activities and completion of passport required and optional elements. (Strongly agree/agree/neutral/disagree/strongly disagree)
The experiences from this elective will improve my understanding of clinicopathologic correlations and/or enhance my future clinical decision-making process. (Strongly agree/agree/neutral/disagree/strongly disagree)
I find the work of a pathologist more interesting than I had prior to this elective. (Strongly agree/agree/neutral/disagree/strongly disagree)
I felt that the course requirements and expectations for grading and participation while on this rotation were clearly outlined in the passport. (Strongly agree/agree/neutral/disagree/strongly disagree)
I felt that the course requirements and expectations for grading and participation while on this rotation were clearly outlined in the passport. (Strongly agree/agree/neutral/disagree/strongly disagree)
Overall, how would you rate the quality of this elective? (Free text)
What were notable strengths of this elective? (Free text)
How might this elective be improved? (Free text)
Were there any passport activities or requirements that you felt were especially difficult to complete or required significantly different time/effort than was listed? (Free text)

**Table 4**  
Pre- and post-elective survey response data.

	Pre-Test Average (n = 21)	Post-Test Average (n = 21)
I have a(n) excellent/very good/good/fair/poor understanding of the daily practice and responsibilities of a pathologist.	2.20	4.4*
I have a(n) excellent/very good/good/fair/poor understanding of the grossing process/macrosopic evaluation of surgical pathology specimens.	1.73	4.4*
I have a(n) excellent/very good/good/fair/poor understanding of how pathology integrates into daily patient care.	3.13	4.6*
I understand the difference between anatomic and clinical pathology. (Strongly agree/agree/neutral/disagree/strongly disagree)	3.27	4.67*
I am interested in applying to pathology residency. (Strongly agree/agree/neutral/disagree/strongly disagree)	3.33	3.4ns

Responses were scored on a 5-point scale: 1 = Poor/Strongly Disagree, 2 = Fair/Disagree, 3 = Good/Neutral, 4 = Very Good/Agree, 5 = Excellent/Strongly Agree. ns = not significant, \* =  $p < 0.0001$ .

(14%) or excellent (86%), with an average score of 4.86 on a scale of poor (1) to excellent (5). See Fig. 7 for additional information.

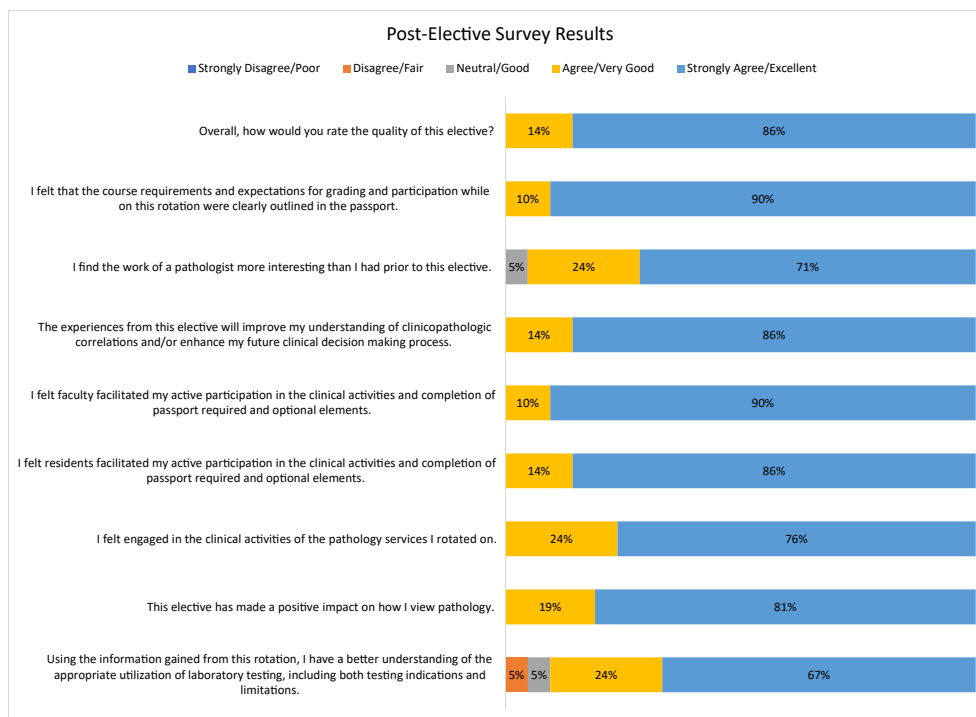
Feedback was also received formally through end-of-elective interviews with the clerkship director. The themes elicited from student interviews expressed deep appreciation for clear elective expectations and transparency of grading, which decreased anxiety associated with nebulous clinical grading processes. Students also discussed how the Passport facilitated meaningful involvement in activities they would not have otherwise pursued (e.g. grossing or previewing cases) and reduced anxiety about asking busy clinical team members to participate in clinical workflows. Students also noted that their participation in clinical workflows enhanced their enjoyment of the learning experience. A student commented, “The independent previewing experience was essential and

