The Surgical Subspecialty Experience Program (SSEP): A Single Institution Prospective Pilot Study


Abstract

Background: We describe the creation and impact of a novel Surgical Subspecialty Experience (OR vs clinic shadowing and surgical skills sessions) Program (SSEP) for pre-clinical medical curricula.

Methods: The program was offered to first year medical students (Fall 2018). Students completed the following surveys: Pre-SSEP, Post-Experience, and Post-SSEP. Paired samples t-test were utilized to determine changes in interest as well as factors that impact this interest.

Results: After one year of participation, there was no significant change in interest in the included surgical subspecialties. Sub-analyses demonstrated an increasingly negative impact of specialty specific characteristics on student interest in the diversity of procedures, work hours, patient outcomes, and call nights.

Conclusions: We successfully designed and implemented the SSEP to supplement our medical school curriculum. Our hope is that other institutions can utilize our model via our online Handbook to provide students firsthand insight into surgical subspecialties prior to the clinical years:
https://github.com/SSEPUVM/SSEP-supplemental-materials.git.

Keywords: Education; Medical Student Education; Recruitment; Pre-clinical; Curriculum; Interest; Surgical
Subspecialties

Introduction

Despite limited exposure to surgical subspecialties during the preclinical years of medical school, residency positions in these fields remain highly sought after and competitive (Resnick, 2000). Prior reports have shown that two important factors in the decision to pursue a surgical residency are interest in surgery prior to the third year of medical school and student "fit" in the culture of the specialty (Erzurum et al., 2000; Berman et al., 2008; Allen et al., 2009; Goldin et al., 2012; Schmidt, Cooper and Guo, 2016; Zuckerman et al., 2016; George et al., 2017; Peel, Schlachta and Alkhamesi, 2018). Initial exposure to a competitive surgical field in the third year is often too late to impact students' specialty decision, as the push to acquire research and meaningful exposure to become a competitive applicant begins early in medical school.

To date, few medical institutions have described a formal model for a preclinical medical student exposure program to surgical sub-specialties, and most are restricted to a single sub-specialty (Allen et al., 2009; Grover et al., 2009; Lee et al., 2011; Patel et al., 2013; Zuckerman et al., 2016; Dallas et al., 2019; Lazow et al., 2019). At the Larner College of Medicine at the University of Vermont (LCOM-UVM), the current study sought to design, implement and examine the impact of a longitudinal program of increased exposure to multiple surgical subspecialties during the preclinical years of medical school, the Surgical Subspecialty Experience Program (SSEP), in order to provide students with an accurate, direct, firsthand exposure to residency and attending life as a surgeon.

Methods

In the fall semester of 2018, the SSEP was offered to all incoming first-year medical students at the LCOM-UVM. The program was organized by medical students (years 1-3), supported by 18 surgeons from all included subspecialties, and led by the Neurosurgery Department Chief and Faculty. Institutional review board (IRB) approval was obtained from the University of Vermont for this prospective, quality-based research endeavor.

Initiation of Program

Specialties included in the program were selected based on the following criteria: (1) they were not part of the required clerkship curriculum and (2) they have their own surgical residency separate from general surgical residency. The authors determined that the research team had the capacity to manage six surgical subspecialties in this first iteration of the SSEP. Selected specialties included cardiothoracic surgery, neurosurgery, otolaryngology, plastic surgery, urology, and vascular surgery.

Attendings were selected in each subspecialty based upon their willingness to participate and interest in medical student education. Eighteen surgeons, three per specialty (6 women and 12 men) participated in the program by opening their operating rooms (OR) and clinics to students and leading surgical skills sessions.

A one-time Pre-SSEP lunch time orientation was held to recruit medical students by outlining the SSEP program as well as providing an opportunity for them to interact directly with participating Surgical Attendings.

Surgical Subspecialty Experiences

The SSEP provided three opportunities: (1) OR, (2) clinic, and (3) surgical skills sessions. Plastic surgery clinic was not offered as an experience because it was located off site of the main hospital campus.

