




Medical students' perspectives on and understanding of anesthesiology: a Canadian cross-sectional survey

Le point de vue et la compréhension de l'anesthésiologie par les étudiant·es en médecine : un sondage transversal canadien

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Abstract

Purpose In Canada, three out of 17 medical schools do not mandate an anesthesia rotation in their clerkship curriculum. Understanding the effects of a mandatory anesthesiology rotation is important in determining its value to the specialty and guiding decision-making for medical educators. We sought to determine whether a mandatory anesthesia rotation affected students' understanding of anesthesiology, as well as their perspectives on anesthesia.

Methods We conducted an anonymous cross-sectional survey of Canadian medical students graduating in 2021. Our survey consisted of 46 questions related to student's perspectives of anesthesiology, understanding of anesthesia, their interest in the specialty, and participant's demographics. This included 16 Likert-scale questions, 19 quiz-style questions, four free-text response questions, and seven demographics questions. The survey

was hosted by SurveyMonkey® (SurveyMonkey Inc., San Mateo, CA, USA) and distributed to the participants by each individual institution.

Results We collected a total of 331 responses across 13 different Canadian medical schools, representing a 17.3% response rate of students surveyed and 11.7% of all graduating medical Canadian students in 2021. A mandatory rotation in anesthesiology was associated with a more positive perspective ($P = 0.01$) but not understanding ($P = 0.07$) of the specialty. A mandatory rotation was not related to students' application to anesthesiology at a statistically significant level ($P = 0.06$).

Conclusions The results of this national survey study show the benefits of including a mandatory clerkship rotation in anesthesiology, namely on increasing positive perceptions of the specialty, while also revealing avenues for future research and insights on how to further optimize a mandatory anesthesiology rotation in clerkship.

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Résumé

Objectif Au Canada, trois facultés de médecine sur 17 n'exigent pas de stage clinique en anesthésie dans leur programme. Il est important de comprendre les effets d'un stage obligatoire en anesthésiologie afin de déterminer sa valeur pour la spécialité et d'orienter la prise de décision en matière d'éducation médicale. Nous avons cherché à déterminer si un stage obligatoire en anesthésie affectait la compréhension de l'anesthésiologie par les étudiant·es, ainsi que leurs points de vue sur l'anesthésie.

Méthode Nous avons mené un sondage transversal anonyme auprès d'étudiant·es en médecine qui ont obtenu leur diplôme en 2021 au Canada. Notre sondage comportait 46 questions portant sur leur point de vue sur l'anesthésiologie, leur compréhension de l'anesthésie, leur intérêt pour la spécialité et les caractéristiques

démographiques des personnes interrogées. Le sondage comprenait 16 questions sur l'échelle de Likert, 19 questions courtes de type quiz, quatre questions à réponse libre et sept questions démographiques. Le sondage était hébergé par SurveyMonkey® (SurveyMonkey Inc., San Mateo, Californie, États-Unis) et a été distribué aux participant-es par chaque institution.

Résultats Nous avons recueilli un total de 331 réponses dans 13 facultés de médecine canadiennes différentes, ce qui représente un taux de réponse de 17,3 % des étudiant-es interrogé-es et de 11,7 % de tous les étudiant-es en médecine diplômé-es en 2021 au Canada. Un stage obligatoire en anesthésiologie était associé à une perspective plus positive ($P = 0,01$) mais pas à une meilleure compréhension ($P = 0,07$) de la spécialité. Un stage obligatoire n'était pas lié aux demandes d'admission en anesthésiologie à un niveau statistiquement significatif ($P = 0,06$).

Conclusion Les résultats de cette enquête nationale montrent les avantages de l'inclusion d'un stage obligatoire en anesthésiologie, notamment pour accroître les perceptions positives de la spécialité, tout en révélant des pistes de recherche futures et des idées sur la façon d'optimiser davantage un stage clinique obligatoire en anesthésiologie.

