



Regular Article

Factors influencing US osteopathic medical students to choose pathology as a specialty



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ABSTRACT

The decline in the number of US allopathic (Medical Doctor or M.D.) medical students matching to pathology residency has been a topic of much discussion at national pathology professional society meetings and in recent publications. A recent survey of fourth-year allopathic medical students was conducted to better understand the rationale behind students' interest or lack thereof in pathology as a specialty. This study utilizes a similar survey tool gauging osteopathic (Doctor of Osteopathy or D.O.) student knowledge and interest in pathology, and offers insight into a possible growth market for the specialty. Similar to allopathic students, osteopathic students noted that clinical or research opportunities in pathology during medical school, autopsy observation/participation, and participation in pathology interest groups correlated with a greater likelihood of selecting pathology as a specialty. However, some key differences in osteopathic medical school curricular elements including microscope use, gross pathology specimen demonstrations, case-based learning by pathologists, exposure to pathology during other rotations, awareness of a pathology interest group, as well as an overall understanding of the everyday work of a pathologist were noted. Experiential exposure to pathology, and direct mentorship from pathologists may present an opportunity for pathology professional organizations, and pathology residency programs to partner with osteopathic medical schools to increase interest in the field, and aid in pipeline development.

Keywords: Career choices, Pathology, Pathology residency, Specialty choice, Osteopathic medical student

Introduction

The decline in US allopathic medical students matching into pathology has been discussed in numerous national forums and well documented in publications. Between 2011 and 2021, the number of US allopathic seniors matching in pathology declined from 267 (1.7% of all graduates) to 198 (1.1%), and between the years 1986 and 2020, the percentage of US

Seniors matching to pathology programs ranged from a high of 2.4% to a low of 0.9%.¹⁻⁶ Pathology in particular matches fewer US medical graduates than other specialties.¹⁻⁶ There is on-going concern for maintaining an adequate number of practicing pathologists to meet the needs of the US healthcare system, and how best to plan for an optimal workforce.⁷⁻⁹

At the same time, the overall increase in pathology positions offered in the National Residency Matching Program (NRMP) Main Residency

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Match (MRM) was about 23% (from 518 in 2011 to 603 in 2020), and the overall increase in positions filled was 23% (from 476 in 2011 to 587 in 2020).⁵ Of those positions, osteopathic students matched into 34 of 476 positions in 2011 and 67 of 587 in 2020. This meant that the percentage of pathology residency positions filled by osteopathic students rose from 6.6% in 2011 to 11.4% in 2020. Of note, the total number of graduating osteopathic students nearly doubled (51% increase) during this same time period from 3,364 in 2008 to 6,886 in 2020, with the addition of new schools and branch campuses for existing schools.^{10–12} The total number of allopathic graduates increased 20% during this same time period, with 16,466 graduates in 2008, and 20,387 in 2020.^{13,14}

Osteopathic Medicine has a long heritage of being primary-care centric with the majority of osteopathic medical schools' mission statements explicitly stating an emphasis on educating and developing primary care physicians. The osteopathic philosophy emphasizes that a strong foundation in primary care makes all physicians better, regardless of the specialty they eventually choose and practice. The tremendous growth of osteopathic medical schools has largely been a response to predicted shortages in primary care providers. This rapid growth of matriculation means that roughly 1 in 5 medical students in the United States attends an osteopathic medical school.¹⁴

A unique difference in the experience of osteopathic versus allopathic students is that prior to 2015, osteopathic students had the option of participating in the American Osteopathic Association (AOA) Match which was exclusive to osteopathic students, or the NRMP's MRM, which is open to senior US allopathic, international medical graduates, senior osteopathic medical students, and graduates of US allopathic and osteopathic medical schools. From 2016–2020, the AOA combined the AOA

match with the MRM, creating a single combined residency matching system. During the same period of time, the accreditation system that oversaw AOA residency programs merged with the ACGME as a single graduate medical education accreditation system.^{15–17} The AOA match had not offered pathology residency in the past 20 years, which meant that applicants applying to pathology had to forego the AOA match and apply to the MRM along with their allopathic counterparts. Overlapping that same time period, from 2008 to 2017, there was a 27.5% decline in the number of graduating US allopathic student matching in pathology.⁵ Despite the primary care centered focus of osteopathic medicine, a steady percentage, and a modest increase in overall applications and matching to pathology residency has been seen in recent years. The introduction of the single accreditation system did not appear to have an impact on the number of osteopathic medical students entering pathology when comparing pre-integration years 2011–2015 to integration/introduction of the single accreditation system during 2016–2020.¹²

Previously the CAP Graduate Education Committee surveyed senior medical students from allopathic medical schools across the country to better understand factors influencing their decision to pursue/not pursue pathology as a specialty. There has been an overall increase in the number of pathology residency applicants from osteopathic medical schools in recent years (2011–2020), with the exception of an outlier year in 2017 which featured decreased applications. This finding correlates with the increase in the number of overall osteopathic medical students, while the overall percentage of osteopathic seniors matching into pathology remains stable at about 1%.^{10–12} We surveyed senior osteopathic medical students to assess their perceptions of pathology as a specialty, and how influences such as medical school curriculum, family and mentors, job and education

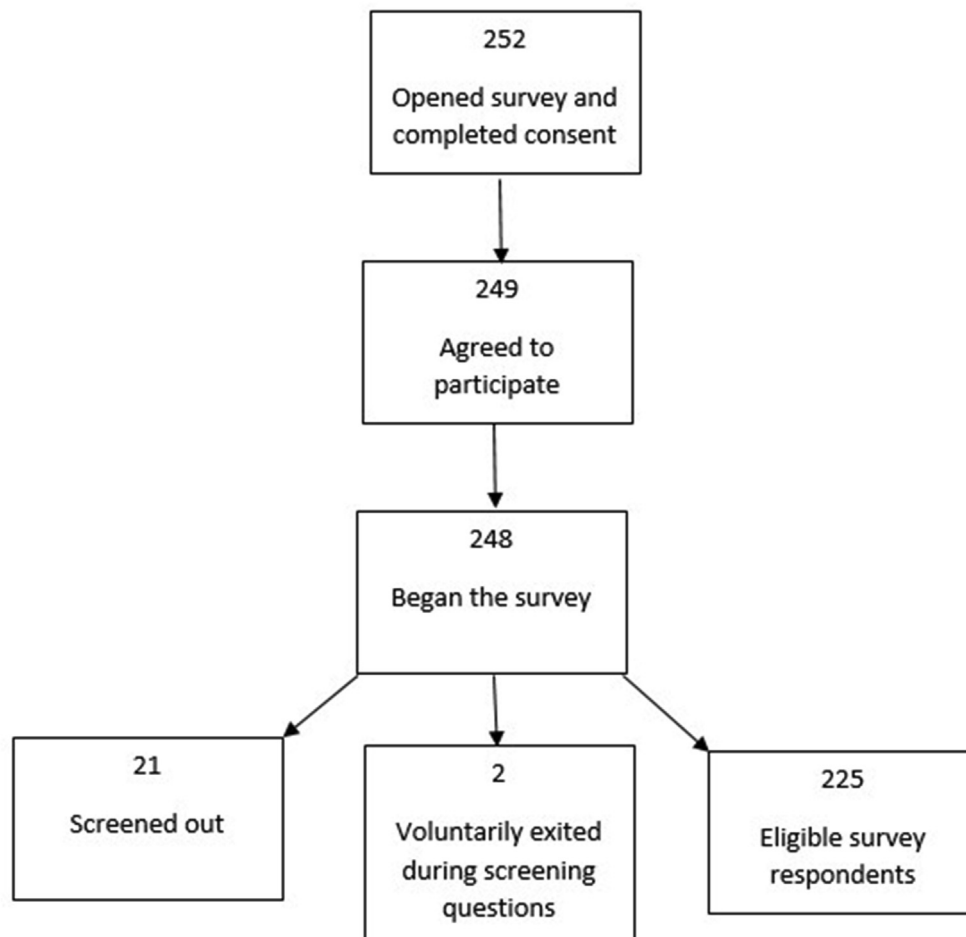


Fig. 1. Osteopathic medical student participation.

history, and social media impact specialty choice. The results from this survey supplement prior data collected from allopathic medical students¹ and will be used to identify factors that may contribute to the declining number of medical students applying to pathology residency positions. Understanding factors that are similar and dissimilar in influencing osteopathic medical student interest in pathology may help identify opportunities to improve medical student interest in the specialty, and ways that pathology professional organizations, and residency programs could partner with osteopathic medical schools in pipeline development.

Methods & materials

We conducted a national survey of fourth-year US osteopathic medical students graduating in spring 2021 to evaluate the factors that influenced their choice of a medical specialty, particularly their level of interest, knowledge, and perceptions about pathology. This study replicated McCloskey C et al.¹ using an equivalent survey instrument for osteopathic medical students. Institutional review board approval was obtained from The University of Oklahoma Health Sciences Center. The Associate Dean of Student Affairs (or other relevant administrator) at US osteopathic medical schools was sent an e-mail explaining the intent of the survey, and a link to the survey instrument. The e-mail requested that the survey be forwarded to all graduating medical students at their respective institutions. If applicable to the institution, the Chair of the Department of Pathology was copied on the email request. The survey was administered through a Survey Monkey instrument and was open from March 22nd to April 30th, 2021. One reminder was sent two weeks into the data collection period. Respondents had the option of not answering questions, which could result in a denominator less than the total number of survey takers for any given question.