To avoid selection bias, students were blinded to which OR, clinic, and surgical skills experience they would receive.
Experiences (OR and clinic) were controlled for by the research team to ensure diversity of surgical subspecialties and type of experience. Students selected available time slots through an online portal. Surgical schedulers for each surgeon were responsible for communicating scheduling changes to the SSEP research team to be relayed to participants. Small group surgical skills-based sessions (8-10 students) were led by faculty attendings. Please reference Table 1 for participation per experience type and surgical subspecialties.

### Table 1. Student Participation by Surgical Subspecialty and Type of Experience

<table>
<thead>
<tr>
<th>Specialty</th>
<th>OR</th>
<th>Clinic</th>
<th>Surgical Skills Session</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiothoracic surgery</td>
<td>6</td>
<td>2</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>8</td>
<td>6</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>8</td>
<td>12</td>
<td>6</td>
<td>26</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>6</td>
<td>0</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>Urology</td>
<td>11</td>
<td>14</td>
<td>7</td>
<td>32</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>8</td>
<td>7</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>47</strong></td>
<td><strong>41</strong></td>
<td><strong>67</strong></td>
<td><strong>155</strong></td>
</tr>
</tbody>
</table>

Surgical Skills Sessions (Table 2) were scheduled around participating attendings availability, clinical/operative, and educational interests. Vascular surgery did not host any surgical skills sessions due to conflicts with scheduling.

### Table 2. Examples of SSEP Surgical Skills Sessions

<table>
<thead>
<tr>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face lifts</td>
</tr>
<tr>
<td>Deep inferior epigastric artery perforated flap harvesting for breast reconstruction</td>
</tr>
<tr>
<td>Scapular flap harvest</td>
</tr>
<tr>
<td>Neck dissection</td>
</tr>
<tr>
<td>Ureteroscopy</td>
</tr>
<tr>
<td>Skull base endoscopy</td>
</tr>
<tr>
<td>Cranial bolts and ventriculostomy</td>
</tr>
<tr>
<td>Craniotomy</td>
</tr>
<tr>
<td>Heart dissections</td>
</tr>
<tr>
<td>Coronary artery bypass grafts</td>
</tr>
</tbody>
</table>

**Online Portal**

The SSEP utilized a Microsoft Office SharePoint Server, an online content management portal designed to host documentation of any type and manage user access in a controlled environment. This portal was already integrated with the medical students’ user database and was hosted behind a secure, LCOM-UVM firewall. The SharePoint platform allowed the SSEP to share documents, build and maintain a group calendar for posting shadowing opportunities, and manage scheduling (participant sign-ups) in a secure environment while preserving data for future analysis.

**Surveys**

All surveys were developed and distributed using the open source survey software tool, LimeSurvey 3.21.4 (LimeSurvey, 2020). Survey questions were developed and adopted from existing published sources that explore factors that influence medical student interest in specialties (American College of Surgeons, 2020; Schwartz et al., 1989; Dorsey, Jarjoura and Rutecki, 2003; Newton, Grayson and Thompson, 2005; Clinite et al., 2013, 2014) and on the personal experiences of the medical student research team and surgeons involved in the SSEP. Surveys were voluntary and consent was implied with completion. Students were asked a series of questions to create a "unique
identifier”, while maintaining confidentiality, that were used to track responses longitudinally.

Pre- and Post-SSEP Surveys were administered to first year medical students during their first month and after completion of their first year pre-clinical curriculum. All surgical subspecialties as defined by the American College of Surgeons were included on the Pre- and Post-SSEP surveys. Questions utilized Likert scales to rank interest in surgical subspecialties (1-not at all interested, 2-slightly interested, 3-somewhat interested, 4-very Interested, 5-extremely interested) and the impact of specialty specific characteristics (Table 3) on interest (1-negatively influenced, 2-neutral Influence, 3-positively influenced) in each surgical subspecialty.

