THE INFLUENCE OF SIMULATION-BASED PHYSIOLOGY LABS TAUGHT BY ANESTHESIOLOGISTS ON THE ATTITUDES OF FIRST-YEAR MEDICAL STUDENTS TOWARDS ANESTHESIOLOGY

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Abstract

***Background**:* The development of medical students' perceptions of different medical specialties is based on many factors and influences their career choices and appreciation of other practitioners' knowledge and skills. The goal of this study was to determine if participation in a series of anesthesiologist-run, simulation-based physiology labs changed first year medical students' perceptions of anesthesiologists.

Methods: One hundred first-year medical students were surveyed at random three months before completion of a simulation-based physiology lab run by anesthesiologists. All participants received the same survey instrument, which employed a 5-point Rating Scale to rate the appropriateness of several descriptive terms as they apply to a particular specialist or specialty. A post-simulation survey was performed to track changes in attitudes.

Results: Response rates to the survey before and after the simulation labs were 75% and 97% (of the initial cohort responding), respectively. All students who filled out the post-simulation surveys had been exposed to anesthesiologists in the prior three months whereas none had interacted with surgeons in the interim. Nearly all had interacted with internal medicine specialists in that time period. No changes in the medical students' perceptions of surgeons or internal medicine specialists were evident. Statistically significant changes were found for most descriptors of anesthesiologists, with a trend towards a more favorable perception after the simulation program.

***Conclusions*:** Using a survey instrument containing descriptors of different medical specialists and specialties, we found an improved attitude towards anesthesiology after medical students participated in an anesthesiologist-run simulation-based physiology lab series. Given the importance of providing high quality medical education and attracting quality applicants to the field, integrati-on of anesthesiology staff into medical student courses at the non-clinical level appears useful.

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Introduction

The influences on medical students' attitudes toward different medical specialties are varied and have been studied extensively[1,2,3,4]. These attitudes may affect medical students' career choices as well as their respect and appreciation of physicians in other fields once they enter practice. Early exposure to clinicians in the basic science years has been identified as one factor that can alter students' perceptions[5]. While work has been done regarding patients' perceptions of anesthesiologists, mostly revealing pervasive misconceptions about their roles, training and abilities[6,7,8,9] little has been done regarding *students'* perceptions towards anesthesiologists.

In order to uphold the goals of the specialty and attract high quality applicants, a good public relations initiative is important to the field of anesthesiology. Indeed, the American Society of Anesthesiologists (ASA) is actively engaged in studying and improving the profile of anesthesiologists through its newly launched Lifeline Campaign[10]. While patients and practicing clinicians of other specialties are the main targets of this campaign, clinicians at their earliest stages seem an equally important demographic to address.

One way the perception of anesthesiologists might be improved is through the active participation of anesthesiologists in medical education during the basic science years where their unique scope of practice makes them particularly suited to teaching human physiology. The use of high fidelity simulation, in particular, allows students to meet anesthesiologists in an environment where their knowledge and skills can enhance the students' educational experience. In this setting, medical students might be surprised to see that anesthesiologists have an exceptional command of physiologic and pharmacologic principles and can be effective communicators and enthusiastic educators.

The simulation team from the Department of Anesthesiology at the Mount Sinai Medical Center has been conducting simulator-based physiology labs for the Mount Sinai School of Medicine (MSSM) for approximately fifteen years. The current course covers the cardiovascular, respiratory and autonomic nervous systems over three weeks and has been unchanged since 1999. Prior to this time, truncated simulations had been performed. This course has allowed students access to anesthesiologists early in their schooling. Indeed, it is likely that in most institutions medical students will at best have a mandatory 3rd year anesthesia rotation of variable length or an elective during their 4th year when match application deadlines have either passed or are looming.

Anecdotally, our team has observed that students' attitudes toward the practice of anesthesiology and anesthesiologists seem to improve dramatically after completing the simulation series with many students asking to "shadow" a faculty member after the experience. This survey was conducted to determine whether the prevailing attitude towards anesthesiology and anesthesiologists changed after first-year medical students participated in a simulator–based physiology lab conducted solely by anesthesiologists.