Keywords anesthesia · anesthesiology · medical education · medical students' perspectives · views of anesthesia

In Canada, clerkship in medical school is structured as a series of mandatory rotations, also known as core rotations, which all students are required to complete for successful graduation, and elective rotations, where students get to choose specific specialties to complete additional rotations to gain increased exposure in those fields. There are currently no specific requirements set out by the Committee on Accreditation of Canadian Medical Schools regarding which rotations are mandatory during medical school.¹ Historically, medical schools in Canada have developed their mandatory rotations based on the curriculum for the Medical Council of Canada Qualifying Examinations (MCCQE). Prior to 2018, the MCCQE tested six specific disciplines: internal medicine; obstetrics/gynecology; pediatrics; population health; ethical, legal, and organizational aspects of medicine; psychiatry; and surgery.² Currently, the MCCQE examination focuses on the common themes of dimensions of care: health promotion and illness prevention; acute, chronic, and psychosocial aspects; and physician activities, which covers assessment/diagnosis, management,

communication, and professional behaviours.³ Without a national general curriculum in place for anesthesiology, there has been variability in anesthesiology clerkship rotations among medical schools.⁴

Currently, on review of Canadian medical schools' curricula, three of the 17 medical schools in Canada do not mandate an anesthesiology rotation. At these universities, students only receive clinical exposure to anesthesiology in clerkship if they choose to do an elective or selective rotation in the specialty. The reasoning for not offering elective rotations at these schools is unclear. At Dalhousie University (Halifax, NS, Canada), the anesthesiology rotation was mandatory at one point, as a three-week rotation in combination with ophthalmology and otolaryngology, but was eventually removed in favour of a three-week emergency medicine rotation. This was due in part to poor feedback from the medical students about the combination rotation, and otolaryngology being incorporated into the mandatory surgical rotation. There is no requirement for medical schools to have an anesthesiology rotation, so it is left to their discretion.

Understanding the effects of a mandatory anesthesiology rotation is important in determining its value to the specialty. For undecided medical students, being exposed to a specialty and having positive role models have been shown to be important factors in specialty selection,⁵⁻⁹ which could result in a stronger applicant pool. In 2020, anesthesiology was the 10th most sought after specialty based on the ratio of applicants to residency positions in Canada, but this has not always been the case.¹⁰ A decade ago, anesthesiology tended to be less sought after, consistently ranking outside of the top ten specialties.¹¹ Given the current shortage of anesthesiologists in Canada,¹² it is especially important to ensure that at a minimum, anesthesiology attracts enough high-quality medical students with a thorough understanding of the career who will go on to become committed anesthesiologists in their communities.

Additionally, the value in knowing the medical graduates' understanding and perceptions of the specialty and how a mandatory rotation impacts them extends beyond specialty selection for medical students to other specialties as well. Specialty stereotypes and specialty disrespect may develop during medical school,^{13,14} influencing students' perceptions of their colleagues in disciplines aside from their own ultimate matched discipline starting in an early stage of training. Anesthesiologists have a broad scope of practice, so interact closely with doctors of specialties beyond surgery, including obstetricians, emergency room physicians, interventional radiologists, cardiologists, pediatricians, and psychiatrists. Therefore, forming successful relationships with these physicians is

important for cohesive interdisciplinary teamwork to provide quality treatment and optimize patient safety.¹⁵ This can ultimately benefit all medical students if they have a deeper understanding of, and more positive attitude toward, their colleagues in anesthesiology, which facilitates a collegial environment as they work together throughout their careers.¹⁶

We sought to determine the effects of a mandatory anesthesiology rotation on Canadian medical students' perceptions, understanding of scope of practice, and understanding of how anesthesiologists do their job. We intended to answer whether completing a mandatory anesthesiology rotation impacts students' perspectives on and understanding of the specialty and whether it makes students more likely to apply to anesthesiology residency programs. We hypothesized that medical students with more clinical experience in anesthesiology would have a more positive perspective and a better understanding of anesthesiology, and that they would be more likely to apply to an anesthesiology residency program.

