Surgical Clinical Correlates in Anatomy: Implementation of a First-Year Medical School Program

Thesis

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By

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Abstract

A need exists among medical students to develop a clinically correlated anatomy program that will maximize their learning experience, improve their academic performance, and allow them to make more informed career choices. Therefore, we designed and implemented an elective program for first-year medical students entitled Surgical Clinical Correlates in Anatomy, which allowed surgeons to teach clinical anatomy concurrent to the traditional anatomy course. This program consisted of sessions on general surgical knowledge, Orthopedic Surgery, Plastic Surgery, Urology, Cardiothoracic Surgery, General Surgery, Vascular Surgery, and Otolaryngology. Each session contained interactive cadaveric operations. Survey data, anatomy exam scores, and MCAT scores were collected from the program participants (n=25), as well as from their peers completing the traditional anatomy course only (n=176). Analyses to evaluate the program and investigate whether participation in the program impacted scores on first-year anatomy curricular exams, changed student perceptions of surgeons, and impacted student interest in surgery were conducted. Of the 25 program participants, 24 reported that the program was helpful and would recommend it to others, while 23 reported that the class should be continued. Program participants averaged 87.7% (±5.00) on first-year anatomy course exams, while those that volunteered for the program but were not chosen to participate averaged 86.8% (±7.34), and the remainder of the class
averaged 86.0% (±7.72). However, the results of a one-way analysis of covariance (ANCOVA), where academic ability was controlled for using MCAT scores, indicated no statistically significant differences in the exam averages between these three groups [F(2,194)=0.951, p=0.388]. Dependent t-tests indicated that although there was a significant increase in positive opinions of surgeons by the entire first-year medical school class [t(215)=-3.053, p=0.003], there was not a significant change in their negative opinions of surgeons [t(215)=1.212, p=0.227] between the pre-survey and post-survey. When the students were divided into groups, however, analysis of variance (ANOVA) indicated that there was no statistically significant difference in the change of positive opinions of surgeons [F(1,180)=3.053, p=0.082] or in the change of negative opinion of surgeons [F(1,180)=0.212, p=0.646] between program participants and non-participants from the pre-survey to the post-survey. Although it appeared that interest in surgery decreased for participants during the program, a dependent t-test showed this reduction in surgical interest for participants was not statistically significant [t(24) = 0.647, p = 0.524]. Additionally, the results of the ANOVA indicated that there was no statistically significant difference in the change in surgical interest between program participants, non-selected program volunteers, and the remainder of the class from the pre-survey to the post-survey [F(2,136)=1.520, p=0.222]. Although this early exposure to surgery via the Surgical Clinical Correlates in Anatomy program did not impact interest in surgery or opinion of surgeons for participants differently than non-participants, future investigation of residency matches is needed as the participating students may choose a surgical residency at different rates than their non-participating peers. Additionally, more
research is needed as participation in this program may provide participants with an
advantage over their non-participating peers during their surgical clerkships.
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There have been many changes and additions to the curriculum of medical schools, but anatomy continues to have a reduced time allotment and a loss of identity in the curriculum (1,2). The Ohio State University College of Medicine is no exception in that their first year medical school anatomy course was recently downsized from 12 to 10 weeks. Furthermore, the field of anatomy has seen a severe decline of qualified teachers (3,4). A survey from 2002 demonstrated that more than 80 percent of the chairs of departments responsible for teaching anatomy anticipated that they would have great or moderate difficulty recruiting qualified faculty to teach gross anatomy (4). Seyfer et al. recently showed that surgeons teaching anatomy can provide surgical clinical correlations and offer support to anatomists and anatomy course directors (3).

The Ohio State University College of Medicine has never had formalized surgical faculty assistance for the anatomy staff during the first-year medical student anatomy dissections. Through this current research, it will be suggested that surgeons teaching anatomy could serve two functions. First, surgeons could help to alleviate the strain on anatomists to assist students in the dissection lab. Secondly, surgeon interaction with medical students could improve student opinions of surgeons and increase student interest in surgery. These outcomes are necessary as indicated by recent reports and
research. First, the All Schools Report suggested a decreasing interest for fourth year medical students in general surgery from 1978 through 2001 (5). Additionally, the national match results for the past few graduating classes have shown a gradual trend of more general surgery positions being filled by international graduates for both categorical and preliminary positions (6, 7). In fact, only 7 of 192 students from The Ohio State University College of Medicine’s Class of 2009 matched into a categorical General Surgery position and only 28 students from the Class of 2009 matched into all surgical specialties combined (8). It has been suggested that a lack of exposure to surgeons and surgical topics in the first two years of medical school may be the cause of the decreased interest in surgery (9). This decreased interest in surgery has been blamed on the failure of surgical educators and their hesitancy to take a leadership role (10). Most surgeons are content to have others educate medical students, likely due to time and personal constraints. Many researchers believe that in order to increase medical student interest in surgery, surgical faculty and residents must become more involved in medical education (9, 10, 11). One study indicated that medical students’ overall satisfaction with their surgical clerkship was related to residents’ and faculty members’ teaching behaviors and attitudes (12). Therefore, we hypothesize that surgeons are uniquely positioned to stop the downward trend of medical student interest in surgery by becoming involved in basic science education.

The trend of decreasing interest in surgery goes beyond the initial matching into surgical residency programs. Many studies have documented a fairly consistent attrition rate of 14 percent to 23 percent (13, 14, 15, 16) in surgical residency programs. One of these studies included both voluntary and involuntary terminations (13). These same
statistics are holding true for The Ohio State University Medical Center’s Department of Surgery. One resident out of six has left each year for the last four years. Nationally, most of the residents that leave general surgery do so in order to switch to a different specialty such as anesthesiology, internal medicine, radiology, and family medicine (14). Additionally, it is unusual for a resident to leave a non-surgical residency and then enter into a surgical one. Dodson and Webb showed an overall attrition rate of 17 percent, with 15 of the 20 residents who left continuing on in other specialties. Fourteen of these residents reported they left for lifestyle reasons. Three of these residents recently had children and chose to change to specialties that required less of a time commitment. Five other residents opted to change to a plastic surgery residency in order to shorten the total time for residency training (13).

Unfortunately, one reason surgical specialties are often not sought after is because surgeons often suffer from an unfavorable image. One study revealed that 34% of third-year medical students believed surgeons to be “unapproachable” (17). Another study showed that 50% of students believed that they were considered an inconvenience by attending surgeons while on their third-year surgical rotations (18). However, it appears these feelings on the part of the students were exaggerated as research indicated that only 27% of attending surgeons confirmed that they actually did consider the students to be an inconvenience (17).

These findings outlined above come at a time when it has been clearly determined that there is an impending overall physician shortage, the effects of which will be felt as early as 2009 (11). This trend is also documented in general surgery with the estimation of a shortage of 1,300 general surgeons by 2010. If this decline continues, it is predicted
that there will be a shortage of 6,000 general surgeons by 2050 (19). One view, which may be an extreme, estimates that the nation will need 10,000 additional first-year residency slots and 60 new medical schools by 2020 to control the crisis (20). This need to increase the number of medical schools will place a greater strain on the already deteriorating anatomy workforce. One alternative is to increase interest in surgery in our current medical students.

It has been previously hypothesized that the way to improve the image of surgeons and to increase interest in surgical careers is to actively integrate surgeons into the first- and second-year curriculum as mentors, counselors, and instructors (10, 21, 22). Kozar et al. showed that even a brief intervention, namely a one hour panel, by general surgeons during the first-year of medical school can favorably influence students toward general surgery (23). One study integrated a surgeon led suturing curriculum into the first-year anatomy lab, with the vast majority of student respondents agreeing or strongly agreeing that the suturing program was enjoyable and worth continuing. The students stated that their interactions with the surgeons were positive and 33% stated that their interest in surgery increased after the program. Qualitative comments praised both the experience and surgical participation (24). Additional studies have shown that a positive medical student operative experience correlates with matching into a categorical surgical position (25, 26, 27). O’Herrin et al. demonstrated an increased interest in surgery from 7% on a pre-clerkship survey to 34% on a post-clerkship survey. Based on their survey data, it was shown that the increased interest in surgery was attributable to positive and constructive operative exposure. Students also cited both resident and faculty interaction as a significant factor in their increased interest (25). In another study, Berman et al.
concluded that students who are encouraged to actively participate in the operating room are more likely to be interested in pursuing a career in surgery. Their results showed that students who handled the camera during a laparoscopic operation were 7.2 times more likely to express an interest in a career in surgery, compared with those who did not actively participate during surgeries. Additionally, students that completed suturing were 4.8 times more likely to be positively influenced for a career in surgery (27). Finally, Andriole et al. observed that students who rate the quality of their required surgery clerkship experience more highly were more likely to plan surgical careers (28).