As an incentive to participate, deans were offered the opportunity to receive aggregate survey data for their school upon request as this information may be beneficial for purposes of career advising. The American Osteopathic Association, Commission on Osteopathic College Accreditation as well as the Liaison Committee on Medical Education have accreditation standards pertaining to career advising.^{18,19}

The specialty choice interest survey was developed by the College of American Pathologists Graduate Medical Education Committee (CAP GMEC) and was designed to make comparisons between those students who considered a career in pathology (i.e., researched the specialty and made a conscious decision to either include or not include pathology in their rank list) versus those who did not consider the specialty. The survey asked specifically about the students' experiences and exposure to pathology in their medical school curriculum, factors that influenced specialty choice and timing of their decision-making, and attitudes about and knowledge of the field of pathology. Responses were summarized using descriptive statistics. Additionally, data was compared to the survey of allopathic medical students by McCloskey et al. to compare similarities and differences between the two student groups.¹ One sample t-tests and 2-way χ^2 tests were used to compare results between groups of respondents. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp).

Results

Deans at 32 osteopathic medical schools received e-mails requesting that the survey be forwarded to their students. Sixteen osteopathic medical schools (50%, N = 16 of 32) participated by forwarding the survey to their students. Two hundred fifty-two students opened the survey and completed consent, of which 249 agreed to participate and 248 actually began the survey. Twenty-one students were screened out because they selected either *No* or *Prefer Not to Answer* when asked if they were graduating from medical school in spring, 2021. An additional two students voluntarily exited the survey immediately after this screening question. In total, 225 students representing 14 osteopathic medical schools were eligible respondents (see Fig. 1). Respondents had the

option not answering questions, such that there are questions in which the response denominator is less than the 225 total survey takers.

Respondent demographics

Among those respondents who chose to answer demographic questions (Table 1), approximately half were female (54%, N = 109 of 203) and half were male (46%, N = 94 of 203) with the majority identifying as white (73%, N = 143 of 195) and between the ages of 25 and 29 years (79%, N = 161 of 203). Most respondents had undergraduate science majors (either alone or as part of a double major), with nearly half (49%, N = 98 of 201) majoring in Biology/Biochemical sciences. Forty-six respondents had graduate degrees with the majority holding a Master of Science (MS) degree (72%, N = 33 of 46). The demographics of osteopathic medical students are quite similar to those of allopathic medical students, and can be found in Table 1.¹

Respondent specialty choice

Most respondents (97%, N = 217 of 224) participated in the National Residency Matching Program (NRMP) to obtain a residency position. All

Table 1
Demographics.

	Frequency	Percent
Stated gender		
Male	94	46%
Female	109	54%
Total Respondents	203	
Age		
< 25 years old	2	1%
25–29 years old	161	79%
30–34 years old	31	15%
35–39 years old	5	2%
40–44 years old	3	1%
> 44 years old	1	0%
Total respondents	203	
Prefer not to answer	3	
Ethnicity		
White	143	73%
Hispanic or Latino	6	3%
Black or African American	5	3%
Asian	30	15%
American Indian or Alaskan Native	0	0%
Middle Eastern or North African	4	2%
Native Hawaiian or Pacific Islander	0	0%
Other, please specify ^a	7	4%
Total respondents	195	
Prefer not to answer	3	
Education		
Undergraduate major		
Biology/biochemical sciences	98	49%
Biochemistry	20	10%
Psychology	18	9%
Biomedical science	12	6%
Chemistry	10	5%
Neuroscience/neurobiology	10	5%
Total respondents	201	
Graduate degree		
PhD ^b	1	2%
MS	33	72%
MPH	0	0%
MBA	2	4%
JD	0	0%
Other ^c	12	26%
Total respondents	46	

Note: Undergraduate major responses were open-ended and only degrees noted by > 5% of respondents are listed.

^a Other comments: Sephardic Jewish; Pakistani; mixed race and Asian; mixed race; Middle Eastern, Asian; Indian; mixed Asian and white.

^b PhD fields of study: Microbiology and molecular genetics.

^c Other comments: MD degree (MBBS) from a foreign country before immigration to the US and pursuing a DO degree; MBS.

others participated in the military match. Respondents most frequently (78%, N = 172 of 221) included only 1 medical specialty on their match rank list. Most respondents (92%, N = 202 of 219) obtained a residency position in the main match. Fig. 2 shows the number of respondents who included each specialty on their match rank list and the number of respondents who obtained a position in that specialty. Among the 10 respondents accepting pathology residency positions, represented in Fig. 2, eight had included only pathology in their match rank list, one had ranked pathology as their first choice, and one preferred not to answer the questions about specialties included on the rank list. Twelve of the 17 respondents (71%) who did not obtain a position in the main Match considered a different specialty in the Supplemental Offer and Acceptance Program (SOAP) of the NRMP match. The most common specialty considered in the SOAP was Family Medicine (58%, N = 7 of 12). Pathology was considered by 2 respondents (17%, N = 2 of 12).

Timing and factors influencing specialty choice

Half of the respondents (53%, N = 117 of 220) decided on the medical specialty during medical school year 3, 14% (N = 31 of 220) in year 4, while 24% (N = 53 of 220) had already decided prior to beginning medical school. Of note, the pattern of results for students selecting pathology as a specialty is different; however, these results should be interpreted with caution due to the small sample size. Of the 10 students entering pathology, decisions were made as follows: 40% (N = 4 of 10) prior to medical school; 40% (N = 4 of 10) during year 4; 10% (N = 1 of 10) during year 2; and 10% (N = 1 of 10) during year 3. There were no statistically significant differences in the timing of medical specialty selection between osteopathic and allopathic medical students (Table 2).

For osteopathic medical students, factors impacting specialty choice are shown in Fig. 3.

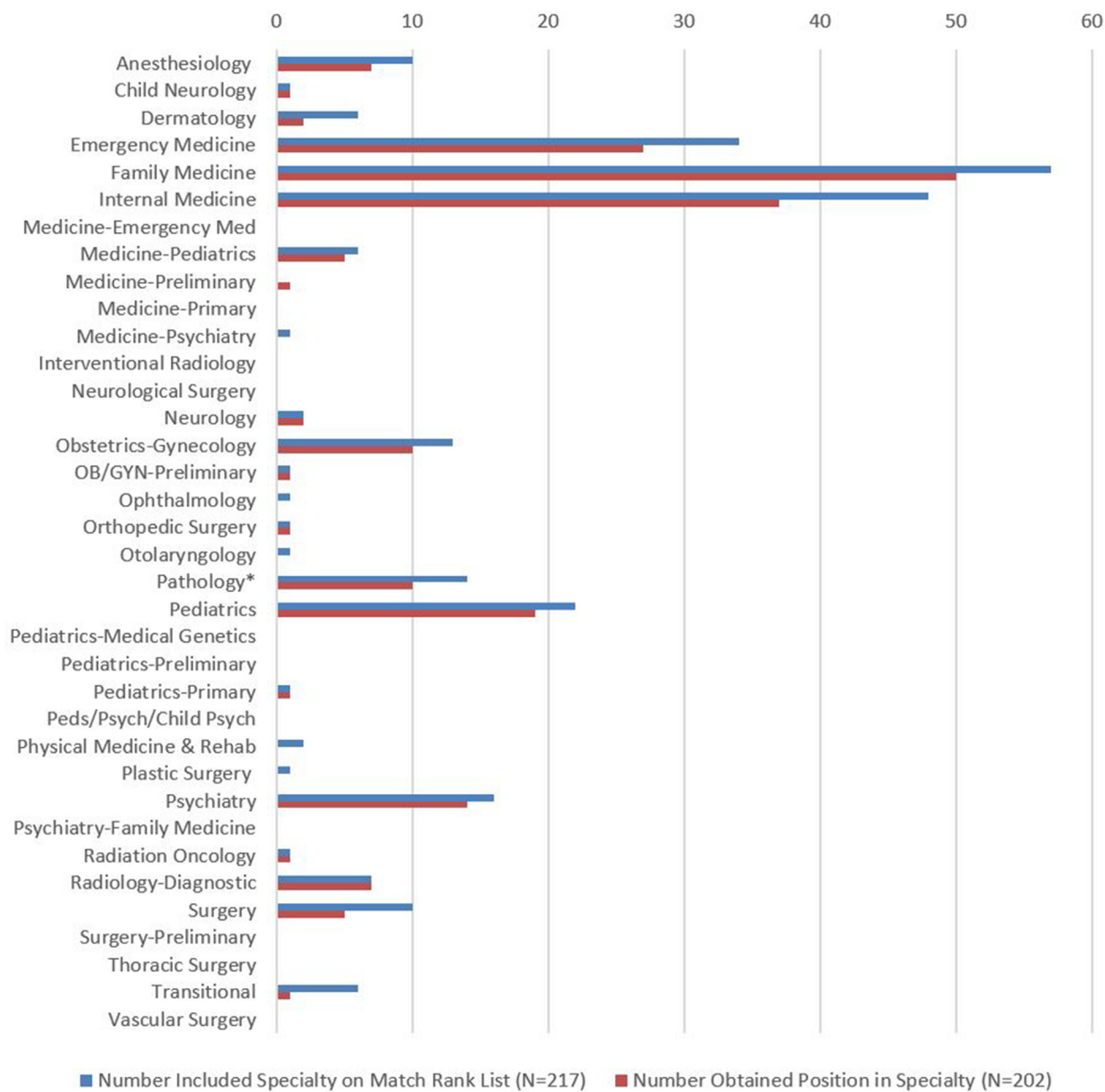


Fig. 2. Match preferences and outcome.