Methods

We conducted a cross-sectional survey of Canadian medical students graduating in 2021. We followed the self-administered survey methods to quantitative research suggested by Phillips *et al.*¹⁷ Additionally, we used the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) as a guide to increase the quality in the reporting of this survey study (Electronic Supplementary Material [ESM] eAppendix 1).¹⁸ We obtained approval from the Hamilton Integrated Research Ethics Board (Hamilton, ON, Canada) as well as Undergraduate Medical Education (UGME) at each participating institution that required their own approval to contact their students.

We used a modified version of the questionnaires described by Levin *et al.*¹⁹ and Robertson *et al.*²⁰ Robertson *et al.*²⁰ used the survey for obtaining medical student perspectives on anesthesiology at the University of Alberta. Levin *et al.*¹⁹ developed a national survey used in the USA to explore medical students' attitudes about anesthesiology and anesthesiologists, and the extent of medical students' exposure to anesthesiology. Our survey consisted of 46 questions (ESM eAppendix 2). This included 16 Likert-scale questions related to students' perspectives on anesthesiology, 19 quiz-style questions related to students' understanding of anesthesiology, referred to as the "quiz," four free-text response questions related to their interest in the specialty, and seven questions about participants' demographics. An expert panel reviewed the draft survey to discuss the

survey content, clarity, and relevance of the questions. Minor alterations were made to the prior surveys. Some items from multiple-choice questions in the original survey were converted to Likert scale statements to better measure the extent of agreement or disagreement among participants. In the quiz section, question number 19 was added to reflect the expanding role of anesthesiologists (i.e., the use of echocardiogram). The free-text response questions were added to explore students' interest in anesthesiology and help to answer this study's specific research questions.

The target population was all graduating medical school students across Canada for the year 2021. Considering that there were 2,854 graduating medical students, we estimated a sample size of 338, calculated using the Krejcie and Morgan formula,²¹ and it was considered adequate for a 95% confidence interval and a standard deviation of 0.5 given a 0.05 margin of error. Participation was voluntary and anonymous, and implied consent was applied. We excluded medical students who had previously attended a different medical school from their graduating medical school because their clerkship experience may not be representative of the curriculum at their graduating medical school.

All departments that are members of the Association of Canadian University Departments of Anesthesia (ACUDA) were contacted by the principal investigator to participate in our study. An introductory email with the link to our online SurveyMonkey® (an online platform; SurveyMonkey Inc., San Mateo, CA, USA) questionnaire was sent to the students by each individual institution, giving each member of the students' population an equal chance to participate in the study. To avoid multiple participation of participants, the online platform was preset to allow only one response per browser or email invitation. The survey was open for students' access from 12 June to 12 July 2021. Reminder e-mails were sent based on each school's survey protocol.

For data analysis purposes, the Likert scale responses were converted to percent favourability where 100% is the most favourable. The quiz had a highest possible score of 21 (scoring determined as there were 19 questions, two of which were worth two marks each, and the remaining 17 questions were worth one mark each, equalling 21 marks in total) and results were displayed out of this. Results are reported as mean (standard deviation) for continuous variables and $n/\text{total } N$ (%) for categorical variables. We compared respondents' perspectives on and understanding of anesthesiology among those who had mandatory rotations and those who did not, as well as those who had clinical anesthesia experience and those who did not, using a *t* test. We also used one-way analysis of variance (ANOVA) to compare respondents' perspectives