It may seem that most of these issues are not related, but in fact they are all interconnected. If surgeons begin teaching anatomy, this could both help to alleviate the stress on the anatomy department in terms of personnel numbers, as well as expose medical students to surgery and surgical subspecialties early in their careers. This would allow medical students to explore surgical career options during their first two years of medical school, instead of waiting until their third year to have these opportunities. In this thesis, we suggest that an early exposure of medical students to surgery could improve student opinions of surgeons, allow for an increased interest in surgery, and create higher match rates into surgical specialties. Furthermore, this early exposure to surgery has the potential to decrease the attrition rate in surgical residencies programs, since students have time to adequately learn about life-style, time commitment, and career satisfaction.

Through personal communications, medical students, both those that enter surgical and medical specialties, have indicated the need for a practical, surgically oriented anatomy class before their clinical surgical rotations. These students believe that
this early surgical exposure could maximize their learning experience and inform them more about residency choices, as medical students currently are not exposed to surgical topics at most medical schools until their third-year of medical school. Therefore, a need exists among medical students to develop a clinically correlated anatomy program that will maximize their learning experience, improve their performance, and allow them to make more informed career choices. For that reason, we designed and implemented an elective program for first-year medical students entitled Surgical Clinical Correlates in Anatomy, which would allow surgeons to teach clinical anatomy concurrent to the traditional anatomy course. In the long-term, we hypothesize that medical students that participate in this elective program will perform better in the traditional anatomy course and their clerkships than their peers, and ultimately be more likely to choose surgical residencies. This current research, however, will focus on results of the first-year of the program and whether participation in the Surgical Clinical Correlates in Anatomy program: 1) impacted scores on first-year anatomy curricular exams; 2) changed student perceptions of surgeons; and 3) impacted student interest in surgery. Based on the research described earlier, we hypothesize that medical students that participate in the elective program will perform better on the first-year anatomy exams than their peers that do not participate. Additionally, we hypothesize that students that participate in the Surgical Clinical Correlates in Anatomy program will gain a more positive perception of surgeons than their non-participating peers. Finally, we hypothesize that participants in the program will have an increased interest in surgery.
Chapter 2: Design and Implementation of Surgical Clinical Correlates in Anatomy

The standard anatomy course for first-year medical students at The Ohio State University College of Medicine prior to the fall of 2008 was 10 weeks long and contained three blocks. The first block was Back and Upper Extremity, the second block was Thorax, Abdomen, Pelvis, and Lower Extremity, and the third block was Head and Neck. The students would attend lectures in the morning followed by a hands-on cadaveric based dissection lab. Each dissection table had approximately six students. The students were assigned to their dissection table by faculty. The dissection lab was overseen by faculty from the Division of Anatomy, anatomy graduate students, and a few selected second-year medical students. There was no involvement by attending surgeons or residents.

During the fall of 2008, the anatomy course still contained the same three blocks in which the students would attend lectures followed by hands-on cadaveric based dissection lab. Surgeons, though, became involved with the dissections for the entire first-year medical school class. Attending surgeons and residents assisted the students throughout their normal dissections. These attending surgeons and residents were asked to participate in the laboratory during dissections which related to their specialties. Therefore, the participants of the Surgical Clinical Correlates in Anatomy program not
only were assisted in the cadaveric lab by the surgeons like the remainder of the first-year medical school class, but also participated in the eight classes that were scheduled outside of the traditional anatomy class schedule.

**Implementation of the Classes**

We began our project by analyzing the anatomy blocks to determine the appropriate amount of classes to be included in Surgical Clinical Correlates in Anatomy. We decided that two to three classes per block for a total of eight classes would be a suitable amount. Each class would last approximately two hours. Then, we chose surgical specialties to correlate with the anatomy blocks. The first block was Upper Extremity and Back. It was determined that a class on general surgical knowledge would be an excellent starting point for the medical students in order to familiarize them with surgery and the operating room. Plastic Surgery was the second class to be included in the first anatomy block. It was decided that the second anatomy block, Thorax, Abdomen, and Lower Extremity, would include classes on Cardiothoracic Surgery, General Surgery, Urology, and Orthopedic Surgery. Head and Neck was the third block and would contain classes on Vascular Surgery and Otolaryngology (Table A.1).

We met with the faculty in the Division of Anatomy and found a time slot that fit for each of the eight classes. We secured a room in Hamilton Hall, which houses the Division of Anatomy, for our classes. We were able to secure two embalmed cadavers for our class, as well as the prossections and cross-sections from the Division of Anatomy to supplement the dissections. An unembalmed cadaver was also obtained for the Otolaryngology class. For the most part, we used surgical instruments that had been donated by the Department of Orthopedic Surgery for our cadaver operations. Since we
did not have every instrument required by Plastic Surgery, General Surgery, and Orthopedic Surgery, the doctors brought extra instruments with them to the classes. The Division of Anatomy provided their digital video camera and a flat screen monitor to use during each class. The digital video camera was connected to the monitor and provided a close-up image of the surgery being performed. This allowed all 25 students a close view of the procedures, even when they were not the ones performing them.

Each class was divided into two parts. For the first part, each surgeon was asked to create a 30 to 45 minute presentation that included a review of the relevant anatomy, clinical correlations, pertinent radiologic studies, and an actual surgical video portraying the surgery the students would be performing. The faculty members were then asked to list procedures pertinent to their specialty that would allow for hands-on experience, but would also fit within the time constraints of the class. During these procedures, the students would be able to work on the cadavers so to fully appreciate the applied surgical anatomy.

**Faculty Recruitment and Participation**

Our next step was to invite surgical faculty to teach the newly created classes. An attending surgeon for each of the eight classes was chosen based on merits of teaching according to resident interaction. A letter was drafted inviting these individuals to participate as teachers (Figure B.1). Each of these faculty members accepted the invitation and most agreed to bring a fellow or a resident with them to assist. A meeting was then scheduled with each of these faculty members to discuss expectations for the class. After meeting with the faculty, it was found that there was a time conflict with two
of the classes due to clinical responsibilities. These two classes were rescheduled based on faculty and classroom availability.

Due to another scheduling conflict, the Cardiothoracic Surgery class was switched with the General Surgical Knowledge class in the schedule. At this time, Surgeon Two and Surgeon Three were asked to lead the Cardiothoracic Surgery session. They accepted the invitation. A meeting was scheduled with both faculty members during which the criteria of the class was discussed. Surgeon Three agreed to create a video of an aortic valve repair to show the class.

**Class Composition/Subject Matter**

For the general surgical knowledge class, the students would take part in an interactive session in order to become familiar with surgical instruments, different types of sutures, wound healing, and how to suture and tie. The class would include a hands-on element in which the students would be taught to suture on a cadaver. In the Plastic Surgery class, the students would actively participate in a carpal tunnel release, facial fracture repairs, and learn about the LeFort classification system. The third class, Cardiothoracic Surgery, would include taking part in a thoracotomy with lobectomy and a sternotomy with dissection of the human heart. Next, the Urologic class would allow the students to assist in a nephrectomy and learn the basics of pelvic floor resuspension. The fifth class, General Surgery, would allow the students to perform an appendectomy and a right hemicolecotomy. The Orthopedic class would include an autograft ACL reconstruction, inside-out meniscus repair, high tibial osteotomy, tibial tubercle osteotomy, and an open reduction internal fixation of a tibial fracture. Vascular surgery was next and would allow the students to actively participate in a carotid endarterectomy.
and lower extremity amputations. The last class, Otolaryngology, would allow the students to perform a radical neck dissection.

After rescheduling due to a last minute scheduling conflict, Cardiothoracic Surgery was the first class of Surgical Clinical Correlates in Anatomy program. During the first 45 minutes, Surgeon Three led the students through an interactive discussion of thoracic anatomy. The students were then divided into two groups and each group worked with a cadaver. Surgeon Three aided the students in performing a sternotomy with a dissection of the heart. At this time, he also showed the aortic valve video discussed earlier. Under Surgeon Two’s guidance, the students participated in a thoracotomy and lobectomy. The students then had time to switch groups and review the procedures performed on the cadavers by their counterparts.

The Plastic Surgery section was led by Surgeon Four, who brought all of his own instruments to the class. The class began with a presentation reviewing hand anatomy, etiology, diagnosis, and treatment of carpal tunnel syndrome and the LeFort Classification system for facial fractures. Relevant radiologic studies were included throughout the presentation. The class then moved to the cadavers. Initially, the students were allowed turns participating in a carpal tunnel release. After each student had an opportunity, the students helped Surgeon Four perform incisions that would be typically used to repair facial fractures.