Table 3. Specialty Specific Characteristics

<table>
<thead>
<tr>
<th>Number of work hours/week in practice</th>
<th>Emotional burden</th>
<th>Patient outcomes</th>
<th>Research opportunities</th>
<th>Diversity of procedures</th>
<th>Amount of call nights during practice</th>
<th>Presumed level of specialty prestige</th>
<th>Lifestyle outside of work</th>
<th>Financial Compensation</th>
</tr>
</thead>
</table>

A Post-Experience survey was offered to each participant after each experience (OR, clinic, or skills session). Questions utilized a Likert scale to determine the impact of the experience on student interest (1-decreased, 2-stayed about the same, 3-increased) as well as the quality of the experience.

**Statistical Analysis**

Comparison of Pre- vs Post-SSEP survey responses were analyzed using paired-sample t-tests. Post-Experience survey responses were analyzed using a one sample test of proportions. Analyses were conducted using SAS 9.4 (Cary, NC: SAS Institute Inc), with significance level (α) set at 0.05 (two tailed). Complete detailed tables of statistical analyses can be found in the e-supplement material, Supplemental File 1 and Supplemental File 2.

A complete step-by-step Handbook to implementing and managing the SSEP is made available publicly at [https://github.com/SSEPUVM/SSEP-supplemental-materials.git](https://github.com/SSEPUVM/SSEP-supplemental-materials.git). The handbook was created as a road map for other institutions to implement their own pre-clinical experience program. Copies of all survey measures are included within the Handbook.

**Results**

Eighty students (male= 33.75%, female = 65%, no answer =1.25%) with a mean age of 24.2 ± 2.1 years completed the Pre-SSEP survey. Twenty-four students (male = 41.67%, female = 58.33%) subsequently completed the Post-SSEP survey after their first year of medical school, a 30% (24/80) response rate. Of the 24 students that completed both the Pre- and Post-SSEP Surveys, 14 of the students, a 58% (14/24) response rate, completed Post-Experience Surveys which indicates that the average number of experiences participated in per participant was 3.6 ± 2.5.

Pre-SSEP vs Post-SSEP Surveys: Change in Interest

No significant changes were observed in the mean change in interest per specialty (Table 4). Although not statistically significant, we see individual changes in interest at the participant level occurring across all surgical subspecialties. On average, 37% of students reported a decrease in interest, 42% reported no change in interest, and
21% reported an increase interest.

Table 4. Pre- and Post-SSEP Mean Interest per Specialty

<table>
<thead>
<tr>
<th>Specialty</th>
<th>n</th>
<th>Pre-SSEP</th>
<th>Post-SSEP</th>
<th>Pre- vs Post-SSEP</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiothoracic surgery</td>
<td>17</td>
<td>2.1 ± 1.1</td>
<td>1.9 ± 1.2</td>
<td>-0.1 ± 1.3</td>
<td>0.71</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>19</td>
<td>2.7 ± 1.2</td>
<td>2.2 ± 1.5</td>
<td>-0.5 ± 1.5</td>
<td>0.14</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>15</td>
<td>1.9 ± 0.8</td>
<td>1.9 ± 1.1</td>
<td>0.0 ± 1.5</td>
<td>1</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>17</td>
<td>2.5 ± 1.5</td>
<td>1.9 ± 1.2</td>
<td>-0.5 ± 1.5</td>
<td>0.17</td>
</tr>
<tr>
<td>Urology</td>
<td>15</td>
<td>1.6 ± 0.7</td>
<td>1.7 ± 0.9</td>
<td>0.1 ± 0.8</td>
<td>0.75</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>14</td>
<td>1.9 ± 0.9</td>
<td>1.6 ± 1.0</td>
<td>-0.3 ± 0.7</td>
<td>0.16</td>
</tr>
</tbody>
</table>

All questions were answered on a Likert Scale (1-not at all interested, 2-slightly interested, 3-somewhat interested, 4-very interested, 5-extremely interested)

Pre-SSEP vs Post-SSEP: Change in impact of specialty specific characteristics on interest

Though overall interest in each sub-specialty did not change, the importance of specific variables on the students’ interest within four specialties did change (Table 5). These changes indicated an increasingly negative impact of specialty specific characteristics on student interest in cardiothoracic surgery, neurosurgery, plastic surgery, and vascular surgery.