increased my engagement and enjoyment because I had skin in the game.” Students also frequently commented on how their learning experiences were positively impacted by the high level of engagement and enthusiasm of resident teachers and faculty, with a student commenting “It was phenomenal to feel like I was part of the team.” Informal faculty feedback positively noted enhanced student engagement with a resultant increase in faculty enjoyment of teaching. However, there were also notes for improvement gathered from students at the end-of-elective interviews. For some, a full week of autopsy seemed “tedious and repetitive” and there were suggestions to have a shorter autopsy experience. Additionally, several students noted carrying the “Pathology Passport” was cumbersome and thought future iterations could benefit from digitization.

### Discussion

Utilizing the conceptual proposal for a “passport to pathology” by Minhas and colleagues, we present the first successful development, operationalization, and implementation of this structure in a medical student pathology elective rotation. Importantly, results from our study show that student rotators had statistically significant improvement in reported understanding of broad pathology topics. Additionally, they endorsed a sense of engagement in their clinical activities and rated the rotation to have high educational value. Both formal and informal feedback indicated enhanced learning environments for both student learners and instructors. Overall, we feel these findings lend support to the use of a learner-guided, task-oriented, and criterion-based grading structure in pathology electives.

Although the rotation attracted students with a wide range of career interests (with only 8/21 expressing definite interest in pathology and 3/21 expressing it as a possibility), we saw essentially no change in student interest in applying to pathology residency programs at the end of the rotation. Indeed, even the undecided students listed the same career interests in their post-residency survey; longer follow-up would be needed to determine which specialty they would ultimately apply for. These data suggest that elective opportunities in pathology in the third and fourth



**Fig. 7.** Post-elective survey results.

years of medical school may be too late for the exposure needed to recruit additional students into pathology. Of note, one elective student noted in their end-of-elective interview that earlier exposure to this elective experience would have encouraged them to apply to pathology instead of surgery. As such, student exposure to pathology workflows earlier in the curriculum is likely essential to enhance recruitment into the field. As mentioned previously, additional efforts to integrate pathology into the clerkship curriculum may help encourage student exploration through earlier pathology elective experiences.

However, it is important to note that many rotators (13/21) expressed possible career interests other than pathology and yet all rotators rated the elective highly. Importantly, all rotators agreed (14%) or strongly agreed (86%) that the rotation served to improve their understanding of clinicopathologic correlations and/or enhance their future clinical decision-making processes. Additionally, there was a significant improvement in the endorsed understanding of how pathology integrates into patient care. As such, the flexibility offered by the modularity of the Passport allows for the curriculum to be inclusive of students with disparate career interests while maintaining sufficient rigor to achieve our goals of improving understanding of pathology as a career, how other clinical practices may interface with pathology, and how these interactions may affect patient care.