The third class, General Surgical Knowledge, was led by Surgeon One. Since each student would be suturing during this class, 25 needle drivers were borrowed from the Clinical Skills Lab, a clinically-oriented lab where medical students are taught procedural skills. The class began with a presentation that discussed the common
surgical instruments and how to correctly handle them. Actual instruments were also passed around during the discussion. The students then learned about wound care through an interactive presentation. Review questions were covered at the end of the interactive wound care presentation to reinforce the information. After that, the students were taught about the different types of sutures and when they are generally used. The final goal of the class was to teach the participants how to suture and tie knots. Since surgical masks have long strings used to tie the mask onto the face, each student received a mask to practice tying. They were instructed in the two-hand tie. We then moved to the cadavers. The students began by each making an incision in the cadaver’s back. Then, they were taught how to suture and were able to practice their tying. If a student was having difficulties learning to tie on the cadavers, practice tie boards were available for the students to use. These use large diameter ropes which allow the students to more easily visualize the knots. Students were able to stay after the allotted two hours of class time to practice their suturing and tying with the supervision of a surgical resident. An issue arose during this particular class. Namely, we had borrowed 25 needle drivers from the Clinical Skills Lab, but did not borrow 25 pick-ups. We only had a handful of pick-ups, so students had to share these instruments.

The next class, Urologic Surgery, was directed by Surgeon Five. His presentation contained pertinent abdominal anatomy and a video of a laparoscopic nephrectomy. He then discussed the importance of anatomy during a pelvic floor reconstruction. The class then began working with the cadavers. The students took turns performing a nephrectomy. At the end of class, Surgeon Five used the cadaver to review abdominal and pelvic anatomy with the students.
Surgeon Six directed the General Surgery class. Surgeon Six began the class with a presentation reviewing abdominal anatomy, typical suffixes used in surgery (ex. -ectomy, -ostomy, and –otomy), reasons to perform abdominal operations, and the incisions needed to perform these operations. Next, the students were able to participate in an appendectomy and a right hemicolecction. Gastrointestinal staplers were supplied to the students in order to more authentically perform these procedures.

The Orthopedic Surgery session was led by Surgeon Seven. To begin the class, an interactive lecture was presented that included discussions of important lower extremity anatomy, radiologic studies showing relevant pathology, and pictures from knee scopes showing anatomical relationships and pathology. An Orthopedic Surgery resident accompanied Surgeon Seven, so the students were divided into two groups and began the hands-on portion of the class by performing an autograft ACL reconstruction on the cadavers. The class continued with an inside-out meniscus repair, a high tibial osteotomy, a tibial tubercle osteotomy, and an open reduction internal fixation of a tibial fracture. The students used actual equipment from the operating room, which gave a more realistic feel to the class.

The seventh class was Vascular Surgery. Surgeon Eight began the session with a presentation relating neck anatomy to carotid endarterectomies. He walked the students step-by-step through a carotid endarterectomy discussing important anatomical landmarks using actual intraoperative photographs. A Vascular Surgery fellow came to the class with Surgeon Eight, so the students were divided equally between two cadavers. They were able to take turns performing the steps of a carotid endarterectomy. After
each student was allotted a turn, they participated in both below-the-knee and above-the-knee amputations.

The eighth and final class, Otolaryngology, was led by Surgeon Nine. He began the class with a discussion of neck anatomy and how it relates to a radical neck dissection versus a modified radical neck dissection. The class then reviewed neck anatomy on a fresh cadaver while performing a radical neck dissection. Prosections and cross-sections were also used to show anatomical relationships.

**Class Size Determination and Selection**

It was determined that 25 of the 211 total entering first-year medical students were needed to participate in Surgical Clinical Correlates in Anatomy to ensure sufficient numbers for subsequent statistical analyses. The mean scores (±standard deviation) of recent final anatomy exams and practicals were 88.1% (±8.5) and 91.4% (±6.9), respectively. There will be a power of 90% to detect at least a 7% increase in both of these scores. This is based on a two-sided test with an alpha = 0.0167 and a common standard deviation using 25 students in the surgical correlates program and 175 students with only the traditional anatomy course. In actuality, the number of students with only the traditional anatomy course that were included in the study was 176 after exclusion of students from the study that did not agree to participate (i.e. did not sign the consent form), those enrolled in the M.D./Ph.D. program, those that took a leave of absence, and/or if an error (i.e. missing or incorrect) occurred when the student provided their mailbox number which was used to link the pre-survey and post-survey. We chose to exclude M.D./Ph.D. students because they would not follow the training course of a traditional medical student. The mean scores (±standard deviation) of recent third year
shelf exams was 72.0% (±8.7). There will be a power of 90% to detect at least a 10% increase in these scores. This power calculation uses the same assumptions as above. The alpha was set to 0.0167 since we will be testing to see if all three exam scores increase thus conserving the type I error at 5% due to the multiple testing. In order to avoid a selection bias, the 25 students in the Surgical Clinical Correlates in Anatomy program were randomly selected from the 94 volunteers.

Three means were used to publicize this program to the first-year medical students. First, a flier describing the program was created and placed in each first-year medical student’s mailbox during orientation week (Figure B.2). A hand-out overviewing the program was also distributed to the entire first-year medical school class on the first day of anatomy lecture (Figure B.3). A short overview of the program was also presented to the students at that time. The overview hand-out was also e-mailed to each student. The students were given until 5:00PM that same day to e-mail their interest in participating in the program. Out of the first-year medical school class, 94 students volunteered to participate in Surgical Clinical Correlates in Anatomy. Three of the 94 students were not included in the lottery because they were M.D./Ph.D. students. Again, we chose to exclude M.D./Ph.D. students because they would not follow the training course of a traditional student. The 25 positions were filled by randomization of the interested students. All but 15 students from the first-year medical school class completed the IRB approved consent form (Figure B.4).

We ran into a few difficulties during the process to select students for the program. To begin with, one student offered his position to a friend that had not met the time deadline. It was decided that spots in the class could not be given to other students.
If a student wanted to give up a position in the program, it would be filled by randomization. We also had several students either e-mail after the deadline or e-mail the wrong person prior to the deadline. It was concluded that these students would not be included in the randomized lottery.

**Monitoring Devices**

A pre-evaluation survey was created (Figure B.5) and distributed to the entire first-year medical class on the first day of anatomy lecture. The students were asked to use their medical school mailbox numbers for identification on the surveys. Out of the entire class, 199 students completed the pre-evaluation survey. Two of these surveys had the same mailbox number, so they were not included for the analyses. Another 17 surveys were collected that did not have mailbox numbers and, therefore, these were also not included. Therefore, a total of 180 surveys were collected that included complete information. Of those 180 surveys, 170 surveys remained after exclusion of students from the study that did not agree to participate (i.e. did not sign the consent form), were enrolled in the M.D./Ph.D. program, and/or if they took a leave of absence. The information from retained pre-evaluation surveys was then inputted to an Excel® spreadsheet.

During the last anatomy lecture of the year, post-evaluation surveys were distributed to the first-year medical school class (Figure B.6). Out of the entire class, 168 students completed the post-evaluation survey. Of those 168 surveys, 164 surveys remained after exclusion of students from the study that did not agree to participate (i.e. did not sign the consent form), were enrolled in the M.D./Ph.D. program, if they took a leave of absence, and/or an error (i.e. missing or incorrect) occurred when the student
provided their mailbox number which was used to link the pre-survey and post-survey. This data from retained post-evaluation surveys was then inputted to an Excel® spreadsheet.

Of the 25 of the participants in Surgical Clinical Correlates in Anatomy program, all 25 completed both the pre-evaluation and post-evaluation surveys. Of the 176 students with only the traditional anatomy course, 114 completed both the pre-evaluation and post-evaluation surveys.

The Excel® spreadsheet data was then converted into Statistical Package for the Social Sciences (SPSS), version 17.0 (SPSS, Inc. Chicago IL), and analyses completed. Descriptive statistics were used to compare student demographics between the two groups, namely those in the Surgical Clinical Correlates in Anatomy program and those in the traditional medical school anatomy course. Descriptive statistics were also used to compare student demographics between three groups, namely those in the Surgical Clinical Correlates in Anatomy program, those that were interested in the program but were not selected, and those that indicated no interest in the program.

In order to determine whether participation in the Surgical Clinical Correlates in Anatomy program impacted student interest in surgery, a dependent t-test was performed on data collected from the 25 program participants on the pre- and post-evaluations. The entire first-year medical school class was then divided into three groups, namely program participants, those that volunteered for the program but were not selected, and the remainder of the class who did not indicate interest in the program. We then used a one-way analysis of variance (ANOVA) to determine if there was a difference in the change
in surgical interest between the three groups. Any student that did not complete both the pre- and post-evaluations were not used in this analysis.

We first determined whether there was a change in positive and negative opinions of surgeons for the entire class from the pre-survey to the post-survey using a dependent $t$-test. Then, an ANOVA was used to determine if there was a difference in the change in opinions (both positive and negative) of surgeons for the program participants versus non-participants. Any student that did not complete both the pre- and post-evaluations were not used in this analysis.