Table 5. Pre- and Post-SSEP Mean Impact of Specialty Specific Characteristic on Interest

<table>
<thead>
<tr>
<th>Specialty</th>
<th>n</th>
<th>Pre-SSEP</th>
<th>Post-SSEP</th>
<th>Pre- vs Post-SSEP</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiothoracic surgery</td>
<td>11</td>
<td>2.5 ± 0.5</td>
<td>1.9 ± 0.7</td>
<td>-0.6 ± 0.7</td>
<td>0.01</td>
</tr>
<tr>
<td>Diversity of procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>14</td>
<td>2.2 ± 0.8</td>
<td>1.8 ± 0.9</td>
<td>-0.4 ± 0.6</td>
<td>0.03</td>
</tr>
<tr>
<td>Patient outcomes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work hours per week in practice</td>
<td>13</td>
<td>1.5 ± 0.5</td>
<td>1.2 ± 0.4</td>
<td>-0.4 ± 0.7</td>
<td>0.05</td>
</tr>
<tr>
<td>Plastic surgery</td>
<td>6</td>
<td>2.3 ± 0.5</td>
<td>1.7 ± 0.5</td>
<td>-0.7 ± 0.5</td>
<td>0.03</td>
</tr>
<tr>
<td>Amount of call nights during practice</td>
<td>8</td>
<td>2.5 ± 0.5</td>
<td>1.9 ± 0.6</td>
<td>-0.6 ± 0.7</td>
<td>0.05</td>
</tr>
<tr>
<td>Vascular Surgery</td>
<td>7</td>
<td>2.6 ± 0.5</td>
<td>2.0 ± 0.6</td>
<td>-0.6 ± 0.5</td>
<td>0.03</td>
</tr>
<tr>
<td>Diversity of procedures</td>
<td>8</td>
<td>2.5 ± 0.5</td>
<td>1.9 ± 0.6</td>
<td>-0.6 ± 0.7</td>
<td>0.05</td>
</tr>
</tbody>
</table>

All questions were answered on a Likert scale (1-negative influence, 2-neutral influence, 3-positive influence)

Post-Experience Survey: Effect of Experience Type on Student Interest

The post-experience survey had a completion rate of 70% (109/155). 48 unique students participated in 155 experiences. Across all experiences, interest "increased" for 67% (n=73), "stayed about the same" for 28% (n=31) and "decreased" for 5% (n=5). A one sample test of proportions indicated that significantly more than half of participants’ interest increased after OR shadowing (p<0.001) and clinical shadowing (p=0.01) but this was not the case after skills sessions (p=0.56), Table 6.

Table 6. One sample test that 50% of the participants’ interest increased after that given experience
### Discussion

We successfully designed and implemented the Surgical Subspecialty Experience Program (SSEP) for preclinical medical students to supplement the medical school curriculum at the LCOM-UVM. Although participation in the SSEP was not associated with statistically significant changes in the mean interest per specialty (Table 4), we clearly see a trend of decreasing interest (Pre- vs Post-SSEP) occurring when we examine the change in interest at the participant level and the impact of specialty specific characteristics on interest (Table 5). Specifically, we found that our program negatively influenced perceptions of the diversity of procedures, (cardiothoracic surgery and vascular surgery) patient outcomes (neurosurgery and vascular surgery), work hours per week in practice (neurosurgery), and amount of call nights during practice (plastic surgery).