on and understanding of anesthesiology among different demographic subgroups and graduating medical schools. Differences were considered statistically significant at $P < 0.05$. All statistical analyses were performed using R version 4.1.2 software (R Foundation for Statistical Computing, Vienna, Austria). Response rate was calculated and adjusted using the American Association for Public Opinion Research (AAPOR) response rate definitions, as suggested by Phillips *et al.*¹⁷ We used the AAPOR definition number 6, meaning that we know that everyone receiving the survey was eligible to answer it.²² For calculation of nonresponse bias and the alpha reliability coefficient, we used Stata MP version 17 (StataCorp LLC, College Station, TX, USA). Nonresponse bias was calculated using Koch and Blohm's method, where individual data were analyzed within the group of respondents.²³ In particular, we compared the scores on both the perspectives and understanding portions of the survey (separately) for early (i.e., those who responded on time/without any follow-up reminders) vs late respondents (i.e., those who were sent follow-up reminders and responded later), the latter of which were equated to "non-respondents" given that they were convinced to respond. We used Cronbach's alpha (range from 0—no inter-item correlation—to 1—perfect item correlation) to measure the internal consistency (reliability) of survey items on the perspectives section, the understanding component, and the perspectives and understanding components overall.²⁴

Results

Overall, we obtained 331 complete responses from 13 medical schools in Canada. The nonparticipating schools were McGill University, Université de Montréal, The University of British Columbia, and the University of Manitoba. The incomplete questionnaires were not included in the data analysis because they were missing necessary information for analysis. These data were collected between the end of clerkship and the beginning of residency to ensure students had equivalent clinical exposure in medical school without having residency experiences influence their responses. There were no respondents from four universities because of logistical barriers to survey distribution to these institutions. The response rate (using AAPOR definition 6) was 17.3%, representing 11.7% of all graduating Canadian medical students. The sample population and final survey responses are summarized in Fig. 1. The average response to the "perspectives" questions on the survey, and the average scores per question on the quiz are summarized in Figs 2 and 3, respectively.

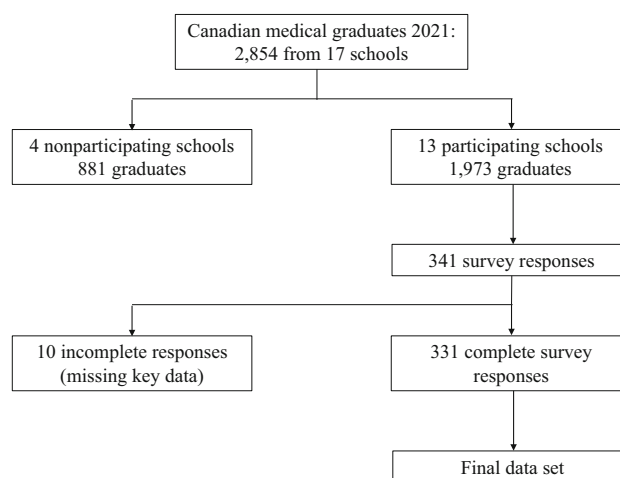


Fig. 1 Survey study flowchart

In this study, 300 participants were early responders, whereas 31 were late responders (considered nonresponders, as described above). We accounted for the nonresponse rate (83.2%) and determined the difference in means between responders and nonresponders to be negligible. Consequently, the nonresponse bias was also negligible: 1.53 points for the *perspectives* component and 0.04 points for the *understanding* component of the survey. Additionally, we observed an overall good internal consistency reliability in our survey, with Cronbach's alpha of 0.81, and similar scores on the perspectives (alpha = 0.82) and understanding components (alpha = 0.76) separately.

Demographics

One hundred and ninety-six (59.2%) students identified as female, 133 (40.2%) as male, and 2 (0.6%) as a different gender. Two hundred and thirty (69.5%) students completed a mandatory rotation in anesthesiology, and the remaining 101 (30.5%) did not have a mandatory rotation. Additionally, 286 (86.4%) respondents had clinical anesthesia experience of some sort, such as a mandatory rotation, electives, or shadowing, while 45 (13.6%) did not have any anesthesia clinical experience. Students in this survey were entering a broad range of disciplines in the next year, including anesthesiology (10.3%), surgical specialties (12.7%), medical specialties (17.8%), diagnostic specialties (3.9%), psychiatry (8.2%), family medicine (35.3%), and pediatrics (6.9%).

None of the demographic factors studied had a statistically significant relationship with students' perspectives on and understanding of the specialty, except for previous education level ($P = 0.045$).