Table 2
Timing of medical specialty selection for DO versus MD students.

When did you decide on your medical specialty?	Osteopathic students		Allopathic students	
	Frequency	Percent	Frequency	Percent
Prior to medical school	53	24%	58	16%
Medical School Year 1	5	2%	11	3%
Medical School Year 2	13	6%	20	6%
Medical School Year 3	117	53%	202	56%
Medical School Year 4	31	14%	66	18%
During a Post-Sophomore Fellowship	0	0%	1	0%
During the PhD portion of a DO/PhD or MD/PhD	0	0%	3	1%
Other	1	0%	3	1%
Total number of respondents	220		364	

Significance: $\chi^2(7) = 9.296, P = .232$.

The survey queried factors influencing specialty choice via selections correlated to a Likert scale of 1–5 corresponding to (1) not at all, (2) only slightly, (3) somewhat, (4) for the most part, and (5) very much so.

Some key differences between osteopathic and allopathic medical students included lifestyle expectations; and reputation/prestige of the specialty with a higher percentage of osteopathic students ranking lifestyle more highly than allopathic students. Conversely, the reputation/prestige of the specialty was ranked as less important to osteopathic students compared to allopathic students. Osteopathic students were also less likely than allopathic students to rank peers, residents, and faculty at their institution as influential in their decision (Fig. 4).

Respondent pathology exposure

Table 3 provides detailed information on curricular exposure to pathology in osteopathic compared to allopathic medical schools. Most

respondents in both osteopathic and allopathic medical schools participated in lectures delivered by a pathologist during the preclinical years of medical school. Approximately 50%–60% of both osteopathic and allopathic students respectively of participated in a separate pathology course for which they received a grade. Consistent to both osteopathic and allopathic training, most students did not have a required pathology rotation, and only roughly one third of students noted having pathology elective rotation opportunities during their clinical third or fourth years of medical school. Of note, however, statistically significant differences (less exposure) were seen in osteopathic versus allopathic medical student participation in autopsy, microscope use, gross pathology specimen demonstrations, case based presentations by, and having exposure to pathology during other rotations such as following a specimen to the laboratory or reviewing slides with a pathologist. These differences are highlighted in Fig. 5.

When comparing students who considered pathology versus those who did not, statistically significant differences were noted including a greater percentage of those who considered pathology had participated in elective opportunities in pathology during 3rd or 4th year, reported microscope use (optical or digital), had exposure to gross pathology specimen demonstrations (not still images), and participated in research opportunities in pathology or related disciplines during medical school. These findings are shown in Table 4.

Post sophomore pathology fellowship

One respondent (< 1%, N = 1 of 211) had participated in a post-sophomore pathology fellowship. This was not the same respondent who indicated their school offers one, so participation was at a different medical school. This participant did not include pathology on their Match rank list. Sixty-one percent of respondents stated their school did not have a post-sophomore fellowship, and the balance did not know of such an offering.

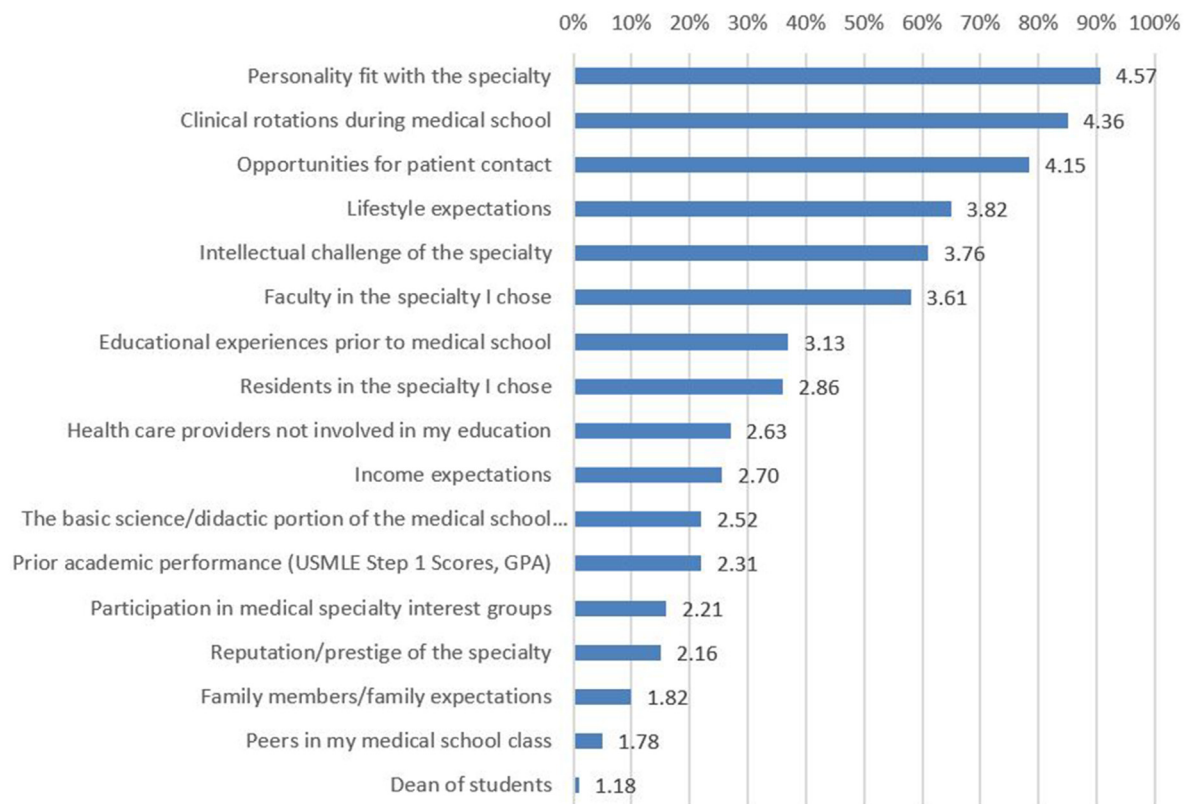


Fig. 3. Factors impacting specialty choice.

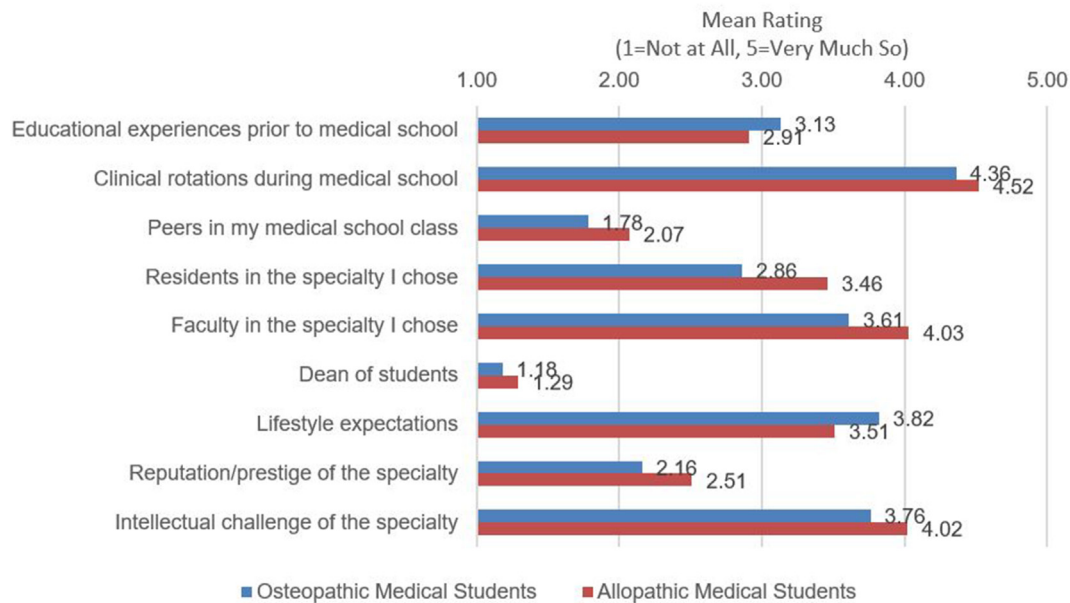


Fig. 4. Medical school type and factors influencing specialty choice. All results shown achieved statistical significance. Significance was tested via independent samples t-tests. Bar graphs reflect selections correlated to a Likert scale of 1–5 corresponding to (1) not at all, (2) only slightly, (3) somewhat, (4) for the most part, and (5) very much so.