Materials and Methods

Study Design

After obtaining institutional review board approval and exemption from written informed consent from the Mount Sinai Hospital Program for the Protection of Human Subjects, a 60-item questionnaire was developed. The questionnaire was designed to elicit data from first-year medical students regarding their perceptions of anesthesiology, but other medical specialties were included to make the purpose appear to be one of more general interest and mask the principle goal of the study. Also, we believed that it was important to prove that the opposite of the study goal was true. Namely, if no exposure occurred, we posited that attitudes should not change. Ten descriptive terms and three medical fields were included in the survey,

which takes approximately 5-10 minutes to complete (Appendix 1). A 5-point rating scale was employed so that students could rate their level of agreement or disagreement with the applicability of an available descriptive term to the specialists (as people) or specialty (as a field).

Appendix 1

Survey instrument regarding perceptions of different specialists and specialties

Please rank the appropriateness (in your honest opinion) of the following descriptions as they apply to the **typical specialist** in each field by placing the appropriate number between 1 and 5 in each box.

1 – strongly disagree
2 – disagree
3 – neither agree nor disagree
4 – agree
5 – strongly agree

	Internist	Surgeon	Anesthesiologist
devoted			
intelligent			
compassionate			
hard-working			
approachable			
focused			
confident			
dexterous/ skillful			
influential/ leader			
problem-solver			

Please rank the appropriateness of the following descriptions as they apply to each **specialty** by placing the appropriate number between 1 and 5 in each box

1 – strongly disagree
2 – disagree
3 – neither agree nor disagree
4 – agree
5 – strongly agree

	Internal Medicine	Surgery	Anesthesiology
stimulating			
prestigious/ respected			
hands-on			
rewarding			
good life style			
competitive/ rigorous			
patient-centered			
intellectual			
boring			
my possible career			

Student subjects from the Mount Sinai School of Medicine (MSSM) class of 2012 were recruited during a physiology lecture in November of 2008. This class has 140 students enrolled. On the day the class was to be surveyed, one hundred students were present. Each student received a survey and was asked to return it to a study group member once completed. The study group members did not identify themselves as members of the department of anesthesiology. Three months later, after completing a simulation-based physiology lab series, the 75 students who completed the initial survey were again surveyed. In addition to the core survey, students were asked if they had any exposure to members of the three medical specialties before and during the time since the initial survey. Exposure was defined as an instructive interaction such as a didactic or "shadowing" experience.

Simulation Course

The simulation-based physiology lab series is an integral mandatory component of the first-year physiology course at the MSSM. Students participate in three different two-hour simulation-based laboratories taught by a team of 2-3 anesthesiologists (residents and attendings) in groups of 10-15 students per session. The first lab covers cardiovascular physiology, the second covers respiratory physiology and the final session is a trauma scenario/autonomic nervous system lesson. During these fundamental laboratories the simulator serves as a means to demonstrate normal and deranged physiology. In the final session, students apply principles of basic cardiovascular and pulmonary physiology to successfully resuscitate a simulated hypotensive trauma patient.

Full environment simulation (FES) is staged for each session using a METI (Medical Education Technologies Inc.) Human Patient Simulator (HPS). The HPS has full drug recognition capabilities and monitoring data are displayed on a large 50-inch plasma cell with Smartboard overlay capability (SMART Technologies Inc.). The overlay affords the ability to operate any Windows based (Microsoft Corporation) program from the plasma cell or write directly on the screen via a blackboard function. The facilitators rapidly change the display between physiologic data and blackboard in order to review key physiologic

concepts as the scenarios unfold. The experience is Socratic and the students are expected to apply physiologic concepts learned in the classroom in order to interpret clinically relevant patient care issues. Each scenario is stopped and started as needed to discuss the application of classroom knowledge to the clinical situation and to allow participants time to develop diagnostic and therapeutic plans. Anesthesiology is not discussed, per se, though the scenario facilitators do introduce themselves as anesthesiologists and discuss the relevance of basic physiologic concepts to the practice of acute care medicine typically encountered in the emergency room, operating room, or critical care bay.