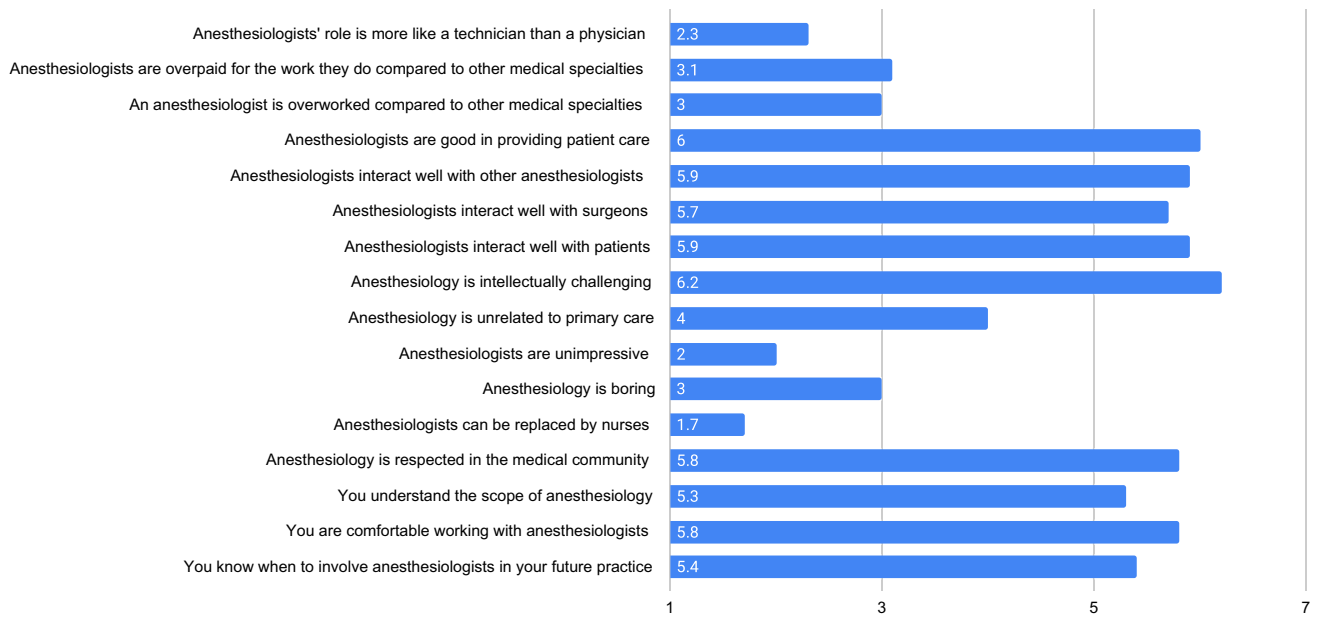


Fig. 2 Respondents average response rates to “perspectives” survey items
 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, 7 = strongly agree

