Early surgical exposure for medical students: Efficacy and effect on choice of electives
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Abstract
Background: The number of students applying to surgical residency programs is declining. The reasons are multifactorial, however early exposure has been shown to increase application rates and decrease residency attrition rates. The objective of this study is to evaluate the Surgical Exploration and Discovery (SEAD) program, an early surgical exposure program, on its efficacy and influence on medical school electives. Methods: Two online surveys were distributed to participants of the SEAD program from 2016-2017. The surveys addressed demographics and prior surgical exposure, efficacy of the program, and the role of SEAD on influencing choice of electives. The Likert scale was used to measure responses along with multiple-choice questions. Univariate descriptive statistics were completed on all variables. Results: All participants (n = 36, 100% response rate) reported that SEAD made them more likely to enter a surgical career (Mean: 4.1 out of 5, SD: 0.8), helped narrow down career options (Mean: 4.0, SD: 0.9), and improved comfort in the OR environment (Mean: 4.7, SD: 0.5). The majority of students were planning to, or had completed at least one surgical elective in second year (72.2%) and felt that the program will influence their choice of electives in fourth year (Mean: 4.0, SD: 0.6). Conclusion: The SEAD program is an effective method to help students make career decisions, offer early surgical exposure, and help with choice of medical electives. With a lack of early surgical exposure, and declining interest in surgical programs the SEAD program is a valuable addition to medical school education.

Introduction
Research has shown that the number of North American medical students applying to surgical residency programs has been declining over the past two decades1-3. This unsustainable trend has led to concern among surgical program directors4-6. With an aging population, a decrease in the quantity of applicants to surgical residency positions is concerning7. Equally concerning is the evident declining match rate and attrition rate of several surgical specialties, such as general surgery8,9. This pattern has the potential to lead to “short-handed” programs that are not able to supply the same quality of service to a growing population or education to those residents remaining.

While the reasons for the declining interest in surgical residency programs are multifactorial, introducing role models and exposure to the operating room early in medical education have been identified as factors that increase interest in a surgical career2,4,6,8,11-13. These factors support the idea that early surgical exposure to pre-clerkship medical students aids in their career decision-making. Specifically, mentorship has been reported as being one of the strongest influences on a medical student’s career decision14. Meyer et al. suggested that the lack of a positive surgical role model in the pre-clerkship years accounted for 80% of students’ negative views of surgery15.

Changes to medical education that encourage the importance of primary care and early career choices have inadvertently affected the field of surgical specialties1-16. Several studies have reported that majority (59-66%) of medical students predict their career specialty prior to clerkship18,19. Furthermore, evidence suggests that the amount of exposure to a medical specialty correlates with the application rates of that specialty20. However, the majority of North American undergraduate medical students receive surgical exposure solely during their clerkship years21,22. One study demonstrated that a nearly five-fold increase was recorded in the number of medical students considering a surgical career based on their clerkship rotation experience alone, much of which was attributable to operating room exposure and resident and faculty interaction2. Two studies have demonstrated that direct participation in surgical procedures prior to clerkship was effective in increasing interest in a surgical career19,23. This suggests that declining interest among medical students and growing attrition among residents could be attributed to the lack of surgical exposure to pre-clerkship medical students. The 2004 American Surgical Association Blue Ribbon Committee Report on Surgical Education outlined this issue when they asked that, “surgical faculty and residents must become more involved in undergraduate medical education to develop and sustain in medical
students an interest in a career in surgery". The Surgical Exploration and Discovery (SEAD) program has attempted to address this inadequacy by providing a wide breadth of exposure to many surgical specialties early in pre-clerkship.

The SEAD program was designed with the goal of increasing surgical exposure to pre-clerkship undergraduate medical students. The program, which was initiated at the University of Toronto in 2012, is a structured surgical program where first year medical students dedicate two weeks of their summer to surgical skills workshops, half-day electives in the operating room and seminars that focus on surgical lifestyle, research and specialties. During the 2015-2016 school year this program extended to Dalhousie University. The program followed the same structure as introduced at The University of Toronto, with the goal of strengthening career-minded decisions related to the field of surgery through early surgical exposure. The program has allowed students the opportunity to not only identify specialties of interest but to also rule out surgical specialties. In doing so, SEAD provides students with the opportunity to better prepare for clerkship as well as their elective choices moving forward.