Statistical Analysis

Returned surveys were reviewed and data entered in an Excel file. Categorical variables are described as frequency and percentage, and continuous variables as means. In order to maintain anonymity, no attempt was made to identify the respondents by name from pre to post surveys. The pre- and post-simulation survey responses to each question were compared using Wilcoxon Two-Sample Tests.

Results

Of the 100 surveys that were distributed prior to the simulation program, a total of 75 (75%) were returned. Seventy-three surveys (97%) were returned in the post-simulation group by the cohort of 75 participants. Table 1 shows the demographic distribution of study participants.

Table 1
Participants by age and gender

	Pre-Simulation (n = 75)	Post-Simulation (n- = 73)
Mean Age (SD, Range)	24 (20-32)	24 (20-33)
Women (%)	45 (60)	44 (60)
Caucasian Race (%)	49(65)	49(67)

Before the simulation labs, 12% and 20% of students had been exposed to anesthesiologists and surgeons as teachers, respectively. Forty-three percent of students had been exposed to physicians from internal medicine before the labs and 95% had been exposed by the time of the last survey. During the period between the two surveys, 100% of the students in the final cohort had exposure to anesthesiologists through the physiology labs. The group had no comparable exposure to surgeons in that time period.

The results of the surveys for specialists (Table 2) and specialties (Table 3) are shown below. In almost every category, the post-simulation anesthesiology scores were significantly higher than their pre-simulation counterparts, whereas no significant differences were noted for the surgery or internal medicine scores. The one negative attribute, "boring", decreased in the post-simulation scores. The anesthesiology match rates for MSSM are included in Table 4.

Table 2
Pre and post-simulation perceptions of surgeons, internists and anesthesiologists

	Surgeon			Anesthesiologist			Internist		
	Mean score pre-sim	Mean score post-sim	p-value	Mean score pre-sim	Mean score post-sim	p-value	Mean score pre-sim	Mean score post-sim	p-value
Devoted	4.2	4.3	0.60	3.6	4.0	0.018	4.3	4.3	0.98
Intelligent	4.4	4.4	0.48	4.2	4.5	0.024	4.2	4.2	0.62
Compassionate	2.9	3.0	0.94	3.1	3.6	0.002	4.3	4.3	0.69
Hard-working	4.6	4.7	0.35	3.7	4.1	0.02	4.3	4.1	0.18
Approachable	2.7	2.7	0.99	3.4	3.9	0.0003	4.3	4.3	0.77
Focused	4.5	4.6	0.64	4.2	4.3	0.71	4.2	3.9	0.06
Confident	4.7	4.8	0.42	4.1	4.4	0.04	4.1	3.9	0.15
Dexterous	4.7	4.8	0.37	4.1	4.5	0.03	3.7	3.6	0.42
Influential/ leader	4.1	4.3	0.13	3.4	3.8	0.012	3.7	3.6	0.48
Problem-solver	4.0	4.2	0.30	4.0	4.4	0.006	4.4	4.5	0.46

Pre and post-simulation scores are reported as mean scores on a Likert Scale. P-values are based on Wilcoxon 2-sample test comparisons of pre and post-simulation survey data.