An additional advantage of the modular nature of the Passport is that it is very easy to add or modify rotations. For example, during the initial iterations of the rotation we had a one-week autopsy rotation. However, we have a high-volume autopsy service, and student feedback showed they felt that they received sufficient exposure before the end of the week. Additional student feedback requested opportunities to rotate on our frozen section service, so a new hybrid autopsy and frozen section week was created. Based on the success of the Passport in our surgical pathology subspecialties, we also plan to create rotations in our clinical pathology subspecialties. Adding additional subspecialty rotations requires identifying relevant required and optional clinical activities for a one-week rotation, using the same process already outlined in our methods. It is easy to then incorporate these rotations for students by assigning them one-week rotations on these new sub-specialties, without requiring any changes to existing one-week rotations.

There are, however, limitations to our evaluation. While we have feedback regarding the elective's positive impact on students' perceived understanding of pathology and their overall learning experience, we do not have adequate comparison data with the previous elective layout to quantify this impact. Additionally, we recognize that the pre-and post-elective surveys evaluate students' self-perceived change in knowledge and do not contain a formal assessment method to objectively showcase the acquisition of knowledge. As such, future steps in curricular development include the creation of formative assessments, which may also be helpful in further guiding curricular changes. Specifically, post-elective assessments may highlight how students either meet or do not meet high-priority learning objectives. For learning objectives that are consistently unmet, additional resources (i.e. creation of educational materials and/or faculty/resident development sessions to highlight key content areas to address with medical students) may be created to facilitate student achievement of these objectives. Another aspect to consider for further evaluation of the elective redesign is the impact it has had on pathology assistants, residents, and faculty. As such, future steps to guide curricular improvements will include the distribution of surveys to these cohorts in order to collect data on their perspectives regarding the elective design's impact on the learning environment, the level of engagement of stakeholders, and clinical workflows.

## Conclusions

Leveraging a learner-driven and activity-oriented curriculum with criterion-based grading through the creation and implementation of a "Pathology Passport" can increase student engagement with pathology workflows and enhance learning environments for both learners and

educators. Furthermore, the curricular design is readily adaptable and can be applied to pathology electives at other institutions as well as other non-pathology clerkships and electives. The passport framework is widely generalizable and offers transparency and guidance to rotators. This is especially important on elective rotations in which medical students may be less familiar with expectations, or where students may less frequently rotate. Additionally, by allowing students to self-select activities and subspecialty areas, the elective experience can be individualized to a diverse learner population, helping to attract students with variable career goals and increasing pathology exposure to our future clinical colleagues.

## Footnote

The poster entitled "The "Pathology Passport": A Redesign of the Pathology Elective Experience to Enhance Medical Student Engagement and Understanding of Pathology as a Clinical Practice" by authors C Post, SE Abbott, and M Lew was presented at the 2023 United States and Canadian Academy of Pathology; March 13, 2023; New Orleans, LA.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.acpath.2024.100123>.