Pathology interest group

Only 18% of respondents (N = 39 of 211) representing 10 medical schools (N = 10 of 13 or 77% of schools with responses this question), indicated that their medical school had a pathology interest group. A larger percentage (60%, N = 127 of 211) of respondents did not know if the medical school had a pathology interest group. Notably, 55% of respondents (N = 85 of 155) from schools with a pathology interest group were uncertain about whether their school had a pathology interest group, and 20% (N = 31 of 155) were unaware of the group (ie, stated they did not have one; Fig. 6). This is another area of statistically significant difference, with a smaller percent of osteopathic students being aware of the existence of their medical school's pathology interest group as compared to their allopathic colleagues ($\chi^2(2) = 74.481, P < .001$) (Fig. 6). Interestingly, the proportion of osteopathic medical schools with a pathology interest group (N = 10 of 13, or 77%) is comparable to what was observed among allopathic medical schools (N = 21 of 28, or 75%). With regards to participation in interest group activities, 26% of respondents (N = 10 of 39) who stated that their school had a pathology interest group had participated in the group's activities. Only 2 of these respondents (20%, N = 2 of 10) are entering pathology. Forty-three percent of respondents who considered pathology (N = 6 of 14) had participated in a pathology interest group versus only 17% (N = 4 of 24) of those who had not considered pathology as a specialty ($\chi^2(1) = 3.128, P = .077$).

Exposure to the field of laboratory medicine

A small percentage of respondents have a friend, family member or mentor who is a pathologist (15%, N = 32 of 210) or clinical/medical laboratory scientist (23%, N = 48 of 210). Additionally few respondents reported prior education or work-related experience in laboratory medicine, with 15% (N = 31 of 210) having worked in a clinical/hospital lab handling patient specimens; 5% (N = 10 of 210) having a degree in medical or clinical laboratory science or medical technology; and 1% (N = 3 of 210) having worked in the forensics field. These responses are very similar to those cited by allopathic students with 19% who had a friend, family member, or mentor who was a pathologist (N = 65 of 349), or 23% a clinical/medical laboratory scientist (N = 82 of 349). Similarly,

few allopathic students reported prior education or work experience in related fields with 17% (N = 61 of 350) indicating they had worked in a clinical/hospital laboratory handling specimens, 3% (N = 10 of 350) reporting a degree in medical or clinical laboratory science or medical technology, and 1% (N = 4 of 349) reporting a degree or work in the field of forensics.¹

Twenty-three percent (N = 49 of 209) osteopathic students considered a career in pathology. This is similar to the 27% (N = 94 of 350) allopathic students in the previously published allopathic study.¹ Fig. 7 shows the percentage of these respondents who used various resources to educate themselves on the field of pathology. The 4 most common resources included internet/social media, professional organization websites, pathologist outside of the medical school, and pathology faculty within the medical school. Respondents who used the internet/social media to research the field of pathology were asked to list the sites used. Sites listed by 5 or more respondents included Reddit (9 comments, 38%) and the American Association of Medical Colleges (AAMC) (5 comments, 21%).

Respondent perceptions of pathology exposure & pathology as a specialty

Respondents were asked to rate statements concerning their perceptions of the field of pathology (Fig. 8). Statements were rated on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5), with an additional option to choose "NA/Don't know enough about pathology to answer" as opposed to rating the statement. Notably many medical students did not feel sufficiently exposed to pathology to consider it as a specialty. Similar to findings in the allopathic study, there is a general consensus that information on social media and perceptions of the pathology job market do not seem to be positive.¹

Only 11% (N = 22 of 194) of osteopathic students agreed or strongly agreed that pathologists at their institution attempted to recruit them into the specialty, and only 31% (N = 62 of 203) felt sufficiently exposed to pathology in medical school to consider it as a career. Not surprisingly, osteopathic medical students who considered pathology rated "I understand the job activities of a pathologist," "Pathologists at my institution attempted to recruit me into pathology," "Pathology residents have high job satisfaction," "the time and workload demands of a pathology

Table 3
Integration of pathology in the medical school curriculum for DO versus MD students.

Did you participate in the following during medical school?		Osteopathic students	Allopathic students	Significance
A separate course in histology for which you received a grade	Total N	202	339	$\chi^2(1) = .817, P = .366$
	Yes	39% (79)	43% (146)	
A separate course in pathology for which you received a grade	Total N	207	341	$\chi^2(1) = 2.097, P = .148$
	Yes	50% (104)	57% (193)	
Lectures delivered by a pathologist during 1st or 2nd year	Total N	208	350	$\chi^2(1) = 7.164, P = .007$
	Yes	95% (198)	99% (346)	
Required pathology rotation during 3rd or 4th year	Total N	210	351	$\chi^2(1) = 6.229, P = .013$
	Yes	0% (1)	4% (14)	
Elective opportunities in pathology during 3rd or 4th year	Total N	194	343	$\chi^2(1) = 2.061, P = .151$
	Yes	31% (61)	38% (129)	
Autopsy (observation or participation)	Total N	209	344	$\chi^2(1) = 12.599, P < .001$
	Yes	18% (37)	31% (108)	
Microscope use (optical or digital)	Total N	210	347	$\chi^2(1) = 80.964, P < .001$
	Yes	55% (115)	88% (307)	
Gross pathology specimen demonstrations (not still images)	Total N	201	345	$\chi^2(1) = 84.508, P < .001$
	Yes	50% (100)	86% (297)	
Case-based learning led by pathologists	Total N	200	333	$\chi^2(1) = 88.802, P < .001$
	Yes	53% (105)	89% (296)	
Research opportunities in pathology or related disciplines during medical school	Total N	187	318	$\chi^2(1) = .889, P = .346$
	Yes	15% (28)	18% (58)	
Exposure to pathology during another rotation (e.g., following a specimen to the laboratory, looking at slides with a pathologist)	Total N	206	349	$\chi^2(1) = 43.274, P < .001$
	Yes	46% (95)	74% (258)	
	No	54% (111)	26% (91)	

Significance was tested via two-way chi-square test.

residency are reasonable,” and “Pathology attendings have high job satisfaction” more highly than those who did not consider the field, as noted in Fig. 9, below.

When compared to allopathic medical students, statistically significant differences were noted in the percentage of osteopathic medical students understanding the job activities of pathologists, believing they had adequate pathology education during the first 2 years of medical school, having sufficient exposure to pathology to consider it as a career choice, and having pathologist at their institution attempt to recruit them to pathology (Table 5).

When asked about perceptions of pathology as a medical specialty, the majority of osteopathic medical students indicated that pathology offers adequate scholarly and research opportunities, the opportunity to utilize new technologies, a good work-life balance, a satisfying degree of

intellectual challenge, and limited opportunities for direct patient contact (Fig. 10).

When comparing osteopathic versus allopathic medical students, areas where osteopathic medical students had statistically significant greater percentages of “don’t know” responses included: pathology attendings have high job satisfaction ($\chi^2(1) = 9.616, P = .002$), the time and workload of pathology residency are reasonable ($\chi^2(1) = 23.014, P < .001$), pathology offers the flexibility to work part-time ($\chi^2(1) = 22.584, P < .001$), pathologists have good work-life balance ($\chi^2(1) = 23.262, P < .001$), the average pathologist spends the majority of his/her time performing autopsies ($\chi^2(1) = 17.419, P < .001$), pathology offers adequate scholarly and research opportunities ($\chi^2(1) = 9.446, P = .002$), pathology offers the opportunity to utilize new technologies ($\chi^2(1) = 5.035, P = .025$), pathologists are introverts

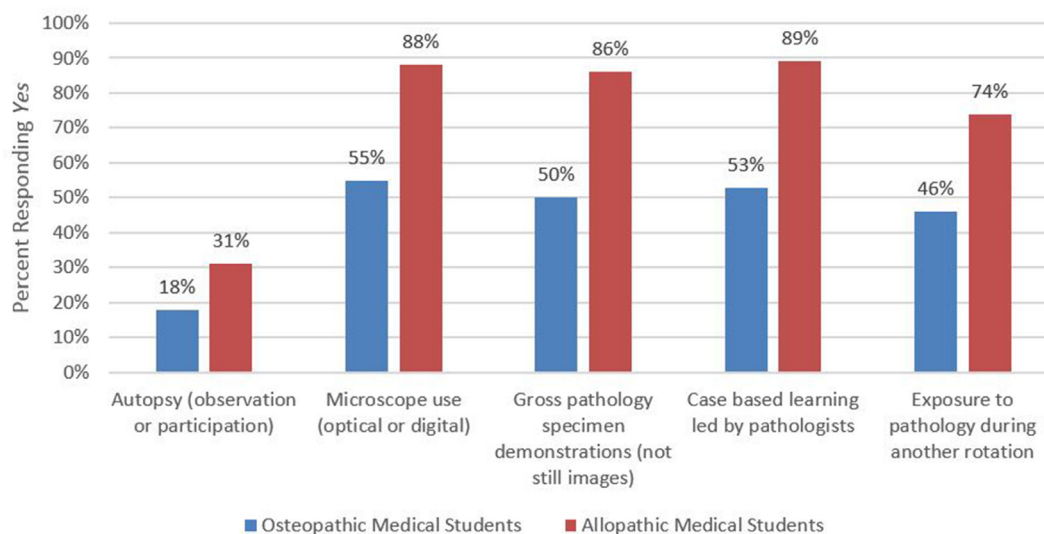


Fig. 5. Medical school type and participation in medical school pathology curriculum elements. All curriculum elements represented achieved statistical significance via two-way chi-square test. Analysis for two additional curriculum elements (lectures delivered by a pathologist and required rotation) achieved statistical significance; however, the difference in participation rates for these activities is not practically meaningful and therefore was excluded from this figure.