Table 3
Pre and post-simulation perceptions of surgery, internal medicine and anesthesiology

	Surgery			Anesthesiology			Internal Medicine		
	Mean score pre-sim	Mean score post-sim	p-value	Mean score pre-sim	Mean score post-sim	p-value	Mean score pre-sim	Mean score post-sim	p-value
Stimulating	4.2	4.3	0.89	3.2	3.9	<0.0001	3.8	3.8	0.62
Prestigious	4.7	4.8	0.61	3.7	4.0	0.046	3.3	3.3	0.91
Hands-on	4.8	4.8	0.65	3.6	4.3	<0.0001	4.0	3.8	0.29
Rewarding	4.1	4.2	0.64	3.3	3.9	0.0002	4.1	4.0	0.31
Good lifestyle	2.3	2.5	0.23	4.1	4.3	0.49	3.3	3.3	0.89
Competitive	4.7	4.7	0.64	3.9	4.3	0.03	3.2	3.1	0.34
Patient-centered	2.9	3.1	0.104	3.1	3.3	0.12	4.7	4.7	0.77
Intellectual	3.8	3.8	0.55	3.6	4.1	0.012	4.3	4.2	0.56
Boring	2.1	2.1	1.0	3.3	2.5	<0.0001	2.5	2.6	0.48
Possible career	2.7	3.0	0.17	2.2	3.1	<0.0001	3.4	3.2	0.46

Pre and post-simulation scores are reported as mean scores on a Likert Scale. P-values are based on Wilcoxon 2-sample test comparisons of pre and post-simulation survey data.

Table 4
Comparison of anesthesiology match rates of medical students at MSSM++ and nationwide

Year	MSSM (%)	National (%)*
1991+	6.9	6.3
1992+	9.2	6.5
1993	3.9	5.8
1994	4.3	4.9
1995**	1.5	2.9
1996**	0.7	1.2
1997+	2.5	1.7
1998+	4.1	2.6
1999**	2.3	2.8
2000+	5.9	3.7
2001	1.8	4.7
2002+	6.7	5.9
2003+	14.5	6.0
2004	4.6	5.8
2005+	8.7	5.9
2006+	9.9	6.5
2007+	12.3	6.3
2008+	7.3	6.5
2009+	10.9	6.7

+ Greater percentage placement than national average.
* Derived from National Residency Matching Program website: www.nrmp.org/index.html
++ Mount Sinai School of Medicine.
** The cardiovascular lab was introduced in 1995, the respiratory lab in 1996 and the complete course in 1999.

Discussion

Misconceptions of anesthesiology are common amongst other medical specialists and patients[6,7,8,9]. Similar inaccurate perceptions amongst medical students may deter them from choosing anesthesiology as a specialty or cause them to have an inaccurate opinion of anesthesiologists as professional colleagues in the future. It makes implicit sense that resources invested by members of academic anesthesiology departments in the form of medical student teaching might help improve the attitudes of these budding clinicians towards the field. This is important not just for recruitment of strong applicants to the field, but for strong professional relationships amongst practitioners which are based on mutual respect and appreciation of each others' roles and abilities. This, ultimately, fosters the teamwork which is so important to safe medical care.

In this study, we showed that exposure of first-year medical students to anesthesiology resident and attending physicians in a series of simulation-based physiology labs improved their attitudes towards the field. Exposure to internal medicine specialists in a more traditional setting (lectures and shadowing opportunities) did not have a similar effect on attitudes. In particular, marked positive improvements ($p<0.001$) were found for the following domains: "approachable", "stimulating", "hands-on", "rewarding", "boring" and "my possible career". None of the students surveyed had been exposed to surgeons and their views of these clinicians did not change. This is important in corroborating the data gathered for anesthesiology, as no change would be expected if no exposure occurred. Most had been exposed to practitioners from internal medicine through lectures and shadowing experiences, yet their overall attitudes did not change significantly.

It is possible that attitudes towards internal medicine did not change because expectations of that field were more in line with reality.