Then, to determine whether participation in the program impacted scores on first-year anatomy curricular exams, we used MCAT scores as a covariate and performed a one-way analysis of covariance (ANCOVA) to determine if participants in Surgical Clinical Correlates in Anatomy performed better on their first-year anatomy curricular exams than those that volunteered for the program but were not selected and the remainder of the class who did not indicate interest in the program. Additionally, we matched 25 students from the Class of 2011 to our 25 program participants and used a paired samples $t$-test to determine if there was a difference in anatomy curricular exams from one year to the next.

IRB approval was obtained for this project.
Chapter 3: Results

INTEREST IN SURGERY

We hypothesized that interest in surgery would increase after students participated in the Surgical Clinical Correlates in Anatomy program. The interest variables were recoded on both the pre-evaluation and the post-evaluation as 1 equals not interested, 2 equals neutral, 3 equals interested and 4 equals very interested. Therefore, the larger the number, the more interested the student was in Surgery. The 25 participants had a mean surgical interest on the pre-evaluation of 3.16 (±0.688) and a mean surgical interest on the post-evaluation of 3.04 (±0.935) (Table A.2). The mean difference for surgical interest for the 25 participants between the pre- and post-evaluation was -0.12 (±0.927) (Table A.3). The dependent t-test showed this reduction in surgical interest for participants, however, was not statistically significant \([t(24) = 0.647, p = 0.524]\).

We then divided the entire anatomy class into three groups, participants in Surgical Clinical Correlates in Anatomy program, students that had volunteered for the program but that were not selected, and the remainder of the class. For those students that had volunteered for the program but that were not selected, 43 completed both the pre- and post-evaluations. These non-selected volunteers had a mean surgical interest on the pre-evaluation of 3.35 (±0.650) and a mean surgical interest on the post-evaluation of
3.02 (±0.859) (Table A.2). The mean difference for surgical interest for the non-selected volunteers between the pre- and post-evaluation was -0.33 (±0.566) (Table A.3). For those students that indicated no interest in the program, 71 completed both the pre- and post-evaluations. These non-interested students had a mean surgical interest on the pre-evaluation of 2.54 (±0.954) and a mean surgical interest on the post-evaluation of 2.42 (±0.981) (Table A.2). The mean difference for surgical interest for the non-interested students between the pre- and post-evaluation was -0.11 (±0.599) (Table A.3). The test of homogeneity of variance was not significant (p=0.067), indicating that variability among groups was similar which is an assumption necessary to conduct an ANOVA.

The results of the ANOVA indicated that there was no statistically significant difference in the change in surgical interest between the three groups from the pre-survey to the post-survey [F(2,136)=1.520, p=0.222]. In other words, there is no statistical significant difference between the three groups with regard to change in interest in surgery from the pre-survey to the post-survey. As the overall F test was not significant, pairwise comparisons were not conducted.

**STUDENT PERCEPTIONS OF SURGEONS**

We hypothesized that student perceptions of surgeons would increase after completing the Surgical Clinical Correlates in Anatomy program. Therefore, we analyzed the change in the opinion of surgeons from the pre-evaluation to the post-evaluation. While creating the evaluations, we developed a list of 14 items including both positive and negative opinions of surgeons. This list was compiled by asking non-medical individuals their stereotype of surgeons. This pool of stereotypical terms describing surgeons was then provided to students on the pre- and post-surveys and
students were asked to select from this pool to describe their opinion of surgeons (Figures B.5 and B.6). Graphs of the responses of the 25 program participants were created (Figure B.18-B.19). Each positive trait that was checked by a student was given a plus one in the positive category and an average was determined by adding all positive traits together. The same system was used for the negative traits. We used this system to create averages of positive and negative traits for the entire first-year medical school class. These averages were then used in dependent $t$-tests (Table A.4). The dependent $t$-test indicated that there was a statistically significant increase ($0.32 \pm 1.560$) in positive opinions of surgeons $[t(215)=-3.053, p=0.003]$ from the pre-survey to the post-survey for the entire first-year medical class. However, a dependent $t$-test indicated that the decrease ($-0.13 \pm 1.515$) in the negative opinions of surgeons from the pre-survey to the post-survey for the entire first-year medical class was not statistically significant $[t(215)=1.212, p=0.227]$.

We then ran analyses to investigate whether there were differences in the change over time in the opinion of surgeons between our participants and non-participants. To do so, a one-way ANOVA was used to test if there was a significant difference between the pre-evaluation and the post-evaluation opinions between the two groups (Table A.5). There was no significant difference in the change of positive opinions of surgeons between the participants in Surgical Clinical Correlates in Anatomy and the non-participants $[F(1,180)=3.053, p=0.082]$. Also, there was no significant difference in the change of the negative opinions of surgeons $[F(1,180)=0.212, p=0.646]$ between the participants and the remainder of the first-year medical students.
FIRST-YEAR ANATOMY EXAM RESULTS

We hypothesized that students who participated in the Surgical Clinical Correlates in Anatomy program would perform better than their peers on their first-year anatomy exams. We divided the first-year medical students into three groups prior to evaluating their anatomy exam results. The first group consisted of the 25 participants of Surgical Clinical Correlates in Anatomy, the second group included the students that were not selected but had volunteered for the program, and the third group consisted of the remainder of the first-year class. Our participants had the highest final average, 87.7% (±5.00), for all combined anatomy exams. The second group was next with a final average of 86.8% (±7.34) and the third group was last with a final average of 86.0% (±7.72). There is a trend for our participants doing better than the rest of the first-year class, so we performed a one-way analysis of covariance (ANCOVA) comparing scores by group, while controlling for academic ability by using each student’s total MCAT score. Since we were using groups of different sizes, we tested the data for heterogeneity of variance and found that it was not significant \([F(2,195)=1.268, p=0.284]\). Therefore, the ANCOVA was the appropriate statistical model. Total MCAT score was used to control for the possibility of pre-existing differences in academic aptitude across the three groups. The ANCOVA showed that there was no significant difference in anatomy exam scores between the three groups \([F(2,194)=0.951, p=0.388]\) (Table A.6).

MATCHED DATA

In order to control for all variables affecting our 25 participants, we matched 25 non-participants from the Class of 2011 using sex, ethnicity, MCAT scores, and Science GPA’s. A paired samples \(t\)-test (Table A.7) was performed between the two groups and
showed that there was no significant difference between overall anatomy exam averages $[t(24)=0.184, p=0.855]$. Since our program encouraged hands-on teaching, we also compared the anatomy practical averages for the two groups. The paired samples $t$-test showed no significant difference between the groups $[t(24)=-1.083, p=0.289]$.

**STUDENT OPINIONS OF SURGICAL CLINICAL CORRELATES IN ANATOMY PROGRAM**

To assist in the evaluation of the program, specific questions were posed on the post-evaluation to our 25 participants. Twenty-four students felt the program was helpful and would recommend it to others (Table A.8). Twenty-three students thought that the class should be continued (Table A.9). Thirteen students felt that taking the Surgical Clinical Correlates in Anatomy program had helped increased their anatomy grade, three had no opinion, and nine felt that participating had no affect on their grade (Table A.10).

We also included questions that would allow us to improve the program for next year. Twenty-two students felt that there were an appropriate amount of classes. Only one student felt there were too many classes and two thought there were not enough (Table A.11). Twenty-two students were of the opinion that the classes were an appropriate length, three students thought that the classes were too short, and zero students felt that the classes were too long (Table A.12). Most students felt that the classes were well-organized, while only three thought that they were not well-organized (Table A.13). Twenty of the 25 participants felt that the dissections were educational (Table A.14), while 24 thought that the lectures were educational (Table A.15). Out of our 25 students, 13 thought that there were an appropriate number of students while 12 felt there were too many students (Table A.16). Those who felt that 25 students were too
many commented that the number would be appropriate if more cadavers and surgeons could be added. Eight students commented that two cadavers with two surgical faculty members were suitable for 25 students. All responses were graphed (B.7-B.17).
Chapter 4: Discussion and Conclusions

The implementation of the Surgical Clinical Correlates in Anatomy program was successful, but challenging on many fronts. For this endeavor, the time commitment from the faculty, as well as the introduction of a new curriculum, often required perseverance and patience. Scheduling was the most difficult task which involved arranging student and faculty times that were amenable to all parties. Each faculty member had clinical responsibilities that had to be worked around. Two classes had to be rescheduled due to conflicts. Lastly, the unpredictability of clinical responsibilities for faculty participants was problematic as indicated by a few, although not many, late arrivals of faculty members for their teaching assignment.