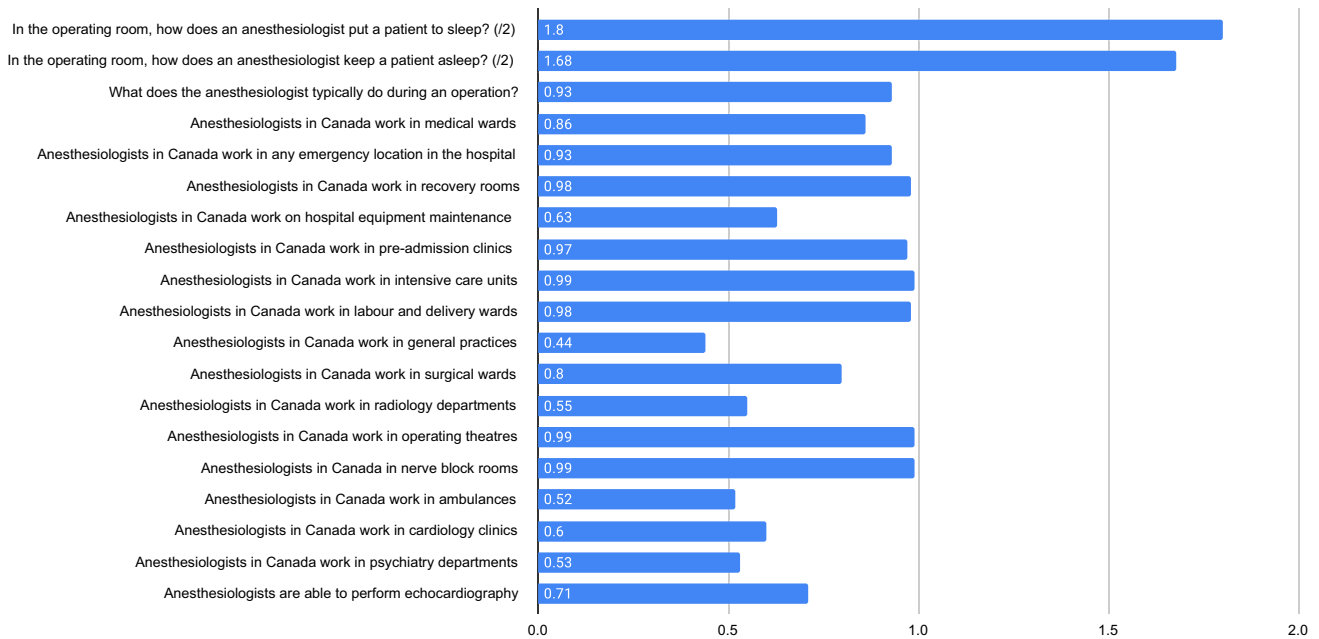


Fig. 3 Respondents average quiz scores per question
 Average points scored per quiz question. Each question is worth one point, except for questions 1 & 2, which are worth 2 points each.

Mandatory anesthesiology rotation

A mandatory rotation in anesthesiology was associated with students' perspectives on ($P = 0.01$) but not

understanding of ($P = 0.07$) the specialty. A mandatory rotation was not related to students' application to anesthesiology at a statistically significant level ($P = 0.06$). These data are summarized in Tables 1 and 2.

Table 1 Difference in perspective and understanding of anesthesiology for students who did and did not complete a mandatory rotation, and students who had clinical anesthesiology experience and who did not

Outcome	Students who completed a mandatory rotation	Students who did not complete a mandatory rotation	<i>P</i> value ^a	Students who had clinical anesthesiology experience	Students who did not have clinical anesthesiology experience	<i>P</i> value ^a
Perspective ^b	84.2% (9.3)	81.3% (8.9)	0.01	84.4% (9.1)	76.8% (7.8)	< 0.001
Understanding ^c	16.9 (2.0)	16.5 (1.9)	0.07	16.9 (2.0)	15.8 (1.9)	0.001

Numbers are mean (standard deviation)

^aOne-way analysis of variance

^bPercent favourability, converted from Likert scale responses, where 100% is the most favourable

^cQuiz score (highest possible, 21; scoring determined from 19 questions, two of which were worth two marks each and 17 of which were worth one mark each)

Table 2 Relationship between completing a mandatory rotation and application to anesthesiology, and clinical exposure to anesthesiology and application to anesthesiology

Application to anesthesiology	Students who completed a mandatory rotation	Students who did not complete a mandatory rotation	<i>P</i> value ^a	Students who had clinical anesthesiology experience	Students who did not have clinical anesthesiology experience	<i>P</i> value ^a
Yes	35/230 (15.2%)	7/101 (6.9%)		42/286 (14.7%)	0/45 (0.0%)	
No, but considered	34/230 (14.8%)	11/101 (10.9%)		42/286 (14.7%)	3/45 (6.7%)	
No, and did not consider	161/230 (70.0%)	83/101 (82.2%)		202/286 (70.6%)	42/45 (93.3%)	
			0.06			0.01

Numbers are *n*/total *N* (%)

^aAnalysis of variance

Clinical anesthesiology experience

Having any clinical experience in anesthesiology was found to be correlated to students' perspectives on ($P < 0.001$) and understanding of ($P = 0.001$) the specialty. Having any clinical experience in anesthesiology had a statistically significant impact on students' application to anesthesiology ($P = 0.01$). These data are summarized in Tables 1 and 2.