Our goal was to provide opportunities and experiences for students to develop their own interests or disinterests in...
surgical subspecialties. Surgical subspecialties consistently have the highest rates of burnout and attrition (Dimou, Eckelbarger and Riall, 2016). It is important for us to help students discover their passions as well as to identify fields in which they do not see themselves practicing. We consider a decrease in interest after participation a success, as it indicates that we have informed students of the realities of a career in a surgical subspecialty that would not have been a good fit. A young student enamored with the idea of being a surgeon without knowledge of the long hours and endurance required is likely to enter their residency program and become quickly disenfranchised with fields that are unequivocally grueling at times. Rather than holding an idea or ill-defined concept of what the training and career of a surgeon entails, we believe that through the SSEP, students experienced an accurate representation of these careers.

One possible explanation for the low Post-SSEP Survey response rate is student disinterest after participation, such that they were no longer engaged enough to complete the survey. Additionally, as part of our study design, when signing up for an experience, we did not allow students to choose the type (OR vs. clinic) or specialty in order to avoid selection bias. Although our goal in doing this was to ensure that students experienced a diverse array of specialties, we recognize that this lack of control may have contributed to students’ disinterest in continued participation. If a lack of interest in surgical subspecialties after participation is indeed the reason for the low response rate, our primary goal was accomplished by helping students discover their own interests and disinterests.

Post-Experience survey responses indicated (Table 6) that experiences in the OR were more likely to be associated with an increase in interest (85%) as compared to surgical skills sessions (54%). One possible explanation for this is that student interest is influenced by more than just the skills and techniques specific to a field. For most medical students in their pre-clinical years, the OR represents a completely novel environment. Moreover, each surgical subspecialty is distinct, such that the environment within their respective ORs is different. We believe that it is within these real-life settings where medical students can ascertain a truly holistic understanding of these surgical fields. Although medical students may be less engaged in the actual operations, due to the inherent high-risk nature, our results indicate that the act of simply being present within the OR setting may be the most important shadowing experience for pre-clinical medical students.

Of note, although Pre-SSEP interest in surgical subspecialties was low, we were able to engage 40.34% (48/119) of the class of 2022 enough to voluntarily attend at least one SSEP experience. It is likely that our program’s one-time Pre-SSEP lunchtime orientation was beneficial to increasing student recruitment and thus is recommended in all future iterations of this program. During the orientation, participating attendings introduced themselves by sharing their own paths to their specialty. We believe that this helped students better relate to them, making the goal of becoming a subspecialized surgeon a more attainable and realistic goal.

In summary, we created and demonstrated a sustainable model for coordinating experiences between medical students and surgical subspecialty attending physicians. We recognize that with the increasing demands of clinical and operative practices, often the barrier to medical student exposure is simply the lack of capacity to organize such experiences. Our model utilizes a team of medical students to lead the management of the day-to-day operations and coordination for the program. In doing so, we create new opportunities for students to engage directly with surgeons as well as becoming involved in the ongoing research and development of the program. Current student team members have participated in IRB processes, survey development, IT web development, team management, grant applications, poster presentations, oral presentations, abstract and manuscript development.

**Limitations**

There are several limitations of the present study. First, our low Post-SSEP survey response rate, 30%, limits our
ability to draw conclusions from our results. Moreover, because six specialties were included within the program, the sample size is spread across these subspecialties, resulting in lower statistical power. Future iterations should consider potential ways to increase the Post-SSEP survey response rate. Second, the LCOM-UVM Class of 2022 is composed of 65% women which is not typical of most medical schools. We acknowledge that this may limit the generalizability of the study to a wider medical student population. Third, LCOM-UVM is a program that traditionally attracts students that are interested in primary care. Per the AAMC State Physician Workforce 2019 data report, Vermont ranks second in the nation in primary care physicians per capita and first in active patient care primary care physicians per capita (AAMC, 2019). Fourth, one factor that may have contributed to the non-significant changes was that students did not pick their own specialty. It is conceivable that if students were able to select experiences in the areas of surgery that they were most interested in, ratings may be higher. In future iterations, we plan to allow students to choose their specialty and suggest other institutions do the same, as this may also improve student satisfaction.