The advertising of Surgical Clinical Correlates in Anatomy program was one of our early challenges. A flier was created to promote the program, but we were not able to share the information with the medical students prior to the first day of anatomy class due to the timing of our program’s creation and the lack of access of students to their OSU email accounts before the first week of orientation. Fliers were placed in the medical students’ mailboxes and the program was announced during the first anatomy class. An e-mail was also distributed to all of the first-year medical students the weekend prior to the first day of class. Due to the late presentation of information, some students did not
receive the flier because they did not check their e-mail, did not check their mailboxes, or did not show-up to class in a timely manner. In anticipation for next year’s class, we plan to update the flier and send it out to the incoming first-year medical students as part of the orientation packet mailed to the students prior to starting classes. Due to the success of our program this year, we have successfully sought the permission of the Dean to do this.

Throughout the process of designing and implementing Surgical Clinical Correlates in Anatomy, we have discovered many improvements that can be made for next years program. We will have cow hearts, as adjuncts, during the Cardiothoracic Surgery class for the students to dissect because we learned cadaver hearts are difficult to dissect. Additionally, we will have better surgical instruments for the students to use throughout the course. Next year, we will borrow both needle drivers and pick-ups, so that students will not have to share while suturing. We will also have a classroom designated for the lecture portion of the class. Although our emphasis is not on the actual didactic component, students are often tired by the end of the day and a rest period is often welcome before operating on the cadavers. The room used for the cadaveric operations this year was a too small for 25 students, two cadavers, and faculty members. Therefore, we will use a larger room for the cadaver section next year with more room for the faculty to interact with the students. We are also going to increase the number of faculty so that each class has two faculty members and possibly a fellow or resident to assist. Three cadavers have been arranged for each class as well. This will allow the students to be divided into three groups allowing for more time per student for hands-on participation. Lastly, the timing of the classes will be more in line with the current
anatomy curriculum. We will start with the General Surgical Knowledge class. By scheduling this class first, students will be able to become acquainted with operative techniques and cadaveric dissections. Student comments support these changes. One student found the class very helpful and interesting and would have liked it as the first class to get oriented to tool names. Another student stated that the General Surgical Knowledge class should have been during the first week because it would have been a great introduction.

We are currently working to improve the quality of both our pre- and post-evaluations. Some questions will be kept the same, but others will be updated so that they are based on the Likert scale (29). The surveys for the upcoming class will be uploaded to the Survey Monkey website, a website available for evaluations. This will allow easier access to students who do not attend class and will eliminate the evaluations turned in without identification.

Students unanimously agreed that the use of the digital camera and flat-screen TV aided their learning throughout the Surgical Clinical Correlates in Anatomy program. Students stated that when the operation was occurring in a small area, they were still able to follow the steps of the procedure due to these devices. The students also requested that each class be videotaped, so it could be viewed at a later time or to watch if a class had to be missed. In the future, we will have the classes professionally taped, edited, and posted on our university course management system. This will not only provide an added aid to the students, but it will also encourage others to partake that could not be there for the actual cadaveric operations.
Based on student surveys and personal interactions, our participants enjoyed their experience during Surgical Clinical Correlates in Anatomy and would recommend it to other students. We hypothesized that participation in the Surgical Clinical Correlates in Anatomy program would positively impact scores on first-year anatomy curricular exams. Although first-year anatomy exam results were higher among participants than non-participants, this difference was not statistically significant. We believe that as surgeons further develop their courses, this impact on exam results will become statistically significant. Teaching first-year medical students is a learning experience for all involved. As the surgeons adapt their teaching skills to first-year medical students, we believe our participants will continue to improve in their first-year anatomy curricular exams.

We hypothesized that students that participated in the Surgical Clinical Correlates in Anatomy program would gain a more positive perception of surgeons than their peers that did not participate. Opinions of surgeons were affected by enhanced surgical exposure. Overall, positive opinions of surgeons increased for the 25 program participants, a change which is consistent with previous research (3,17). However, this change was not statistically different than the non-participants.

We hypothesized that participation in Surgical Clinical Correlates in Anatomy would positively impact student interest in surgery. This, however, was not the case. Although opinions of surgeons improved, interest in surgery decreased for the program participants, although this decrease was not statistically significant. This contradicts previous research that showed an increase in surgical interest for medical students after an intervention by surgeons (24, 26, 27, 28). Perhaps the decrease we saw is secondary
to the students’ perception of a surgeon’s lifestyle. Throughout the Surgical Clinical Correlates in Anatomy program, the surgeons were occasionally late due to patient obligations, were paged throughout the classes, and did not have time to talk with the students after the classes were over. This could have given the program participants a glance into the busy lifestyle of a surgeon, which could have decrease interest in surgery as a prospective career choice for the students.

Although this early exposure to surgery via the Surgical Clinical Correlates in Anatomy program did not impact interest in surgery or opinion of surgeons for participants differently than non-participants, a future investigation of residency matches is needed as the participating students may be more likely to choose a surgical residency than their non-participating peers. Additionally, more research is needed as participation in this program may provide participants with an advantage over their non-participating peers during their surgical clerkships.

The design and implementation of Surgical Clinical Correlates in Anatomy has been perceived as a success based on student feedback. As such, the program will continue next year, with implemented improvements, as support has been unwavering from the Division of Anatomy and the Vice Chair of Education at The Ohio State University College of Medicine. We were able to create and effectively integrate this program into the first-year medical school curriculum. We will continue to follow The Ohio State University College of Medicine Class of 2012 throughout their careers. We will track their third-year surgery clerkship evaluations and exams, along with which specialty they ultimately match. As such, we will be able to test our long-term
hypotheses but also implement a program with the potential to shape and influence the image of academic surgery.
LIST OF REFERENCES


Appendix A: Tables
<table>
<thead>
<tr>
<th>Date</th>
<th>Anatomy Block</th>
<th>Class</th>
<th>Procedure(s)</th>
</tr>
</thead>
</table>
| September 9  | Thorax, Abdomen, and Lower Extremity   | General Surgical Knowledge   | • Identify and handle common surgical instruments  
|              |                                       |                              | • Identify assorted sutures and their uses  
|              |                                       |                              | • Learn how to tie knots  
|              |                                       |                              | • Learn general techniques of wound re-approximation |
| August 26    | Upper Extremity and Back               | Plastic Surgery              | • Carpal Tunnel Release  
|              |                                       |                              | • Repair of facial fractures |
| August 19    | Upper Extremity and Back               | Cardiothoracic Surgery      | • Thoracotomy with lobectomy  
|              |                                       |                              | • Sternotomy with dissection of heart |
| September 26 | Thorax, Abdomen, and Lower Extremity   | Urologic Surgery             | • Nephrectomy  
|              |                                       |                              | • Pelvic Floor Resuspension |
| September 23 | Thorax, Abdomen, and Lower Extremity   | General Surgery              | • Appendectomy  
|              |                                       |                              | • Right Hemicolecotomy |
| October 7    | Thorax, Abdomen, and Upper Extremity   | Orthopedic Surgery           | • Tibial osteotomy  
|              |                                       |                              | • ACL reconstruction  
|              |                                       |                              | • ORIF tibial fracture  
|              |                                       |                              | • Meniscus repair |
| October 14   | Head and Neck                         | Vascular Surgery             | • Carotid Endarterectomy  
|              |                                       |                              | • Above and below knee amputation |
| October 21   | Head and Neck                         | Otolaryngology               | • Radical neck Dissection |

Table A.1 Schedule for Surgical Clinical Correlates in Anatomy Program.
<table>
<thead>
<tr>
<th>Group</th>
<th>Survey</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Pre-Survey Interest in Surgery</td>
<td>25</td>
<td>2.00</td>
<td>4.00</td>
<td>3.16</td>
<td>0.688</td>
</tr>
<tr>
<td>Yes</td>
<td>Post-Survey Interest in Surgery</td>
<td>25</td>
<td>1.00</td>
<td>4.00</td>
<td>3.04</td>
<td>0.935</td>
</tr>
<tr>
<td>No</td>
<td>Pre-Survey Interest in Surgery</td>
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<td>1.00</td>
<td>4.00</td>
<td>3.35</td>
<td>0.650</td>
</tr>
<tr>
<td>No</td>
<td>Post-Survey Interest in Surgery</td>
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<td>1.00</td>
<td>4.00</td>
<td>3.02</td>
<td>0.859</td>
</tr>
<tr>
<td>3</td>
<td>Pre-Survey Interest in Surgery</td>
<td>71</td>
<td>1.00</td>
<td>4.00</td>
<td>2.54</td>
<td>0.954</td>
</tr>
<tr>
<td>3</td>
<td>Post-Survey Interest in Surgery</td>
<td>71</td>
<td>1.00</td>
<td>4.00</td>
<td>2.42</td>
<td>0.981</td>
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</table>