($\chi^2(1) = 9.273, P = .002$), and pathology has limited opportunities for direct patient contact compared to other specialties ($\chi^2(1) = 14.132, P < .001$), pathology is a highly regarded specialty ($\chi^2(1) = 5.176, P = .023$), and pathology offers a satisfying degree of intellectual challenge ($\chi^2(1) = 5.064, P = .024$) (Table 6).

In reviewing the data for osteopathic students who had versus those who had not considered pathology as a career, those who had considered the specialty expressed a statistically greater agreement when rating statements regarding understanding the job activities of the pathologist ($t(88.481) = 6.699, P < .001$), pathologists at their institution attempting to recruit them ($t(62.879) = 3.174, P = .002$), pathology residents having high job satisfaction ($t(70) = 2.904, P = .005$), the time and workload demands of pathology residency being reasonable ($t(71.843) = 3.099, P = .003$), attending pathologists having high job satisfaction ($t(74) = 4.027, P < .001$), Pathology being a highly regarded specialty ($t(173) = -2.466, P = .015$), pathologists having good work-life balance ($t(86.074) = 2.519, P = .014$), and Pathology offering a satisfying degree of intellectual challenge ($t(173) = 4.342, P < .001$; Figs. 11 and 12). Those who considered pathology provided significantly lower agreement ratings with the statement concerning pathologists spending the majority of their time performing autopsies ($t(120) = -3.049, P = .003$).

Free text responses regarding specialty choice

Survey respondents who did not consider a career in pathology were asked to provide comments as to why. Eighty-nine percent ($N = 143$ of 160 respondents) provided free text comments. Thematic analysis of the comments identified the following major themes: (1) desire for more patient contact (63%, $N = 90$), (2) too little exposure to the field to seriously consider it (20%, $N = 29$), (3) lack of interest/perception that pathology is boring (14%, $N = 20$), and (4) interest in a different specialty (9%, $N = 13$). Survey respondents who did consider pathology as a specialty were invited to comment as to why they did or did not choose pathology. Ninety-six percent ($N = 47$ of 49) commented. Of respondents who ultimately did choose a career in pathology ($N = 9$), themes represented in 5 of the 9 comments (56% each) included personality fit, enjoyment of the intellectual nature of the work, and lifestyle. Respondents specifically mentioned enjoying the behind the scenes work, and being able to make a definitive diagnosis. For those who considered, but ultimately did not choose a career in pathology ($N = 38$), key themes included preference for patient contact (55%, $N = 21$), the perception of a poor job market (24%, $N = 9$), and not having enough exposure to make

an informed decision or feel motivated to learn more about the field (26%, $N = 10$ of 38). There appeared to be some overlap with interest in dermatology, however, a few respondents indicated that they preferred the patient interaction and procedural aspects of dermatology over the diagnostic aspects of dermatopathology.

Discussion

The factors which influence osteopathic medical students' decisions regarding a medical specialty are similar to that of allopathic medical students. These decisions can be distilled into medical school characteristics, student characteristics, student values, career expectations, and perceptions of a specialty.²⁰ Of particular note, osteopathic medicine has a long and proud tradition of producing primary care practitioners. Not surprisingly, the match data for osteopathic medical students features family medicine, internal medicine, and pediatrics as the top 3 specialties ranked and matched. That said, with the rapid growth of osteopathic medical schools, and the stable percentage of osteopathic students entering the field of pathology, there appears to be a growth opportunity for the pathology pipeline within osteopathic medical schools.

While it has been hypothesized that shifting toward a more integrated medical school curricula and moving away from a standalone pathology course may impact interest in the field, this does not seem to have influenced osteopathic students very much, similar to that previously reported for allopathic medical students.¹ The majority of our osteopathic respondents, much like allopathic respondents had participated in lectures delivered by a pathologist during the preclinical years of medical school. Additionally similar percentages, of approximately 50%–60% of osteopathic and allopathic students, participated in a separate pathology course for which they received a grade. These areas, while exposing students to the subject of pathology, do not necessarily provide a better understanding of a pathologist daily work, intellectual challenges, and overall lifestyle. Therefore these areas appear to be less important in fostering student interest in pathology as compared to more experiential exposure, such as autopsy participation, microscopy, gross specimen demonstrations, and case based learning led by pathologists. Of note, however, osteopathic medical students were statistically less likely to have participated in autopsy, microscope use, gross pathology specimen demonstrations, case based presentations by pathologists, and to have exposure to pathology during other rotations such as following a specimen to the laboratory or reviewing slides with a pathologist. As noted in

Table 4

Comparison of integration of pathology into the medical school curriculum for those respondents who considered pathology as career choice versus those who did not.

Integration of pathology in the medical school curriculum by consideration of pathology		Pathology considered	Pathology not considered	Significance
Did you participate in the following during medical school?	A separate course in histology for which you received a grade	Total N 47 49% (23)	153 51% (24)	$\chi^2(1) = 2.550, P = .110$
		No 36% (55)	64% (98)	
	A separate course in pathology for which you received a grade	Total N 49 57% (28)	156 43% (21)	
	No 48% (75)	52% (81)		
Lectures delivered by a pathologist during 1st or 2nd year	Total N 49 98% (48)	157 95% (149)	$\chi^2(1) = .834, P = .361$	
	No 2% (1)	8% (8)		
Required pathology rotation during 3rd or 4th year	Total N 49 0% (0)	159 1% (1)		$\chi^2(1) = .310, P = .578$
	No 100% (49)	99% (158)		
Elective opportunities in pathology during 3rd or 4th year	Total N 48 60% (29)	144 22% (32)	$\chi^2(1) = 24.227, P < .001$	
	No 40% (19)	78% (112)		
Autopsy (observation or participation)	Total N 49 22% (11)	158 16% (25)		$\chi^2(1) = 1.143, P = .285$
	No 78% (38)	84% (133)		
Microscope use (optical or digital)	Total N 49 67% (33)	159 50% (80)	$\chi^2(1) = 4.379, P = .036$	
	No 33% (16)	50% (79)		
Gross pathology specimen demonstrations (not still images)	Total N 48 69% (33)	151 43% (65)		$\chi^2(1) = 9.627, P = .002$
	No 31% (15)	57% (86)		
Case based learning led by pathologists	Total N 49 61% (30)	149 49% (73)	$\chi^2(1) = 2.210, P = .137$	
	No 39% (19)	51% (76)		
Research opportunities in pathology or related disciplines during medical school	Total N 45 31% (14)	140 10% (14)		$\chi^2(1) = 11.816, P = .001$
	No 69% (31)	90% (126)		
Exposure to pathology during another rotation (e.g., following a specimen to the laboratory, looking at slides with a pathologist)	Total N 48 52% (25)	156 44% (68)	$\chi^2(1) = 1.068, P = .302$	
	No 48% (23)	56% (88)		

Significance was tested via two-way chi-square test.

a survey of allopathic medical students, pathology appears to become even less visible in the clinical years of medical school. Roughly one third of osteopathic medical students had pathology elective opportunities in the third or fourth year, and just under half had exposure to pathology during other rotations such as following a specimen to the laboratory or directly viewing slides with the pathologist. When comparing osteopathic medical students who considered pathology versus those who did not, the most influential curricular elements were microscope use, gross pathology specimen demonstrations, availability of elective rotations in

the third or fourth years, and research opportunities, all being more prevalent, and achieving statistical significance, for those students considering pathology versus those who did not. Proportions of osteopathic versus allopathic medical students were similar in regard to those who availed themselves of participating in elective opportunities in 3rd or 4th year. While it is not surprising that those who considered pathology would be more likely to pursue 3rd and 4th year electives in pathology, and may reflect selection bias, it does beg the question of how many students are aware of pathology electives.