The purpose of this study is to evaluate the efficacy of the Surgical Exploration and Discovery (SEAD) Program at Dalhousie Medical School and its influence on elective choices in the second and fourth year of medical school.

Methods

Two online surveys were distributed to all medical students who participated in the SEAD program from 2016-2017 via SurveyMonkey software (Survey Monkey Inc., San Mateo, CA). A total of 36 students were invited to complete the survey, as there were two years of programming and 18 students per cohort. There were no inclusion or exclusion criteria. A cover letter informed participants about the goals of the surveys, eligibility criteria and informed consent. Approval for this study was obtained through the Nova Scotia Health Authority research ethics board (File number 1088203).

The surveys were initially developed as quality control initiatives and to determine the effect of the SEAD program on choice of electives. The surveys went through a series of revisions by three medical students (C.M, T.D, and K.M.) and a staff surgeon (D.D.) prior to sending the survey to participating students. The study was then sent to the research ethics board for approval. A total of three reminders to complete the surveys were sent to participants.

The first “pre-program” survey addressed basic demographics, prior surgical exposure and efficacy of the SEAD program and was administered at the end of each respective SEAD program. This survey was administered to both cohorts of participants in 2016 and 2017. The second “post-program” survey addressed the role of the SEAD program on prospective elective choices and was developed and then administered following the second cohort of SEAD participants in 2017. The first cohort of SEAD participants did not complete this survey. By the time it had been disseminated, they had already completed their second-year electives. Survey questions were principally completed using a Likert scale (1-strongly disagree, 5-strongly agree) and using checkbox answers and multiple choice where required.

Univariate descriptive statistics were conducted on all variables to examine responses, distributions and potential errors. Continuous variables are presented as means and standard deviations (SD) and categorical variables are presented as counts and proportions. Statistical analyses were completed in SPSS Version 22.

Results

A total of 36 SEAD program participants responded to the surveys (100% response rate). Participants were more commonly male, between the ages of 25 and 26 years old and have a bachelor's degree (Table 1). Participants had generally observed between six and ten operating room (OR) half days and between one and two surgical specialties prior to beginning the SEAD program (Table 1).

Survey participants were strongly interested in a career in surgery prior to the SEAD program (Likert score of Mean: 4.2, SD: 0.7) and when asked about the efficacy of the program, students found the SEAD program helped them become more interested in pursuing a career in surgery (Mean: 4.1, SD: 0.8). They also agreed that the SEAD program was a positive addition to their medical education (Mean: 4.8, SD: 0.4; Table 2).

The majority of Med 1 survey participants intended to complete their second-year elective in a surgical specialty (Mean: 3.9, SD: 0.9; Table 3). The majority of Med 2’s completed their first semester elective in a surgical specialty (72.2%), however approximately half did in second semester (55.6%). Med 2’s also agreed that they selected their clerkship track as a reflection of their desire to enter a surgical specialty (Mean: 4.2, SD: 1.3; Table 3).

All participants agreed that participating in the SEAD program helped them choose electives for second year (Mean: 4.1, SD: 0.7), and will likely help
them choose their fourth year electives when the time comes (Mean: 4.0, SD: 0.6; Table 3). When asked about the specific components of the SEAD program and their respective influence on elective choices, participants found that observing in the operating room was the most beneficial (Mean: 4.5, SD: 0.6) followed by lunch time talks (Mean: 4.2, SD: 0.7), skills sessions (Mean: 4.1, SD: 0.8), and call night (Mean: 3.3, SD: 1.2; Table 3).

The SEAD program, in general, had a significant influence on participants in terms of gaining and losing interest in specific surgical specialties, as demonstrated in Table 4.

**Discussion**

This study determined that the majority of student participants had limited surgical exposure prior to beginning the SEAD program. This was based on the student’s self-reported number of surgical specialties observed and half days spent in the operating room prior to engaging in the SEAD program. Participants reported that the SEAD program made them more
likely to enter a surgical career, and that the program was a positive addition to their medical education that would benefit them in the future with respect to career minded decisions. Survey information indicated that the majority of participants are planning to, or have already, completed at least one surgical elective in their second year. Furthermore, SEAD student participants felt that their involvement with the program influenced their choice of electives in fourth year prior to residency. Participant’s reported that the operating room component of the SEAD program was the most influential component.