**Table A.2 Interest in Surgery.** This table shows change in interest of surgery from the pre-evaluation to the post-evaluation across groups. Group Yes are the participants in Surgical Clinical Correlates in Anatomy. Group No includes the volunteers that were not selected for the program. Group 3 are the remainder of the first-year medical students that did not indicate interest in the program. The interest variables were recoded as follows: 1=not interested, 2=neutral, 3=interested, and 4=very interested.
<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>25</td>
<td>-2.00</td>
<td>1.00</td>
<td>-0.12</td>
<td>0.927</td>
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<td>43</td>
<td>-2.00</td>
<td>0.00</td>
<td>-0.33</td>
<td>0.566</td>
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<tr>
<td>3</td>
<td>71</td>
<td>-1.00</td>
<td>1.00</td>
<td>-0.11</td>
<td>0.599</td>
</tr>
</tbody>
</table>

**Table A.3 Mean Difference Score for Interest in Surgery.** A mean difference in surgical interest score was calculated for each group by subtracting the reported post-evaluation interest in surgery from the reported pre-evaluation interest in surgery. Group Yes are the participants in Surgical Clinical Correlates in Anatomy. Group No includes the volunteers that were not selected for the program. Group 3 are the remainder of the first-year medical students that did not indicate interest in the program. The results of the ANOVA indicated that there was no statistically significant difference in the change in surgical interest between the three groups from the pre-survey to the post-survey \([F(2,136)=1.520, \ p=0.222]\).
Table A.4 Dependent t-Test for Opinions of Surgeons. The list of opinions for surgeons was divided into five positive and seven negative opinions. Two opinions were neutral and were discarded from the statistical analysis. Pre-evaluation opinions and post-evaluation opinions were tabulated. A dependent t-tests were performed investigating the change in positive and negative opinions of surgeons for the entire first-year medical school class. A dependent t-test indicated that there was a statistically significant increase (0.32 ±1.560) in positive opinions of surgeons [t(215)=-3.053, p=0.003] from the pre-survey to the post-survey for the entire first-year medical class. However, a dependent t-test indicated that the decrease (-0.13 ±1.515) in the negative opinions of surgeons from the pre-survey to the post-survey for the entire first-year medical class was not statistically significant [t(215)=1.212, p=0.227].

<table>
<thead>
<tr>
<th>Survey</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Survey Positive Traits</td>
<td>216</td>
<td>1.05</td>
<td>1.247</td>
</tr>
<tr>
<td>Post-Survey Positive Traits</td>
<td>216</td>
<td>1.38</td>
<td>1.379</td>
</tr>
<tr>
<td>Pre-Survey Negative Traits</td>
<td>216</td>
<td>0.76</td>
<td>1.211</td>
</tr>
<tr>
<td>Post-Survey Negative Traits</td>
<td>216</td>
<td>0.63</td>
<td>1.323</td>
</tr>
<tr>
<td></td>
<td>Opinion</td>
<td>N</td>
<td>Pre-Survey Mean (SD)</td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>----</td>
<td>----------------------</td>
</tr>
<tr>
<td>Yes</td>
<td>Positive</td>
<td>25</td>
<td>1.16 (±0.987)</td>
</tr>
<tr>
<td>Yes</td>
<td>Negative</td>
<td>25</td>
<td>0.72 (±0.678)</td>
</tr>
<tr>
<td>No</td>
<td>Positive</td>
<td>157</td>
<td>1.26 (±1.307)</td>
</tr>
<tr>
<td>No</td>
<td>Negative</td>
<td>157</td>
<td>0.93 (±1.356)</td>
</tr>
</tbody>
</table>

**Table A.5 ANOVA for Opinions of Surgeons.** The first-year medical school class was divided into two groups. Group Yes contained the participants and Group No included the remainder of the first-year class. An ANOVA was performed using the tabulated positive and negative mean changes of student opinions of surgeons from the pre-evaluation and the post-evaluation. Mean changes were calculated by subtracting the post-survey mean from the pre-survey mean. There was no significant change in the positive opinions of surgeons when the two groups were compared \[F(1,180)=3.053, p=0.082\]. There was also no significant change in negative opinions when the two groups were compared \[F(1,180)=0.212, p=0.646\].
Table A.6 ANCOVA for First-Year Anatomy Exams. The first-year medical school class was divided into three groups. Group Yes are the participants in Surgical Clinical Correlates in Anatomy. Group No includes the volunteers that were not selected for the program. Group 3 are the remainder of the first-year medical students that did not indicate interest in the program. The first-year anatomy exam grade for each student was tabulated using three test averages, one from each block test. The test average for each block test included the combined grade for the practical and the written exams. A Levene’s Test of Equality of Error Variances was performed. It was found to not be significant \((p=0.284)\), so an ANCOVA was performed which did not find a significant difference in the anatomy exam means between the three groups \([F(2,194)=0.951, p=0.388]\). Total MCAT was used as a covariate when conducting the ANCOVA. Those who did not take the MCAT were excluded.
Table A.7 Paired Samples *t*-Test for Matched Groups. Table A=Cumulative Exam Averages, Table B=Practical Exam Averages – The 25 participants of Surgical Clinical Correlates in Anatomy were matched with 25 students from the Class of 2011 based on sex, ethnicity, MCAT scores, and Science GPA’s. A paired samples *t*-test was performed that compared the anatomy cumulative exam averages for the participants and the matched 25 students (Table A). This showed there was no statistically significant difference between the two groups’ cumulative anatomy exam averages (*p*=0.952). A paired samples *t*-test was performed comparing the practical exam averages of the participants and the matched 25 students (Table B). This showed there was no significant difference between the two groups (*p*=0.764).
Table A.8 Student Opinion Regarding Recommend Program to Others. This table compares the number of participants who would recommend Surgical Clinical Correlates in Anatomy (YES) to other students and those who would not recommend (NO) the program to other students.

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24</td>
<td>1</td>
</tr>
</tbody>
</table>

Table A.9 Student Opinion Regarding Enjoyed Participating. This table compares the number of participants who enjoyed participating in Surgical Clinical Correlates in Anatomy (Strongly Agree and Agree) and those who did not enjoy (Disagree and Strongly Disagree) the program.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Students</td>
<td>12</td>
<td>11</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table A.10 Student Opinion Regarding Grades Improved by Program. This table compares the number of participants who thought that Surgical Clinical Correlates in Anatomy improved their grades (YES) with those who did not think that the program improved their grades (NO).

<table>
<thead>
<tr>
<th>Survey</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Survey</td>
<td>15</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Post-Survey</td>
<td>13</td>
<td>9</td>
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<td>2</td>
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</table>
Table A.11 Student Opinion Regarding Amount of Classes. This table compares the number of participants who thought that there were too many classes with those who thought that there were the appropriate amount or not enough.

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Too Many</th>
<th>Appropriate</th>
<th>Not Enough</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>22</td>
<td>2</td>
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Table A.12 Student Opinion Regarding Length of Classes. This table compares the number of participants who thought that the classes were too long with those who thought that they were the appropriate length or not short.

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Too Long</th>
<th>Appropriate</th>
<th>Too Short</th>
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<tr>
<td></td>
<td>0</td>
<td>22</td>
<td>3</td>
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Table A.13 Student Opinion Regarding Organization of Class. This table compares the number of participants who thought that the classes were well-organized (YES) and not well-organized (NO).

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>22</td>
<td>3</td>
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</table>

Table A.14 Student Opinion Regarding Dissections Educational. This table compares the number of participants who thought that the dissections were educational (YES) with those who did not think that they were educational (NO).

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
<td>5</td>
</tr>
</tbody>
</table>
### Table A.15 Student Opinion Regarding Lectures Educational

This table compares the number of participants who thought that the lectures were educational (YES) with those who did not think that they were educational (NO).

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Yes</th>
<th>No</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>24</td>
<td>1</td>
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</tbody>
</table>

### Table A.16 Student Opinion Regarding Number of Students

This table compares the number of participants who thought that there were too many students per class with those that thought there were an appropriate amount. No participants thought that there were not enough students per class.

<table>
<thead>
<tr>
<th>Number of Students</th>
<th>Too Many</th>
<th>Appropriate</th>
<th>Not Enough</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
<td>12</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendix B: Figures
Lisa Haubert M.D.  
XXXXXXXXXXXX  
XXXXXXXXXXXX  
Pager: XXX-XXX-XXXX  
Cell Phone: XXX-XXX-XXXX  
January 12, 2008

Name  
Address

Dear Name:  

I am a second year General Surgery resident and I will be obtaining my Master’s of Science in Anatomy starting July 2008, as my academic enrichment year. For my thesis, I will design and implement a program entitled Surgical Clinical Correlates in Anatomy, working with Dr. Susan Moffatt-Bruce (Cardiothoracic Surgery) and Dr. Ken Jones (Anatomy). It will be directed at the first year medical students to run concurrently with their anatomy classes. It will consist of 2 additional sessions per anatomy block. The sessions will be individualized to include General Surgical Knowledge, Orthopedic Surgery, Plastic Surgery, Urology, Cardiothoracic Surgery, General Surgery, Vascular Surgery, and ENT specialty exposure. Each session will be designed so to highlight a pertinent surgical procedure particular to the surgical specialty. I plan to work with the attending surgeon to design and implement each session. To make this even more clinically applicable, cadavers will be available for use during the sessions which I think will really allow us to apply surgical anatomy. I hypothesize that with early introduction of surgical specialties by way of the Surgical Clinical Correlates in Anatomy program, students will have the ability to make more informed decisions, score better on examinations and ultimately successfully match to surgical specialties.