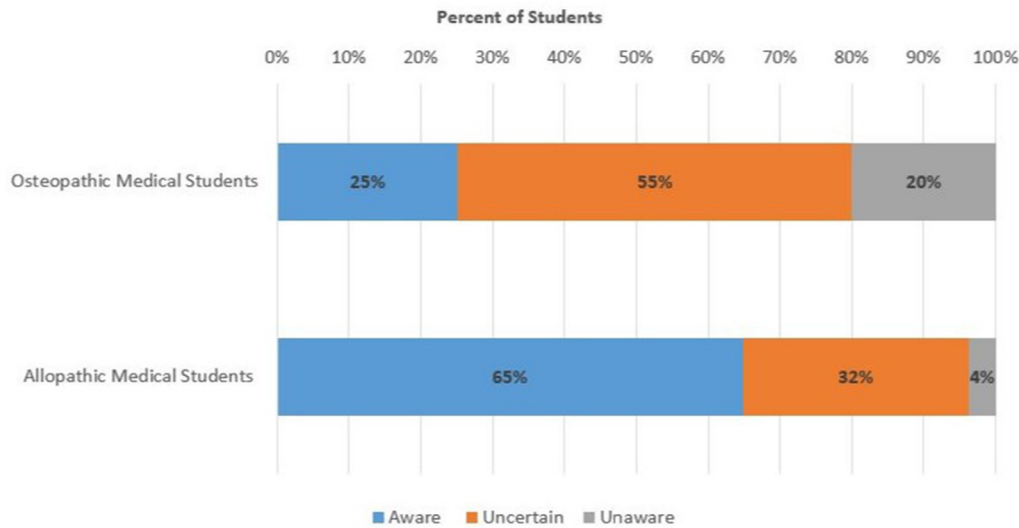


Fig. 6. Pathology interest group awareness among students attending schools that have an Interest Group.

A high percentage of osteopathic medical students selected I do' not know enough responses in regard to their understanding of quality of life criteria in pathology careers, including: residents have high job satisfaction, pathology attendings have high job satisfaction, the time and workload demands of a pathology residency are reasonable, the pathology job market is strong, pathology offers the flexibility to work part-time, and pathologists have good work-life balance. These would seem to be opportunities to provide osteopathic medical students with sufficient exposure to make an informed decision. Perhaps more would consider the field if they were provided insight into these areas. It seems that more hands-on or experiential pathology exposure is more influential in informing understanding than traditional didactics which is aimed more at medical knowledge, rather than systems-based practice and understanding the interconnectedness of medical specialties and the unique role that pathology plays in patient care. While it is true that most subspecialties of pathology do not have direct patient contact, students may not be aware of subspecialties like Transfusion Medicine, where the pathologist directly interacts with patients and donors and oversees

therapeutic and donor procedures; Cytopathology, where pathologists may directly perform the diagnostic procedures, and Surgical Pathology special clinics where pathologists show patients their slides. Students may also be unaware of the degree of interdisciplinary communications that pathologists participate in daily, and shared patient management, solving diagnostic puzzles behind the scenes. Getting a glimpse of a day in the life of various types of pathologists would give students the opportunity to better appreciate the intellectual challenges, and high job satisfaction of attending pathologists. Most students probably do not realize that pathology ranks among the top 5 specialties for career satisfaction.²¹

Similarly proportioned to allopathic medical students, the majority of osteopathic students decide upon a medical specialty in the third year of medical school. The next most frequently cited timing is prior to medical school. These areas could be important opportunities for professional organizations, and pathology residency programs to partner with osteopathic medical schools to supplement these experiences. There could also be opportunities for pathology residency programs to offer summer

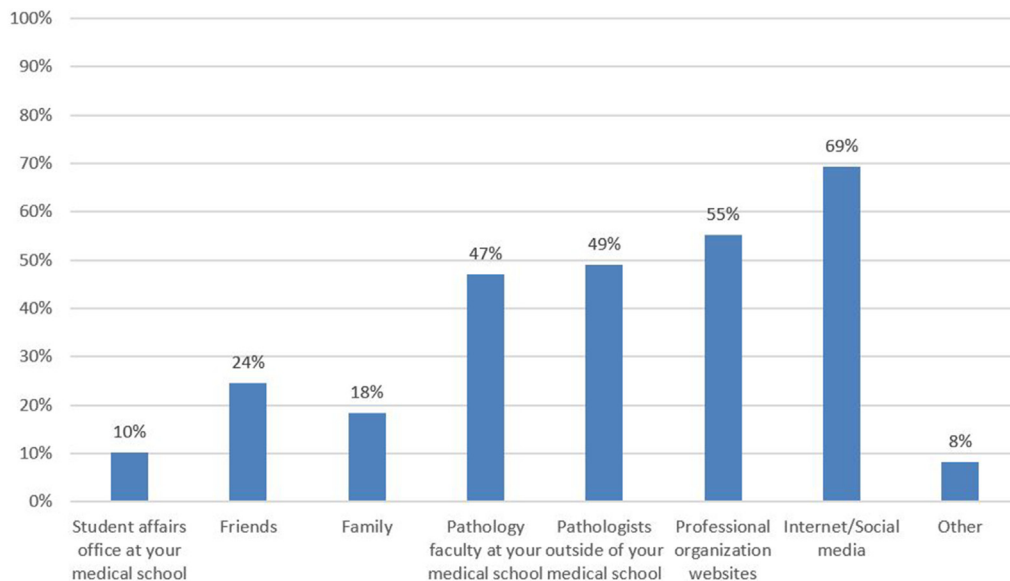


Fig. 7. Resources used to research pathology. The percentages represent the percentage of the 49 of 209 respondents who considered a career in pathology who used various resources to research pathology as a career.

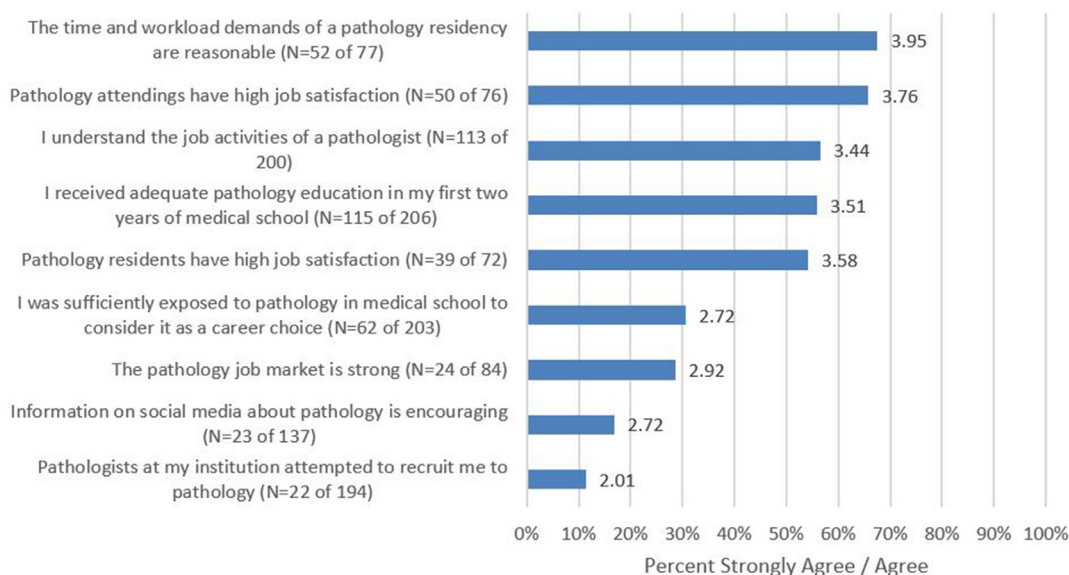


Fig. 8. Perceptions of pathology exposure. The numbers in the graph represent the mean rating across all respondents. Each criterion was ranked on a Likert scale of (1) not at all, (2) only slightly, (3) somewhat, (4) for the most part, and (5) very much so. The numbers labeling each bar indicate the mean rating across all respondents. Percentage on the X-axis designates the percent responding very much so (5) or for the most part (4). Numbers in the graph represent mean rating across all respondents.

research experiences/internships for college students pursuing medical school, osteopathic or allopathic. Pathology residency programs with nearby osteopathic medical school campuses could make a concerted effort to partner with osteopathic medical schools to offer elective rotation experiences in the third and fourth years.

Small rotation curricular changes, such as including a requirement to follow a specimen from the operating room to the gross room, and through the process of making and interpreting histologic slides would be a value added experience for students and would serve as a micro-experience exposing them to pathology as a discipline. Encouraging student participation in hospital laboratory utilization committees could also provide students with a better understanding of the role of pathologists in providing and enhancing the quality of patient care, as well as stewardship of costs and resources. Students should also become aware of diagnostic management teams and clinics in which pathologists show

patients their slides to enhance their understanding of their medical condition. These activities would help students see the more tangible impact of pathologists in the daily patient care teamwork, beyond issuing diagnostic reports.