## References

1. Division of Laboratory Systems. *National Center for Preparedness, Detection, and Control of Infectious Diseases, Centers for Disease Control and Prevention. Laboratory Medicine: a National Status Report*. (Prepared by The Lewin Group under subcontract to Battelle Memorial Institute); 2008:151. Published May Accessed July 23, 2023 [https://www.lewin.com/content/dam/Lewin/Resources/Site\\_Sections/Publications/3993.pdf](https://www.lewin.com/content/dam/Lewin/Resources/Site_Sections/Publications/3993.pdf).
2. Talbert ML, Ashwood ER, Brownless NA, et al. Resident preparation for practice: a white paper from the College of American pathologists and Association of Pathology Chairs. *Arch Pathol Lab Med*. 2009;133(7):1139–1147. doi:10.5858/133.7.1139.
3. Magid MS, Cambor CL. The integration of pathology into the clinical years of undergraduate medical education: a survey and review of the literature. *Hum Pathol*. 2012 Apr;43(4):567–576.
4. Lew M. Increasing medical student exposure to pathology by creating an integrated rotation during surgery clerkship. *Acad Pathol*. 2021 May;8, 23742895211015344. doi:10.1177/23742895211015344.
5. Al Nemer A. Undergraduate medical students' perception of pathology. *Ann Diagn Pathol*. 2020 Feb;44, 151422. doi:10.1016/j.anndiagpath.2019.151422.
6. Holland L, Bosch B. Medical students' perceptions of pathology and the effect of the second-year pathology course. *Hum Pathol*. 2006 Jan;37(1):1–8. doi:10.1016/j.humpath.2005.10.004.
7. Raphael S, Lingard L. Choosing pathology: a qualitative analysis of the changing factors affecting medical career choice. *J Int Acad Med Sci Educ*. 2005;15:81–91.
8. Masuadi EM, Mohamud MS, Alhassan AM, et al. Factors and determinants of Choosing pathology as a future career: results from a Multi-Institution study. *Cureus*. 2021 Jun;13(6), e15790. doi:10.7759/cureus.15790.
9. Results and Data. *Residency Match*. National Resident Matching Program; 2003. Accessed August 1, 2023 <https://www.nrmp.org/wp-content/uploads/2021/07/resultsanddata2003.pdf>.
10. Results and Data. *Main Residency Match*. National Resident Matching Program; 2008. Accessed August 1, 2023 <https://www.nrmp.org/wp-content/uploads/2021/07/resultsanddata2008.pdf>.
11. Results and Data. *Main Residency Match*. National Resident Matching Program; 2010. Accessed August 1, 2023 <https://www.nrmp.org/wp-content/uploads/2021/07/resultsanddata2010.pdf>.
12. Results and Data. *Main Residency Match*. National Resident Matching Program; 2013. Accessed August 1, 2023 <https://www.nrmp.org/wp-content/uploads/2021/07/resultsanddata2013.pdf>.
13. Results and Data. *Main Residency Match*. National Resident Matching Program; 2018. Accessed August 1, 2023 <https://www.nrmp.org/wp-content/uploads/2021/07/Main-Match-Result-and-Data-2018.pdf>.
14. Results and Data. *Main Residency Match*. National Resident Matching Program; 2021. Accessed August 1, 2023 [https://www.nrmp.org/wp-content/uploads/2022/11/MMR-Results\\_and-Data\\_2021\\_revised.pdf](https://www.nrmp.org/wp-content/uploads/2022/11/MMR-Results_and-Data_2021_revised.pdf).



15. Results and Data. *Main Residency Match*. National Resident Matching Program; 2023. Accessed August 1, 2023 <https://www.nrmp.org/wp-content/uploads/2023/03/Match-Rates-by-State-Specialty-and-Applicant-Type-2023.pdf>.
16. McCloskey CB, Johnson K, Brissette M, et al. Factors influencing US allopathic medical students to choose pathology as a specialty. *Acad Pathol*. 2020;7, 2374289520951924. doi:10.1177/2374289520951924.
17. Minhas PS, Enogieru IE, Mitchell RN, Mata DA. Passport to pathology: transforming the medical student pathology elective from a passive educational experience to an exciting, immersive clinical rotation. *Hum Pathol*. 2017;68:34–39. doi:10.1016/j.humpath.2017.08.031.
18. Fu L, Swete M, Selgrade D, et al. Virtual pathology elective provides uninterrupted medical education and impactful pathology education during the COVID-19 pandemic. *Acad Pathol*. 2021;8, 23742895211010275. doi:10.1177/23742895211010275.
19. Tanaka KS, Ramachandran R. Perceptions of a remote learning pathology elective for advanced clinical medical students. *Acad Pathol*. 2021;8, 23742895211006846. doi:10.1177/23742895211006846.
20. Hartsough EM, Arries C, Amin K, Powell D. Designing and implementing a virtual anatomic pathology elective during the COVID-19 pandemic. *Acad Pathol*. 2021;8, 23742895211010265. doi:10.1177/23742895211010265.