I would like to invite you to be a part of this wonderful opportunity to teach students about anatomy and surgery. This class will give you the ability to reach prospective surgeons early in their medical training. I do not anticipate that the commitment of time to be onerous and I will certainly help in every way possible in the preparation phase. Together, we can show the first year medical students that surgeons are good teachers, approachable and excellent clinicians. I feel that we need to work as a team to strengthen anatomy training, instill pertinent clinical correlations and ultimately allow students the ability to consider a career in surgery. I would greatly appreciate your contribution to this project. Please let me know if you are interested in participating.

Sincerely,

Lisa Haubert

Figure B.1 Letter of Invitation.
Attention:
First Year Medical Students

**Surgical Clinical Correlates in Anatomy** is a new program being offered that will run concurrently with your first year anatomy class. It will consist of two classes per anatomy block. Each session will be individualized to highlight the following areas: General Surgical Knowledge, Orthopedic Surgery, Plastic Surgery, Urology, Cardiothoracic Surgery, General Surgery, Vascular Surgery and ENT. Each session will involve a surgeon performing the pertinent steps of an operation on cadavers, with participation by students in the actual dissection and conduct of the operation. Some examples of surgical procedures include shoulder surgery, repair of facial fracture, nephrectomy, thoracotomy with a lobectomy, sternotomy with aortic and mitral valve replacement, appendectomy, bowel resection, femoral-popliteal artery bypass and radical neck dissection.

Each class will last approximately two hours. The program is elective and will not be graded. The students that elect to participate in this program will be asked to have their progress throughout medical school followed in a confidential manner by the investigators listed below. Our goal is to determine how this program will affect medical school grades and eventual career choices.

For more information or if you have any questions, please feel free to contact: XXXXXX@osumc.edu or XXXXXXXX@osumc.edu.

**Figure B.2 Program Flier for Students’ Mailboxes.**
Objectives for Surgical Clinical Correlates in Anatomy Program

Length: Two hours per session; two to three sessions per anatomy block; total of 8 sessions

Surgical Specialties:

General Surgical Knowledge
Orthopedic Surgery
Cardiothoracic Surgery
General Surgery
Urologic Surgery
Vascular Surgery
Otolaryngologic Surgery
Plastic Surgery

First Anatomy Block: Back/Upper Extremity
Session One: Cardiothoracic Surgery  Date: August 19, 2008
Attending Surgeons: XXXXXXX

Procedures:
1) Thoracotomy and lobectomy.
2) Sternotomy, opening the pericardium, exposing the ascending aorta and right atrium simulating preparation for cardiopulmonary bypass. The aortic and mitral valves will be exposed and techniques for repair/replacement demonstrated.

Session Two: Plastic Surgery  Date: August 26, 2008
Attending Surgeon: XXXXXXX

Procedures:
1) Repair of a maxillofacial fracture.
2) Carpal tunnel release.

Second Anatomy Block: Thorax/Abdomen/Pelvis/Lower Extremity
Session Three: General Surgical Knowledge  Date: September 9, 2008
Attending Surgeon: XXXXXXX

Goals:
1) Identify and handle common surgical instruments.
2) Identify assorted sutures and their uses.
3) Learn how to tie knots and the amount of throws needed for each type of suture.
4) Learn general techniques of wound re-approximation.

Figure B.3 Program Hand-Out.  (Continued)
Figure B.3: Continued

**Session Four:** Urologic Surgery  
**Attending Surgeon:** XXXXXXX  
**Date:** September 23, 2008

Procedures:  
1) Nephrectomy.  
2) Pelvic reconstruction of a male.

**Session Five:** General Surgery  
**Attending Surgeon:** XXXXXXX  
**Date:** September 26, 2008

Procedures:  
1) Appendectomy.  
2) Right hemicolectomy.

**Session Six:** Orthopedic Surgery  
**Attending Surgeon:** XXXXXXX  
**Date:** October 7, 2008

Procedure:  
1) Open knee arthrotomy.

**Third Anatomy Block: Head/Neck**

**Session Seven:** Vascular Surgery  
**Attending Surgeon:** XXXXXXX  
**Date:** October 14, 2008

Procedures:  
1) Carotid endarterectomy.  
2) Below-the-knee amputation.

**Session Eight:** Otolaryngologic Surgery  
**Attending Surgeon:** XXXXXXX  
**Date:** October 21, 2008

Procedure:  
1) Radical neck dissection.
The Ohio State University Consent to Participate in Research

Study Title: Surgical Correlates in Anatomy: Implementation of a First Year Medical School Program
Principal Investigator: Susan Dianne Moffatt-Bruce, M.D., Ph.D.

Sponsor:

- **This is a consent form for research participation.** It contains important information about this study and what to expect if you decide to participate. Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to participate.

- **Your participation is voluntary.** You may refuse to participate in this study. If you decide to take part in the study, you may leave the study at any time. No matter what decision you make, there will be no penalty to you and you will not lose any of your usual benefits. Your decision will not affect your future relationship with The Ohio State University. If you are a student or employee at Ohio State, your decision will not affect your grades or employment status.

- **You may or may not benefit as a result of participating in this study.** Also, as explained below, your participation may result in unintended or harmful effects for you that may be minor or may be serious depending on the nature of the research.

- **You will be provided with any new information that develops during the study that may affect your decision whether or not to continue to participate.** If you decide to participate, you will be asked to sign this form and will receive a copy of the form. You are being asked to consider participating in this study for the reasons explained below.

1. **Why is this study being done?**

   A group of 25 students from the first year medical school class will be participants in this new anatomy program. We are interested in investigating if this novel way of teaching anatomy to students will help students in their medical school exams, their clinical rotations and ultimately in residency career choices.
2. How many people will take part in this study?

25 students will be chosen randomly from those that apply to take the Surgical Clinical Correlates in Anatomy course. The remaining students that do not take the course will serve as a comparison and will also therefore be part of the study. This comparison group would therefore consist of approximately 225 students.

3. What will happen if I take part in this study?

If you participate in this study you will partake in 8 sessions whereby surgeons introduce surgical clinical correlates in anatomy to your group. This program has the potential to help you better appreciate anatomy, improve exam scores and ultimately help you in your medical career decisions. We will be collected the following data: pre and post course questionnaires, first year anatomy scores, third year surgical rotation scores, third year surgery exam score and residency choice.

4. How long will I be in the study?

The program sessions are during your regularly scheduled anatomy block. We will however continue to follow your progress until the end of medical school.

5. Can I stop being in the study?

You may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you, and you will not lose any benefits to which you are otherwise entitled. Your decision will not affect your future relationship with The Ohio State University.

6. What risks, side effects or discomforts can I expect from being in the study?

There is the potential for breach of confidentiality by participating in this study. However, we will de-identify all data and limit access to the data so to minimize this possibility.

7. What benefits can I expect from being in the study?

You have the potential to understand anatomy better, have improved exam marks and the ability to make more informed career decisions.

(Continued)
8. What other choices do I have if I do not take part in the study?

You may choose not to participate without penalty or loss of benefits to which you are otherwise entitled. You will continue to participate in the anatomy course as it is currently designed. This program is in addition to the curriculum that currently exists.

9. Will my study-related information be kept confidential?

Efforts will be made to keep your study-related information confidential. However, there may be circumstances where this information must be released. For example, personal information regarding your participation in this study may be disclosed if required by state law. Also, your records may be reviewed by the following groups (as applicable to the research):

- Office for Human Research Protections or other federal, state, or international regulatory agencies;
- U.S. Food and Drug Administration;
- The Ohio State University Institutional Review Board or Office of Responsible Research Practices;
- The sponsor supporting the study, their agents or study monitors; and
- Your insurance company (if charges are billed to insurance).

If the study involves the use of your protected health information, you may also be asked to sign a separate Health Insurance Portability and Accountability Act (HIPAA) research authorization form.

10. What are the costs of taking part in this study?

There are no added costs.

11. Will I be paid for taking part in this study?

No, there is no payment for participation.

12. What happens if I am injured because I took part in this study?

If you suffer an injury from participating in this study, you should notify the researcher or study doctor immediately, who will determine if you should obtain medical treatment at The Ohio State University Medical Center.