Students at osteopathic medical schools were less aware of the existence of a pathology interest group at their school. While reasons for this are unclear, we may speculate at the membership of these groups is smaller, and their events may have less socialization through the campus. This could be another prime opportunity for pathology professional organizations to identify practicing pathologist members in the vicinity of the school to provide mentorship, shadowing/rotation opportunities, and partner with these campuses to provide access to provide more robust engagement and education on the specialty of pathology. There could also be opportunity to combat the hidden curriculum that pathologists are introverts who shy away from patient care and the perception that the

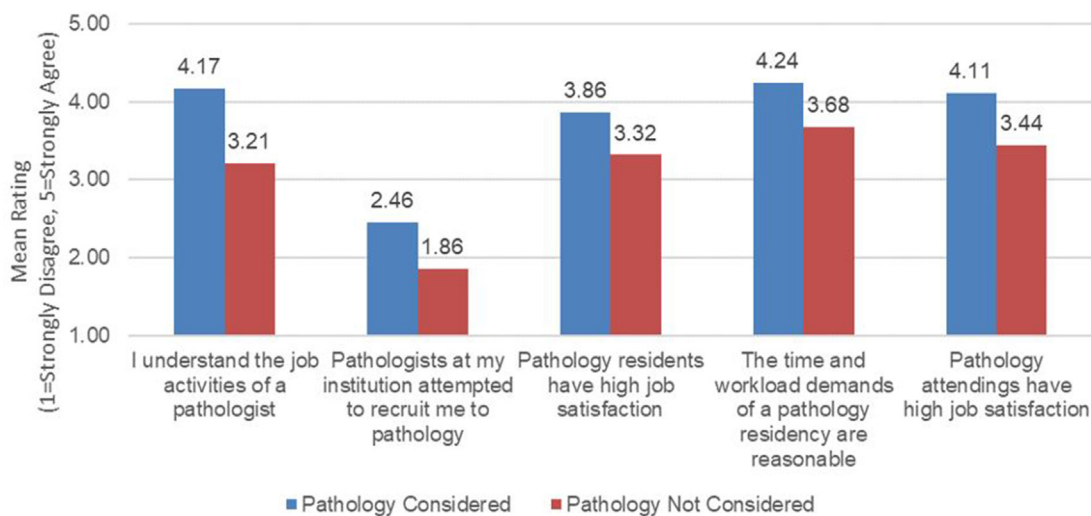


Fig. 9. Perceptions of pathology exposure in osteopathic medical students who considered versus those who did not consider pathology as a specialty. The numbers in the graph represent the mean rating across all respondents who considered pathology versus those who did not. All categories represented achieved statistical significance. Significance was tested via independent samples t-tests.

Table 5
Perceptions of pathology exposure for DO versus MD students.

Please rate your level of agreement with each of the following statements about pathology	Osteopathic students			Allopathic students			Significance
	N	Mean	Top box %	N	Mean	Top box % ¹⁵	
I understand the job activities of a pathologist	200	3.44	57%	339	3.80	76%	$t(199) = -5.062, P < .001$
I received adequate pathology education in my first two years of medical school	206	3.51	56%	342	3.99	79%	$t(205) = -6.787, P < .001$
I was sufficiently exposed to pathology in medical school to consider it as a career choice	203	2.72	31%	341	3.51	60%	$t(202) = -9.080, P < .001$
Information on social media about pathology is encouraging	137	2.72	17%	215	2.73	12%	$t(136) = -.191, P = .849$
The pathology job market is strong	84	2.92	29%	161	2.99	36%	$t(83) = -.666, P = .507$
Pathologists at my institution attempted to recruit me to pathology	194	2.01	11%	320	2.78	33%	$t(193) = -10.906, P < .001$
Pathology residents have high job satisfaction	72	3.58	54%	146	3.80	72%	$t(71) = -2.248, P = .028$
The time and workload demands of a pathology residency are reasonable	77	3.95	68%	200	4.11	83%	$t(76) = -1.659, P = .101$
Pathology attendings have high job satisfaction	76	3.76	66%	173	3.95	77%	$t(75) = -2.042, P = .045$

Significance was tested via one-sample t-tests.

Values in the “top box %” column for both osteopathic and allopathic medical students reflect the percentage selecting Strongly Agree or Agree.

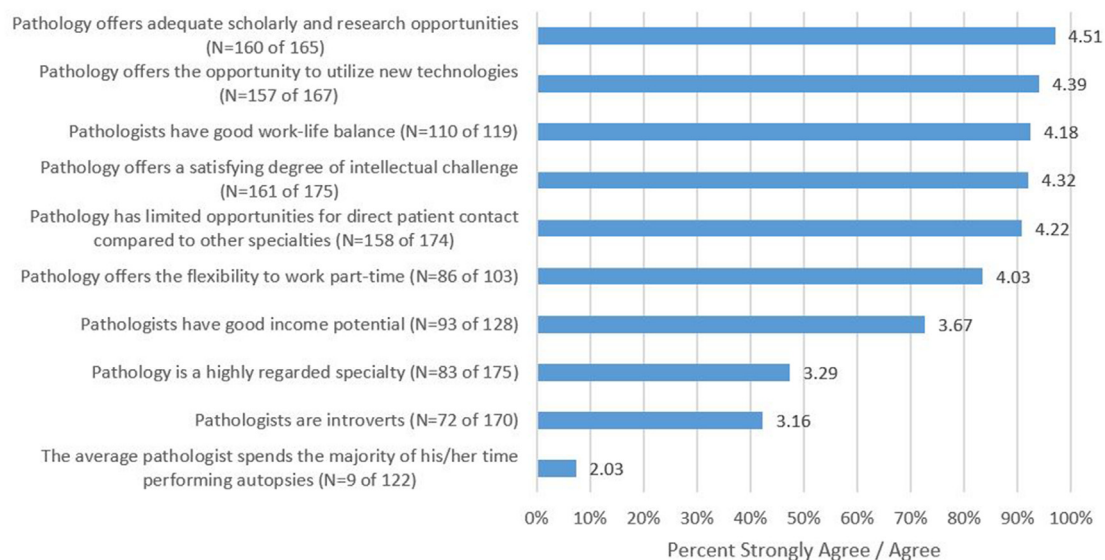


Fig. 10. Perceptions of pathology as a medical specialty. The numbers in the graph represent the mean rating across all respondents. Each criterion was ranked on a Likert scale of (1) not at all, (2) only slightly, (3) somewhat, (4) for the most part, and (5) very much so. The numbers labeling each bar indicate the mean rating across all respondents. Percentage on the X-axis designates the percent responding very much so (5) or for the most part (4). Numbers in the graph represent mean rating across all respondents.

pathology job market is poor, despite numerous recent publications to the contrary.²²⁻²⁴ Actual facts presented in these publications could do much to dispel the negative press surrounding the pathology job market on social media and Internet platforms commonly used by medical students. Making a concerted effort to have “Pathology Pipeline Champions” at osteopathic medical schools would go a long way toward role modeling pathology as a profession, and offering students mentoring.²⁵

Outreach need not be difficult. The COVID-19 pandemic revolutionized the use of virtual teaching platforms. This, too poses opportunity to

facilitate engagement with osteopathic medical students. Electronic platforms negate some of the challenges of time and distance to reach a wider audience and to make reaching out to guest speakers easier for both the inviter and the invited. Electronic platforms also offer the opportunity to host remote rotations even when travel restrictions are in place. While never quite the same as an in-person visit, experiences like PathElective can give users a glimpse of the world of pathology beyond lectures and textbooks.²⁶ Webinars offered by national professional organizations have been easy to access and student-friendly. Such webinars

Table 6
Percent of DO versus MD students who do not know enough to rate perceptions of

Please rate your agreement with the following statements.		Osteopathic students	Allopathic students	Significance
Pathology residents have high job satisfaction	Total N	206	344	$\chi^2(1) = 3.021, P = .082$
	%/Count Don't know	65% (134)	58% (198)	
Pathology attendings have high job satisfaction	Total N	207	344	$\chi^2(1) = 9.616, P = .002$
	%/Count Don't know	63% (131)	50% (171)	
The time and workload demands of a pathology residency are reasonable	Total N	207	343	$\chi^2(1) = 23.014, P < .001$
	%/Count Don't know	63% (130)	42% (143)	
The pathology job market is strong	Total N	207	344	$\chi^2(1) = 2.026, P = .155$
	%/Count Don't know	59% (123)	53% (183)	
Pathology offers the flexibility to work part-time	Total N	206	343	$\chi^2(1) = 22.584, P < .001$
	%/Count Don't know	50% (103)	30% (102)	
Pathologists have good work-life balance	Total N	206	343	$\chi^2(1) = 23.262, P < .001$
	%/Count Don't know	42% (87)	23% (78)	
The average pathologist spends the majority of his/her time performing autopsies	Total N	205	343	$\chi^2(1) = 17.419, P < .001$
	%/Count Don't know	40% (83)	24% (81)	
Pathologists have good income potential	Total N	206	343	$\chi^2(1) = .223, P = .637$
	%/Count Don't know	38% (78)	36% (123)	
Information on social media about pathology is encouraging	Total N	207	343	$\chi^2(1) = .687, P = .407$
	%/Count Don't know	34% (70)	37% (128)	
Pathology offers adequate scholarly and research opportunities	Total N	206	343	$\chi^2(1) = 9.446, P = .002$
	%/Count Don't know	20% (41)	11% (36)	
Pathology offers the opportunity to utilize new technologies	Total N	206	343	$\chi^2(1) = 5.035, P = .025$
	%/Count Don't know	19% (39)	12% (41)	
Pathologists are introverts	Total N	206	343	$\chi^2(1) = 9.273, P = .002$
	%/Count Don't know	17% (36)	9% (30)	
Pathology has limited opportunities for direct patient contact compared to other specialties	Total N	206	343	$\chi^2(1) = 14.132, P < .001$
	%/Count Don't know	16% (32)	6% (20)	
Pathology is a highly regarded specialty	Total N	206	343	$\chi^2(1) = 5.176, P = .023$
	%/Count Don't know	15% (31)	9% (30)	
Pathology offers a satisfying degree of	Total N	206	341	$\chi^2(1) = 5.064, P = .024$
	%/Count Don't know	15% (31)	9% (30)	