Graduating medical schools

The students' medical school of graduation was related to students' perspectives on ($P = 0.05$) and understanding of ($P = 0.05$) anesthesiology. In terms of specific schools of graduation, only Western University had a significant difference, which was a more favourable perspective on anesthesiology ($P = 0.02$). These data are summarized in Table 3.

Factors affecting application to anesthesiology

The most common factors affecting students' applications to anesthesiology were not feeling as though they would

excel (42% of respondents), finding the specialty uninteresting (41.1%), and a lack of exposure to the specialty (35.3%). These factors are summarized in Table 4.

Discussion

Our study surveyed medical students across Canada to determine if completing a mandatory rotation in anesthesiology or having clinical exposure to anesthesiology improved their perspectives on and understanding of anesthesiology and anesthesiologists. Overall, our results show that any clinical exposure in anesthesiology increased students' perspectives on and understanding of anesthesiology, as well as their interest in applying to anesthesiology. This is significant, as mandatory rotations can ensure that all students get this critical exposure to anesthesiology included in their medical training, potentially introducing the specialty to someone who had not considered it before. There is a potential confound in these results, as students who are interested in anesthesiology are more likely to have a higher baseline

Table 3 Significance of the difference in “perspective” and “understanding” score from overall mean score for each graduating school

Graduating medical school	Perspective ^a	P value ^b	Understanding ^c	P value ^b
University of Alberta	80.9% (8.5)	0.09	16.4 (1.9)	0.31
University of Calgary	82.0% (9.2)	0.34	17.1 (1.7)	0.10
Dalhousie University	82.4% (8.2)	0.62	16.2 (2.6)	0.35
Université Laval	79.0% (10.3)	0.06	16.1 (1.8)	0.15
McMaster University	85.0% (9.2)	0.15	16.7 (2.3)	0.88
Memorial University	82.0% (11.1)	0.83	14.3 (2.2)	0.11
Northern Ontario School of Medicine	82.6% (8.4)	0.70	17.1 (1.2)	0.11
University of Ottawa	85.9% (9.8)	0.14	16.8 (1.7)	0.63
Queen’s University	85.1% (9.7)	0.46	17.0 (1.5)	0.44
University of Saskatchewan	86.0% (8.1)	0.12	17.6 (2.1)	0.05
Université de Sherbrooke	82.1% (10.4)	0.59	16.3 (1.4)	0.21
University of Toronto	81.3% (10.1)	0.58	17.3 (2.0)	0.37
Western University	89.8% (6.6)	0.02	16.9 (2.4)	0.82
Overall P value ^d		0.05		0.05

Numbers are mean (standard deviation)

^aPercent favourability, converted from Likert scale responses, where 100% is the most favourable

^bOne-way analysis of variance for comparing respondents’ perspectives on and understanding of anesthesiology among different demographic subgroups and graduating medical schools

^cQuiz score (highest possible, 21; scoring determined from 19 questions, two of which were worth two marks each and 17 of which were worth one mark each)

^dAnalysis of variance

Table 4 Factors affecting application to anesthesiology among all respondents

Factors affecting application	Responses
Did not feel they would excel	139/331 (42.0%)
Found specialty uninteresting	136/331 (41.1%)
Lack of exposure	117/331 (35.3%)
Poor faculty models	30/331 (9.1%)
Concern with job market/future of specialty	26/331 (7.9%)
Not a prestigious specialty	4/331 (1.2%)
Poor compensation	4/331 (1.2%)
Other	77/331 (23.3%)