### Conclusion

We believe that it is necessary to provide medical students opportunities for early exposure to a wide array of surgical subspecialties for them to make informed decisions about their interests and future careers. Early exposure, and thus identification of career interests, will allow students the necessary time to pursue extracurricular research projects and mentorship relationships to be competitive in the surgical subspecialty residency match, which is now being described as an "arms race" due to the increasingly robust pre-residency criteria (Wadhwa et al., 2019).

Our goal was to create a formal model for a pre-clinical shadowing program that can be adapted to other medical universities and other specialties, including non-surgical. To aid in this effort, our team has created a Handbook that presents a step by step methodology to establish our program at other institutions: [https://github.com/SSEPUVM/SSEP-supplemental-materials.git](https://github.com/SSEPUVM/SSEP-supplemental-materials.git). As the SSEP continues to develop and mature, our team hopes to work with other institutions to help continually improve our methodology while ensuring students can explore and pursue their interests.

### Take Home Messages

- The SSEP is a sustainable model for shadowing during the medical school pre-clinical curriculum
- This shadowing model can be adopted at other institutions for any specialty
- Pre-clinical exposure to surgical subspecialties may decrease student interest
- Operating Room shadowing may have the most impact on medical student interest

### Notes On Contributors

**Jonathan H. Borden BS** -- an MD Candidate at the Larner College of Medicine at the University of Vermont, Class of 2021. He hopes to pursue a career within neurosurgery. During his medical school career, he developed an interest in medical education, particularly, understanding what influences medical student's career interests.

**Katherine E. Callahan BA** -- an MD candidate at the Larner College of Medicine at the University of Vermont, Class of 2021. She is pursuing a career in neurological surgery. In addition to her research interests in medical student education and gender diversity within neurosurgery, she is an active participant in the UVM Global Health Program.
Scott L. Zuckerman MD MPH -- completed his undergraduate education at Cornell University in 2008, graduating magna cum laude with a Bachelor of Science in Biology & Society. He graduated from Vanderbilt University School of Medicine in 2012. There, he served as class president for four years and was awarded the School of Medicine Award of Distinction. Dr. Zuckerman's research interests include spine tumor, adult deformity, peripheral nerve, and sport-related concussion. He is a member of the Vanderbilt Sports Concussion Research group (V-SCORE) led by Dr. Gary Solomon and Dr. Allen Sills. Scott is pursuing a Master in Public Health focusing on Epidemiology through the Harvard T.H. Chan School of Public Health. Outside of the hospital, Scott is an avid sports fan, rooting for the Yankees and Knicks. He enjoys baseball, softball, basketball, golf, crossfit, and reading about baseball history.

Kyle W. Leonard BS -- a medical student in the class of 2022 at the Larner College of Medicine at the University of Vermont. He is interested in the field of otolaryngology and hopes to pursue a career as a head and neck surgeon. During medical school, he developed an interest in medical education research, especially the impacts of different curricular interventions on students.

Alyssa Heiser BA -- an MD Candidate of the class of 2022 at The Robert Larner, M.D. College of Medicine at the University of Vermont. She hopes to pursue a career in ENT/Otolaryngology-Head and Neck Surgery. Her research interests include medical education, surgical outcomes, health economics, and facial plastic surgery.

Cara S. Rathmell BS -- a part of Larner College of Medicine at the University of Vermont Class of 2022. She received her undergraduate degree in Mathematics from the United States Naval Academy. Her goal is to pursue a career in Anesthesiology with the hope of doing a fellowship in Critical Care.

Kevin C. DiBona BS -- an MD candidate of the class of 2023 at the Larner College of Medicine at the University of Vermont. He is the current leader of the urology and cardiology student interest groups at the Larner College of Medicine. He hopes to pursue a career in surgery with an accompanying focus on clinical research in an academic medical center.