Table 6 (continued)

Please rate your agreement with the following statements.		Osteopathic students	Allopathic students	Significance
intellectual challenge	Total N	206	344	$\chi^2(1) = .279, P = .597$
	%/Count Don't know	6% (12)	7% (24)	
Pathologists at my institution attempted to recruit me to pathology	Total N	207	344	$\chi^2(1) = 2.255, P = .133$
	%/Count Don't know	3% (7)	2% (5)	
I understand the job activities of a pathologist	Total N	207	343	$\chi^2(1) = 2.178, P = .140$
	%/Count Don't know	3% (7)	1% (2)	
I was sufficiently exposed to pathology in medical school to consider it as a career choice	Total N	207	344	$\chi^2(1) = .023, P = .879$
	%/Count Don't know	2% (4)	1% (2)	
I received adequate pathology education in my first two years of medical school	Total N	207	344	$\chi^2(1) = .023, P = .879$
	%/Count Don't know	0% (1)	1% (2)	

Significance was tested via two-way chi-square test.

could supplement medical school curricula. Making sure that osteopathic medical students and key educational leaders at osteopathic medical schools are aware of such resources could go a long way toward increasing osteopathic medical school students' understanding of pathology as a discipline and allow them to make an informed decision regarding their future specialty.

Similar to the allopathic student community, osteopathic medical students glean much of their information about medical specialties from the internet. The majority of students used the internet or social media to inform their understanding of pathology as a medical specialty. The most common websites mentioned sources of information about medical specialties were Reddit (38%, N = 9 of 24), and AAMC (21%, N = 5 of 24). Here another opportunity presents itself for pathology professional organizations to better market specialty-specific information to medical students. It would be far better for students to have factual, curated information rather than relying on potentially suspect commentary on social media.

Limitations

There are several limitations of our study. This survey, like the prior allopathic survey, only measures a point in time. It does not evolve with the student's selection of a specialty. There are several aspects unique to osteopathic medical education that were not fully captured in the survey. Among these are the fact that many osteopathic schools do not have their own connected hospital, and students often rotate through multiple community sites, therefore and osteopathic medical schools pathology department may not always employ clinically practicing pathologists. Additionally, there are no known pathology residencies that are affiliated with osteopathic medical schools. In light of these unique features, it may have been interesting to query students about how they pursue outside pathology electives for additional rotations. The survey also did not particularly query what type of pathology rotation osteopathic medical students had pursued, such as forensic pathology at the local Medical Examiner's Office, or a more broad-based experience at either an academic medical center or community hospital. Given the relatively small number of osteopathic medical students having completed an elective rotation

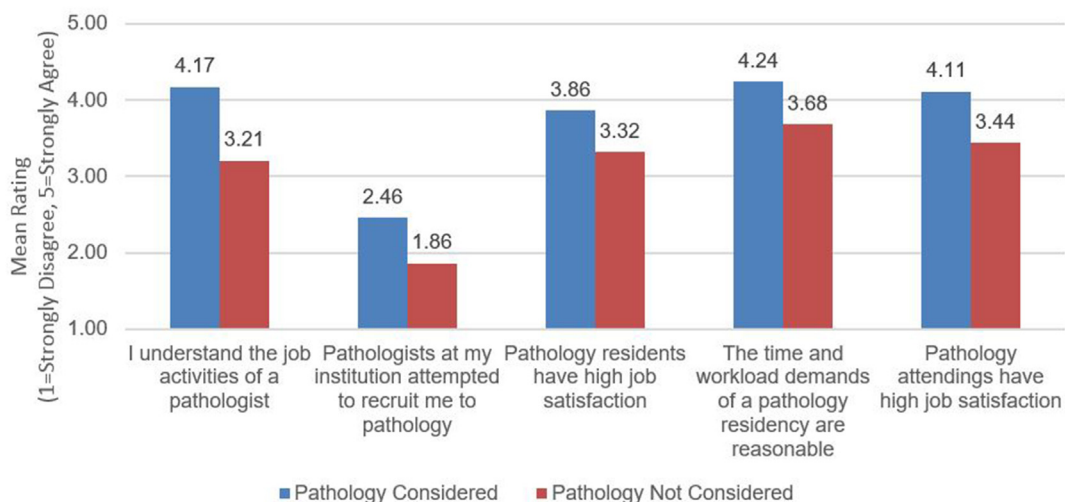


Fig. 11. Consideration of pathology and perceptions of pathology exposure. The numbers in the graph represent the mean rating across all respondents who considered pathology versus those who did not.

of pathology or entering pathology residency this information may have been of limited utility regardless.

The original survey of allopathic medical students was conducted before the COVID-19 pandemic. The pandemic itself has imposed some unique challenges on the ability to perform elective rotations and may also have impacted pathology exposure for osteopathic medical students. Unfortunately, these differences cannot be easily measured between the two surveys.

The sample size overall may be considered small: 225 students made it through complete screening to complete the survey. Those who responded represented 14 osteopathic medical schools. A particular challenge in surveying the osteopathic medical students is the fact that some schools have multiple campuses, some of which have a unified curriculum, others function more independently under the same overarching institution. This led to some initial challenges in navigating best points of contact. Fears over survey fatigue especially in an environment where students already spend so much time learning over electronic

platforms led to rejection of administering the survey by some schools. Additionally, the survey did not address any potential “hidden curriculum” whereby students might be dissuaded from choosing pathology based on misconceptions that people who are good with patients should not enter a less hands-on patient care discipline, nor some of the interdisciplinary dynamics between specialties which impart prestige or lack thereof.

While there is much discussion about the fluctuating and declining number of US medical graduates into Pathology, this survey suggests reasons for optimism, as the growth of osteopathic medical schools has correlated with an increase in osteopathic medical applicants to our specialty. Additionally, the curricular gaps identified are a fixable problem and present opportunities for professional organizations and pathology residency programs to partner with osteopathic medical schools. It is not up to medical schools to address the pathology pipeline issue. Is up to practicing pathologists and professional organizations to curate accurate information and provide experiences and mentorship to

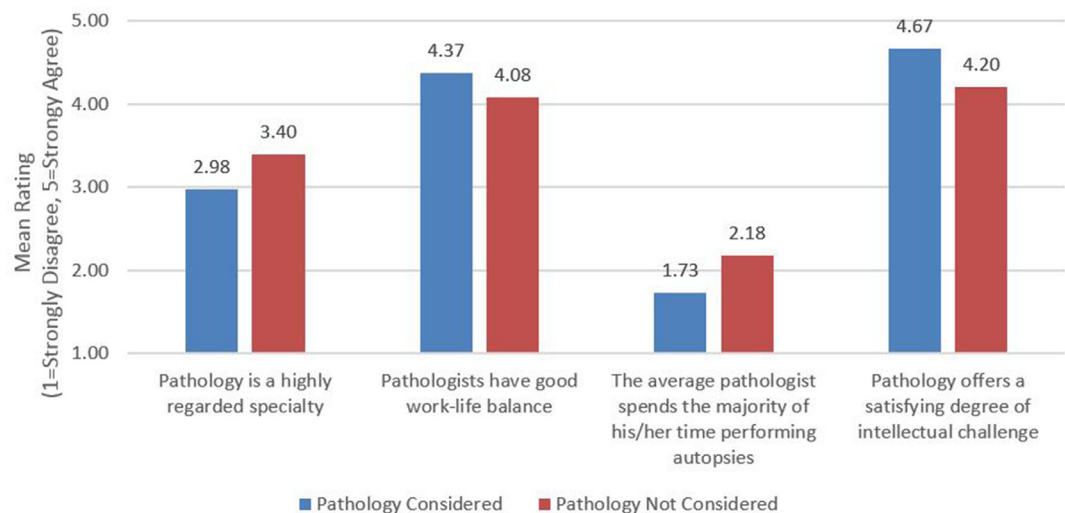


Fig. 12. Consideration of pathology and perceptions of pathology as a medical specialty. The numbers in the graph represent the mean rating across all respondents who considered pathology versus those who did not.

improve student understanding of our discipline, allowing them to make informed decisions about their specialty choice. Pathologists with the expertise and interest must reach out to foster these connections. Such interventions may have a tangible impact on the pathology pipeline.

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 article.

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