To date, a number of studies have been completed on the other SEAD programs across Canada at the University of Ottawa and the University of Toronto. Our demographic information and prior surgical exposure variables are comparable with these previously published reports. However, our participants were generally older, and a greater percentage had received a master’s degree prior to participating in the SEAD program (44.4% compared to 16.7%)26. In general, prior to participating in the SEAD program, participants had a low amount of surgical exposure (8.8 OR half days observed, and 2.5 surgical specialties observed). These findings are similar to other studies and likely reflect the inability to observe a wide range of surgical specialties in the first year of medical school25-28. Most medical schools across Canada do not have electives until second year, and it is increasingly difficult to coordinate observerships with specific surgeons. This is due to time constraints, conflicts with classes/tutorials, and procedural hurdles with undergraduate medical education departments. The SEAD program allows students to observe upwards of ten surgical subspecialties within a two-week period. Consequently, this results in the student identifying new interests and filtering potential career paths in a short time frame25,26.

Prior studies have shown that before starting the SEAD program the majority of student participants are already interested in a surgical career, which is congruent with our results25-28. We found that the mean Likert scale value was 4.2 out of 5 (SD: 0.7) compared to 13 out of 18 students being “very interested” in a surgical career prior to the SEAD program in the cohort described by Gawad and colleagues25. What has not previously been demonstrated is that early exposure through a program such as SEAD improves comfort in the operating room environment. This has typically been perceived as a complex and sometimes challenging environment for medical students29. In addition, our study mirrored previous results in regard to narrowing career options and aiding with future career decisions25-28. These results are encouraging due to the deceasing application rates to surgical residency programs1,4. It is our hope that the SEAD program initiated at Dalhousie medical school will not only help increase the number of applications to surgical residency programs, but will also help to decrease attrition rates throughout residency by allowing students to make more informed career decisions prior to application. Future research will be necessary at the time of application and matching to residency to determine the influence of the SEAD program on these processes. It is our intent to engage in future discussions.

### Table 4. Interest in specific surgical specialties before and after the SEAD program (N=36). *Pediatric orthopedics was only available to the second cohort of SEAD participants (Med 1’s).

<table>
<thead>
<tr>
<th>Surgical Specialty</th>
<th>Number before SEAD</th>
<th>Number after SEAD</th>
<th>Number that developed a new interest</th>
<th>Number that ruled out prior interest</th>
<th>Net change in number interested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otolaryngology</td>
<td>18</td>
<td>23</td>
<td>9</td>
<td>4</td>
<td>+5</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>20</td>
<td>22</td>
<td>6</td>
<td>4</td>
<td>+2</td>
</tr>
<tr>
<td>Thoracic surgery</td>
<td>9</td>
<td>11</td>
<td>5</td>
<td>3</td>
<td>+2</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>17</td>
<td>18</td>
<td>7</td>
<td>6</td>
<td>+1</td>
</tr>
<tr>
<td>Pediatric general surgery</td>
<td>10</td>
<td>10</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
<td>9</td>
<td>7</td>
<td>1</td>
<td>3</td>
<td>-2</td>
</tr>
<tr>
<td>Pediatric orthopedics*</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>-2</td>
</tr>
<tr>
<td>Cardiac surgery</td>
<td>17</td>
<td>12</td>
<td>2</td>
<td>7</td>
<td>-5</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>14</td>
<td>4</td>
<td>0</td>
<td>10</td>
<td>-10</td>
</tr>
<tr>
<td>General surgery</td>
<td>23</td>
<td>13</td>
<td>0</td>
<td>10</td>
<td>-10</td>
</tr>
<tr>
<td>Other specialties</td>
<td>6</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>Median</td>
<td>14</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>-1</td>
</tr>
</tbody>
</table>

Early surgical exposure for medical students
with students who have participated in the program to
determine whether the SEAD program influenced their
decision to apply and work as surgeons.