While our results are limited by several factors (e.g., relatively low initial response rate, p-values not adjusted for the influence of doing many significance tests in a survey-based design) the trends we observed are compelling. It is possible that although we attempted to feign that anesthesiology was the principal study subject we were unsuccessful in doing so. This may have led participants to give favorable ratings to anesthesiologists once the course facilitators were identified as such. Additionally, the results of this study may be heavily influenced by selection bias since those more interested in the simulation labs or in anesthesiology may have been more likely to return the surveys. Indeed, the study was done for one course and one class by one group at only one medical school. Also, a lack of subject identifier use means that no individual shifts in attitude could be determined and this negatively impacts the statistical significance of our data. It is also impossible to tell whether the observed shift in attitudes towards anesthesiologists was due to faculty skill or the educational environment. The current design does not allow the necessary comparisons to identify the sources of the change or the relative weight of either factor. Future work should be done to more effectively determine the importance of faculty skill versus environment in improving attitudes.

We are currently investigating whether this change in perception is sustained or manifests as a higher number of students ultimately pursuing anesthesiology as a career. Each year, the simulation labs are rated very highly by students. In this most recent cycle, 98.5% of students (138 completers of 140 total students) rated the course as "excellent" and all respondents agreed that the course should continue to be integrated into the physiology curriculum. The course in its current form was first introduced in 1999 and effects, if any, would be expected from 2002 to present assuming normal graduation pathways. We have accordingly seen a significant percentage of the graduating class entering anesthesiology since the introduction of the complete course, with rates higher than the national average in 7 out of the past 8 years (Table 4). However, this is a correlation not based on rigorous data gathering and is certainly the result of many confounding factors. Other than this brief exposure to anesthesiologists in the first year, students have a 1-week mandatory clerkship in their 3rd year. We believe that respect for anesthesiologists fostered in students' first year simulation course may result in students entering this brief clerkship with positive expectations and that this potentially explains the high rate of placement in anesthesia programs.

We propose it is crucial for anesthesiologists to maintain a strong presence in the basic science curriculum to enrich the educational experience of students and potentially foster interest in and respect for the specialty. Most simulation centers are run by or have anesthesiologists on staff. The simulated environment allows students to learn basic science in a unique way and also see anesthesiologists "in action" and dynamically applying basic physiologic concepts to patient care. In this fashion, students get a high quality educational experience and gain an appreciation of the knowledge and scope of practice of anesthesiologists. Anesthesiologists should therefore take a more active role in the education of medical students at even the earliest stages. In this fashion, simulation serves not just as a powerful educational tool, but a recruiting tool as well.

This effect may be true for other specialties as well, such as nursing, emergency medicine and critical care.

References:

1. Levin KJ, Friedman CP, Scott PV: Anesthesiology and the graduating medical student: a national survey. *Anesth Analg*; 1979, 58(3):201-7.
2. Samra SK, Davis W, Pandit SK, Cohen PJ: The effect of a clinical clerkship on attitudes of medical students toward anesthesiology. *J Med Educ*; 1983, 58(8):641-7.
3. Henderson E, Berlin A, Fuller J: Attitude of medical students towards general practice and general practitioners. *Br J Gen Pract*; 2002, 52(478):359-63.
4. Hauer KE, Durning SJ, Kernan WN et al: Factors associated with medical students' career choices regarding internal medicine. *JAMA*; 2008, 300:1154-1164.
5. Grayson MS, Klein M, Franke KB: Impact of a first-year primary care experience on residency choice. *J Gen Intern Med*; 2001, 16(12):860-3.
6. Klafta JM, Roizen MF: Current understanding of patients' attitudes toward and preparation for anesthesia: a review. *Anesth Analg*; 1996, 83:1314-21.
7. Ho RY, Wong DT: Anesthesiology: the misunderstood occupation! *Can J Anaesth*; 2005, 52(2):208-9.
8. Garcia-Sanchez MJ, Prieto-Cuelar M, Galdo-Abadin JR, Palacio-Rodriguez MA: Can we change the patient's image of the anesthesiologist? (Spanish). *Rev Esp Anestesiol Reanim*; 1996, 43:204-7.
9. Huang Y, Yang K, Ren H, Luo A: A survey of elective surgical patients' attitudes toward anesthesia in PUMC hospital. *Chin Med Sci J*; 2002, 17:77-80.
10. http://lifelinetomodernmedicine.com/ accessed September 30, 2009.