The cost for this treatment will be billed to you or your medical or hospital insurance. The Ohio State University has no funds set aside for the payment of health care expenses for this study. (Continued)
13. What are my rights if I take part in this study?

If you choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights you may have as a participant in this study.

You will be provided with any new information that develops during the course of the research that may affect your decision whether or not to continue participation in the study.

You may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled.

An Institutional Review Board responsible for human subjects research at The Ohio State University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

14. Who can answer my questions about the study?

For questions, concerns, or complaints about the study you may contact Dr. Susan Moffatt-Bruce, M.D., Ph.D. or Dr. Lisa Haubert, M.D. at (XXX) XXX-XXXX.

For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-XXX-XXXX.

If you are injured as a result of participating in this study or for questions about a study-related injury, you may contact Darla Talbott (XXX) XXX-XXXX.
Figure B.4: Continued

Signing the consent form

I have read (or someone has read to me) this form and I am aware that I am being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to participate in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

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<th>Signature of subject</th>
<th>AM/PM</th>
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Relationship to the subject          Date and time

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Witness(es) - *May be left blank if not required by the IRB*

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<td></td>
<td></td>
</tr>
<tr>
<td>Date and time</td>
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<td></td>
</tr>
</tbody>
</table>


1- □ Participant in Surgical Clinical Correlates in Anatomy
□ Non-participant in Surgical Clinical Correlates in Anatomy

2a- If you did not participate in the class, please comment on why you did not choose to participate.

2b- If you chose to participate in the class, please comment on why you chose to participate.

3a- Please rank your interest in the following specialties:

- Family Medicine □ Very Interested □ Interested □ Neutral □ Not Interested
- Surgery □ Very Interested □ Interested □ Neutral □ Not Interested
- OB/GYN □ Very Interested □ Interested □ Neutral □ Not Interested
- Internal Medicine □ Very Interested □ Interested □ Neutral □ Not Interested
- Anesthesiology □ Very Interested □ Interested □ Neutral □ Not Interested
- Radiology □ Very Interested □ Interested □ Neutral □ Not Interested
- Dermatology □ Very Interested □ Interested □ Neutral □ Not Interested
- Ophthalmology □ Very Interested □ Interested □ Neutral □ Not Interested
- Other___________ □ Very Interested □ Interested □ Neutral □ Not Interested □ Undecided

4- If you chose to participate in the class, please comment on what you want to achieve by taking this class.

5- Do you feel that participation in this class will affect your exam results? If so, how?

6- Have you taken an anatomy class prior to medical school? If so, please state at which level of education and for how long.

7- Have you ever observed or participated in an operation?

Figure B.5 Pre-evaluation Survey. (Continued)
8- Are any of your family members physicians? If so, which specialties?

9- What is your opinion of surgeons (check all that apply):
☐ friendly   ☐ approachable   ☐ good teachers   ☐ unapproachable   ☐ reserved   ☐ do not take time to teach
☐ rushed   ☐ busy   ☐ good listener   ☐ not team players
☐ arrogant   ☐ cold   ☐ compassionate   ☐ inconsiderate

10- The course objectives are clear to me.
☐ True   ☐ False

11- Please list goals you have for this course.

12- Comments:
Post-Evaluation

Mailbox Number: _______

1- □ Participant in Surgical Clinical Correlates in Anatomy
   □ Non-participant in Surgical Clinical Correlates in Anatomy

2a- If you did not participate in the class, please comment as to whether or not you think you should have participated in this class.

2b- If you chose to participate in the class, please comment on whether or not you would recommend this class to another student.

3a- Please rank your interest in the following specialties:

- Family Medicine □ Very Interested □ Interested □ Neutral □ Not Interested
- Surgery □ Very Interested □ Interested □ Neutral □ Not Interested
- OB/GYN □ Very Interested □ Interested □ Neutral □ Not Interested
- Internal Medicine □ Very Interested □ Interested □ Neutral □ Not Interested
- Anesthesia □ Very Interested □ Interested □ Neutral □ Not Interested
- Radiology □ Very Interested □ Interested □ Neutral □ Not Interested
- Dermatology □ Very Interested □ Interested □ Neutral □ Not Interested
- Ophthalmology □ Very Interested □ Interested □ Neutral □ Not Interested
- Other __________ □ Very Interested □ Interested □ Neutral □ Not Interested
   □ Undecided

4- If you chose to participate in the class, please comment on whether or not you achieved your goals by taking this class.

5- Do you feel that participation in this class affected your grades? If so, how?

6- Have you taken an anatomy class prior to medical school? If so, please state during at which level of education and for how long.

7- Have you ever observed or participated in an operation?

Figure B.6 Post-evaluation Survey.  (Continued)
Figure B.6: Continued

8- Are any of your family members physicians? If so, which specialties?

9- What is your opinion of surgeons (check all that apply):
   √ friendly √ approachable √ good teachers √ unapproachable √ reserved √ do not take time to teach √ rushed √ busy √ good listener √ not team players √ arrogant
   √ cold √ compassionate √ inconsiderate

10- The course objectives were clear to me.
   √ True    √ False

If you did not participate in the class, please skip to question 19.

11- Do you think the length of the classes were appropriate?

12- Do you think there were too many classes, not enough classes, or the right amount of classes?

13- Was the video section of each class educational? Please comment on likes and dislikes of the videos.

14- Was the dissection component of each class educational? Please list specific likes and dislikes of each dissection.

15- Please rank each surgeon on a scale of 1 to 5 with 1 being poor, 2 being below average, 3 being average, 4 being above average, and 5 being exceptional. Please list specific comments about each attending surgeon:

   A- General Surgical Knowledge:
      √ 1  √ 2  √ 3  √ 4  √ 5

   B- Orthopedic Surgery:
      √ 1  √ 2  √ 3  √ 4  √ 5

   C- Cardiothoracic Surgery:
      √ 1  √ 2  √ 3  √ 4  √ 5

   D- Cardiothoracic Surgery:
      √ 1  √ 2  √ 3  √ 4  √ 5

   (Continued)
Figure B.6: Continued

E- General Surgery:
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

F- Urologic Surgery:
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

G- Vascular Surgery:
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

H- ENT:
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

I- Plastic Surgery:
☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

16- Do you think the number of students in the class was appropriate?

17- Do you think the classes were well-organized?

18- I enjoyed participating in this program.
☐ Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly Disagree

19- Comments:
Figure B.7 Student Reported Interest in Other Specialties. This chart shows the other specialties the entire first-year medical school class showed interest in.
**Figure B.8 Student Opinion Regarding Enjoyed Participating.** This chart compares the number of participants who would enjoyed and would like to see Surgical Clinical Correlates in Anatomy continue (Strongly Agree and Agree) and those who would not like the program to continue (Disagree and Strongly Disagree).
Figure B.9 Student Opinion Regarding Grades Improved by Program. This chart compares the number of participants who thought that Surgical Clinical Correlates in Anatomy improved their grades (YES) with those who did not think that the program improved their grades (NO).
Figure B.10 Student Opinion Regarding Amount of Classes. This chart compares the number of participants who thought that there were too many classes (Too Many) with those who thought that there were the appropriate amount (Appropriate) or not enough (Not Enough).
Figure B.11 Student Opinion Regarding Amount of Students per Class. This chart compares the number of participants who thought that there were too many students per class (Too Many) with those that thought there were an appropriate amount (Appropriate). No participants thought that there were not enough students per class (Not Enough).
Figure B.12 Student Opinion Regarding Dissections Educational. This chart compares the number of participants who thought that the dissections were educational (YES) with those who did not think that they were educational (NO).
Figure B.13 Student Opinion Regarding Presentations Educational. This chart compares the number of participants who thought that the lectures were educational (YES) with those who did not think that they were educational (NO).
Figure B.14 Student Opinion Regarding Recommend Class to Others. This chart compares the number of participants who would recommend Surgical Clinical Correlates in Anatomy to other students (YES) and those who would not recommend the program to other students (NO).
Figure B.15 Student Opinion Regarding Interest in Surgery. This chart shows the level of interest, very interested, interested, neutral and not interested, the participants had in surgery for both the pre-evaluation and the post-evaluation.
Figure B.16 Student Opinion Regarding Class Organization. This chart compares the number of participants who thought that the classes were well-organized (YES) and not well-organized (NO).
Figure B.17 Student Opinion Regarding Length of Classes. This chart compares the number of participants who thought that the classes were too long (Too Long) with those who thought that they were the appropriate length (Appropriate) or too short in length (Too Short).
**Figure B.18 Student Opinion of Surgeons.** This chart shows seven of both the pre-evaluation and post-evaluation opinions of surgeons for the participants.
Figure B.19 Student Opinion of Surgeons Continued. This chart shows the other seven opinions of surgeons for the participants for both the pre-evaluation and the post-evaluation.