The influence of the SEAD program on the
student's choice of electives in second and fourth year
has largely been understudied. Electives are offered
at varying times in Canada depending on the medical
school and are a crucial step to solidifying interest in a
career. Research has shown that students who complete
early electives in any medical specialty, both surgical
and medical, are more likely to pursue that specialty as
a career.\(^{6,11,30}\) We have demonstrated that the majority
of SEAD participants intend to complete at least one
second year elective in a surgical specialty, and felt that
completing the SEAD program will help them to choose
electives for both second and fourth year. Currently,
it is difficult to assess whether or not students are
choosing surgical electives based on their experience
with the SEAD program, or due to their prior interest
in a surgical career before participating in the program.
Future studies may incorporate pre and post-SEAD
surveys to limit bias in determining the influence of the
SEAD program on the student's choice of electives.

Gawad and colleagues found that the operating
room component of the SEAD program, compared to
the lunchtime seminars and skills sessions, was the most beneficial component.\(^{25}\) We were able to
evaluate these components in terms of influence on
student's choice of electives and found comparable
results. However, the Dalhousie SEAD program also
incorporated a call night, which was not found to be as
helpful with elective choices (Mean: 3.3, SD: 1.2). This is
likely due to the inherently variable experience a night
on call may bring. During informal discussion with the
students during the two-week period, many remarked
how they either had a very positive experience on call or
were simply not called in. It is difficult to predict which
evenings may be busy and consequently, a beneficial
and stimulating experience for the students. However,
we believe that incorporating the call night component
into the SEAD program can be a valuable experience,
one that further demonstrates the true lifestyle of a
surgeon and provides additional influential interaction
with residents and faculty. We plan on trying to improve
the call night experience in the future by refining which
specialties are involved and speaking with attending
physicians and residents to figure out which nights on
call would be most beneficial.

The majority of participating students were able
to gain interest in or rule out a surgical specialty over
the course of the program. Lifestyle friendly specialties,
like plastic surgery and otolaryngology gained interest,
whereas specialties generally considered as having an
inferior work life balance, like general surgery, lost
interest. Interest in neurosurgery also decreased in our
study population. Studies have revealed that medical
students have shown an increased desire for work-life
balance, citing factors like the length of residency
training, job concerns, and the rates of mental illness as
underlying concerns.\(^{31-33}\) Greene and colleagues found
similar results when examining interest in surgical
subspecialties before and after the SEAD program,
however their results were not as robust due to a
smaller sample size.\(^{27}\) It will be important to determine
if participation in SEAD negatively impacts applications
to these specialties. It is our hope that the students who
do apply to them will be better informed and prepared
improving overall attrition even if application rates
decline.

The benefit of the SEAD program on career-minded
decisions, such as students identifying interest in a
certain specialty, has been well described.\(^{25-28}\) However,
of equal or greater importance is the examination of
students' loss of interest and the various avenues of
discussion this allows for. These discussions could
assist in identifying solutions as to how to attract
students to specialties with declining application
rates. One hypothesized reason for the substantial
decrease of interest in specialties like general surgery
and neurosurgery through the Dalhousie SEAD
program is the fact that students largely interacted with
residents from these specialties during the program.
Whereas for a specialty like pediatric general surgery,
they were able to interact with faculty, who would be
more suitable for alleviating lifestyle related concerns.
Research has shown that when a staff surgeon as
opposed to a resident addresses concerns related to the
work-life balance of a specialty, it has been found to
positively influence opinions of that specialty.\(^{35}\) In
the future, SEAD programs may find it beneficial to focus
on exposing students to a mixture of both staff and
residents in all components of the program to promote
an understanding of a surgical lifestyle.

The strengths of our study include a large
sample size, high survey response rate, exposure to
many components of a surgical practice, and the
generalizability of the data to other SEAD programs
across Canada. The weaknesses of our study include
the use of subjective measures, the retrospective nature
of the study, and the short follow-up. We acknowledge
the need for long-term, prospective studies examining
the efficacy of the program. Nevertheless, our study
provides important data on an area of surgical
education that increases interest in surgical careers and
helps students with career-minded decisions early in
medical school.
Conclusion
The SEAD program is an effective method to help students make career decisions, offer early surgical exposure, and help with choice of medical electives. With a lack of early surgical exposure, and declining interest in surgical programs the SEAD program is a valuable addition to medical school education.

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References