Emma C. Dunne BS -- an MD Candidate of the class of 2023 at the Larner College of Medicine at the University of Vermont. She is particularly interested in clinical and translational research in pediatric and surgical subspecialties. Additionally, she hopes to help to foster opportunities for medical student engagement in these areas of investigation.

Megan N. Eubank BA -- an MD Candidate of the class of 2023 at the Larner College of Medicine at the University of Vermont. She has a strong interest in surgery and hopes to work in an academic medical center. She is a co-leader of the Surgery, Orthopaedic, Cardiothoracic Surgery, and Wilderness Medicine Student Interest Groups.

Lauren A. Okamoto BS -- an MD Candidate of the class of 2023 at the Larner College of Medicine at the University of Vermont. She is currently serving as the Vice President of a non-profit organization, the Public Health Coalition. Her interests include advancing medical education, public health, and surgical subspecialties.

Peter W. Callas PhD -- Director of the Biomedical Statistics Research Core at the University of Vermont Larner College of Medicine. He has been a faculty member at the University of Vermont since 1994, with expertise in the design, analysis, and interpretation of clinical and translational research. In addition to his research work, he teaches biostatistics and epidemiology to physicians, medical students, nurses, biostatistics graduate students, and others.

Sheila R. Russell BS SRS LATG -- a Researcher/Analyst and Director of Surgical Skills and Skull Base laboratory
at the Larner College of Medicine at the University of Vermont. In addition to participation in numerous research endeavors she has a passion for developing hands on educational opportunities in support of young medical professionals.

**Susan R. Durham MD MPH** -- the J Gordon McComb Family Endowed Chair and Chief of the Division of Neurosurgery at Children's Hospital Los Angeles and a Clinical Professor of Neurosurgery at University of Southern California Keck School of Medicine. Her research interests include gender- and education-related issues in neurosurgery.

**Ryan P. Jewell MD** -- completed his undergraduate education at the University of Notre Dame in 1995, graduating with a Bachelor of Science. He graduated from University of Vermont School of Medicine in 1999 and received the Gordon Page Excellence in Surgery Award. He completed his Neurosurgical residency at University of Vermont and a complex spine fellowship at University of Alabama Birmingham. He joined the University of Vermont Department of Neurosurgery as an Associate Professor in 2007 with a particular interest in medical student and resident education. Outside of the hospital, Ryan is an avid fly fisherman, lacrosse coach, and gardener.

**Acknowledgements**

Kristin Littlefield -- Lead Surgical Scheduler. Kristin's efforts allowed the SSEP team to seamlessly coordinate shadowing experiences between medical students and surgical attendings.

Frank P. Ittleman, MD, Cardiothoracic surgery -- A senior advisor on the project. Dr. Ittleman's guidance was invaluable towards our efforts to create a sustainable shadowing program model for medical school curricula.

Jesse S. Moore, MD, Colorectal surgery -- A senior advisor on the project. Dr. Moore's experience within medical education and his guidance was invaluable towards our efforts to create a sustainable shadowing program model for medical school curricula.

**Subspecialized Surgeons that volunteered their time and effort to the SSEP:**

- Bruce Leavitt, MD – Cardiothoracic surgery
- Fuyuki Hirashima, MD – Cardiothoracic surgery
- Brandon Liebelt, MD – Neurosurgery
- Tamara Rimash, MD – Otolaryngology
- Mirabelle Sajisevi, MD – Otolaryngology
- George Kurien, MD – Otolaryngology
- Robert Nesbit, MD – Plastic surgery
- Meredith Collins, MD – Plastic surgery
- Thomas Wilson, MD – Plastic surgery
- Brian Irwin, MD – Urology
- Kevan Sternberg, MD – Urology
- Peter Holoch, MD – Urology
- George Steinthorsson, MD – Vascular surgery
- Matthew Alef, MD – Vascular surgery
- Julie Lahiri, MD – Vascular surgery
Bibliography/References


**Appendices**
None.

Declarations

The author has declared that there are no conflicts of interest.

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