Numbers are n/total N (%)

understanding of the specialty and feel more positively towards it, and these are the students who would be more likely to seek additional clinical exposure if their program did not require a mandatory rotation. Although the survey did not formally study the rationale for students seeking out elective rotations in anesthesiology, past research indicates that, when given a choice, medical students select clerkship rotations that provide them transferrable skills and assist in their pursuit of a desired specialty.²⁵

Notably, a mandatory rotation in anesthesiology improves students’ perspectives on anesthesiology and anesthesiologists, which has implications for collegiality

between anesthesiologists and physicians in related disciplines, particularly in the surgical specialties. A mandatory anesthesiology rotation has the potential to mitigate the negative specialty stereotypes associated with anesthesiology that develop throughout medical training. An anesthesiology mandatory rotation’s lack of benefits on graduates’ understanding of the specialty and application to the specialty warrants future research to study how mandatory rotations can be restructured to improve these, or if there are better curricular changes than mandatory rotations to target these outcomes.

Of note, 117 (35.3%) respondents cited “lack of exposure” as a factor that influenced their application to anesthesiology residencies, showing a definite role for mandatory rotations to eliminate this barrier. Additionally, a mandatory rotation could prepare or encourage students for subsequent anesthesiology rotations through increased clinical time, structured teaching sessions, and even simulations, depending on the school’s clerkship curriculum, which could then tackle the most cited reason for not applying to an anesthesiology residency program: “did not feel like they would excel.” It would be useful for future research to further explore how students interpreted this response: did they feel that they did not possess the character traits to excel in anesthesiology, that they were not technically or clinically prepared to excel in anesthesiology, or simply that they would not be able to successfully match to anesthesiology? Finally, mandatory rotations increase students’ interactions with both residents and staff, targeting the fourth most cited reason for not applying to an anesthesiology residency, “poor faculty models.” These results highlight the potential for mandatory rotations to further increase value to the specialty through an intentional clerkship curriculum designed to specifically address these factors.

Finally, it is important to acknowledge the response rate in the study (17.3%), representing 11.7% of all graduating Canadian medical students in 2021. This significantly limits generalizability. Nevertheless, despite the low response rate, the nonresponse bias of our survey was found to be minimal in both sections of our survey, and there was good reliability in both sections of our survey as well.

Our study had some limitations, as described above. In addition, students who are interested in anesthesiology are more likely to have a higher baseline understanding of the specialty and feel more positively towards it. Furthermore, these are also the students who would be more likely to seek additional clinical exposure if their program did not require a mandatory rotation. Another limitation is that four medical schools were not included in this survey, which may have affected the representativeness of the Canadian population. Some institutions required their own local investigator and/or research ethics committee and/or (UGME) approval to contact their students. These requirements created a barrier for timely distribution of the survey. Importantly, every medical school without a mandatory anesthesiology rotation was included.

To avoid this problem in future studies, we recommend that future national surveys seek ethics approval through one centralized institution, such as the Association of Faculties of Medicine of Canada, to reduce bureaucratic load and increase response rate. Additionally, the time frame between the end of clerkship and the start of residency, which was necessary to target equivalent clinical

experiences across medical schools, proved to be short and likely contributed to the low response rate. This time period was shorter than usual given later clerkship end dates due to COVID-19-related clerkship delays. During this time, recent graduates are preparing for residency, studying for their licensing exams, and potentially moving to a new city or even a new province, and as such have little free time to answer voluntary surveys.

Conclusions

The results of this survey study reveal the benefits of including a mandatory clerkship curriculum in anesthesiology, namely on increasing positive perspectives on the specialty, while also revealing avenues for future research and insights on how to further optimize a mandatory anesthesiology rotation in clerkship.

Author contributions Michael Nixon and Daniel Cordovani contributed to protocol design, data collection, data analysis, and manuscript preparation. Monica Brundage contributed to data analysis and manuscript preparation. Ligia Cordovani contributed to protocol design, data analysis, and manuscript preparation. Adrienne Carr contributed to protocol design and manuscript preparation. Joycelyne Ewusie contributed to data analysis.

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