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Evolution of an obstetrics and gynecology interprofessional simulation-based education session for medical and nursing students

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Abstract

Simulation and Objective Structured Clinical Examination assessment of learners can teach clinical skills proficiency in a safe environment without risk to patients. Interprofessional simulation-based education (IPSE) contributes to a transformation in students' understanding of teamwork and professional roles. Long term outcomes for stimulation and IPSE sessions, are less well studied. We hypothesized that a progressive interprofessional education simulation program incorporating both faculty and interprofessional student collaboration would improve medical students' knowledge retention, comfort with procedural skills, positive teamwork and respectful interaction between students.

An Obstetrics and Gynecology IPSE for medical and nursing students (NS) was developed in collaboration between a school of medicine and a school of nursing from 2014 to 2017. By 2017, content included

(1) fetal heart rate case-based workshop;

(2) simulated vaginal delivery;

(3) cervical examination and assessment;

(4) contraception station including intrauterine device insertion practice;

(5) obstetric procedures including hands-on B-Lynch Suture practice.

From 2014 to 2016, medical students completed attitude, knowledge, and perception surveys both pre and immediately post simulation, at 4 months, and 8 months. In 2017; all students completed self-assessments and received faculty-assessments.

The program trained 443 medical and 136 NS. Medical students' knowledge, comfort, and interest increased significantly post simulation. Outcome scores decreased but were still significantly improved at 4 months but nearly dissipated by 8 months. There were no significant differences between medical and NS self-assessment or faculty-assessment scores regarding IUD insertion, cervical examination, or contraception quiz scores. Medical students' birth simulation self-assessment versus faculty-assessment scores were 8.6 vs 8.9, $P < .001$.

Simulation improved students' short-term medical knowledge, comfort, and perception with some long-term persistence at 4–8 months. Medical and NS learned obstetrics and gynecology skills in a collaborative environment and in role-specific situations. Medical students had the opportunity to learn from NS. Positive teamwork and respectful interaction occurred between the students.

Abbreviations: IPE = interprofessional education, IPSE = interprofessional simulation-based education, MS2 = second year medical students, NS = nursing students, OBGYN = obstetrics and gynecology, OSCE = objective structured clinical examination.

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1. Introduction

Simulation training has increased significantly across medical schools and residency programs as a way to teach learners valuable skills. Simulation can reproduce a wide range of clinical conditions; thus novices can practice and hone their skills in a risk-free environment.[1] This allows learners to approach clinical scenarios with more confidence, creating an atmosphere that puts patients at ease, improves patient safety, and decreases medical errors.[2] Most medical students make the transition from the classroom to clinical settings in their third year of training; simulations may facilitate bridging that transition if students can get exposure and practice concepts in the year prior to their first interactions with patients.

To ensure high quality patient care, an effective interprofessional collaboration between healthcare professionals is required. Interprofessional education (IPE) has a positive impact on teamwork and improves patient safety.[4] In addition, Objective Structured Clinical Examination (OSCE) assessment of learners in simulation and controlled environments can promote competence of clinical skills and application to real-life scenarios.[5–7] This follows Miller's Pyramid Level 3 "Shows How"[3] or Kirkpatrick's Model of Evaluation Level 3 "Behavioral Change."[8]

The purpose of this report is to describe the evolution and progression of an Obstetrics & Gynecology (OBGYN) IPE simulation program for medical and nursing students (NS) over a 4-year period.

2. Methods

This was a prospective cohort educational and programmatic study from 2014 to 2017 conducted at the Oakland University William Beaumont School of Medicine (OUWB), with approval granted by the Oakland University Institutional Review Board. The conceptual framework used was deliberate interprofessional simulation practice in which the teacher plans learning and provides immediate feedback.[9] The active learning technique utilized was simulation.

We utilized a deductive investigational pathway that was initiated based on the hypothesis that a progressive IPE simulation program incorporating both faculty and interprofessional student collaboration would improve medical students' knowledge retention, comfort with procedural skills, positive teamwork and respectful interaction between students. Our study utilized a step-by-step approach in a logical progression of 4 steps based on educational principles and needs assessment.

From 2014 to 2017; progressive modification of the educational principles and the OBGYN curriculum concepts occurred as a collaboration between the co-directors, nurse clinical skills instructors, Maternal Fetal Medicine (MFM) fellows, and basic scientists inclusive of the feedback from the students-end -of course assessments. From 2014 to 2017 all second-year medical students at OUWB and from 2015 to 2017 NS on their obstetrics rotation participated (inclusion criteria included a new cohort of second-year medical students and NS annually with the exclusion of all other students). There was an obstetrical experience mismatch between the medical students and the NS; the medical students had no previous obstetrical experience while the NS were finishing their obstetrical rotation and had training on vaginal delivery and fetal heart rate patterns.

Both students and faculty evaluated the program. The program evaluation included the students-end-of-course assessments that contained both qualitative comments and quantitative scores. On procedures, students were assessed by Objective Structural Clinical Assessments checklists (OSCE) which were completed both by students (self-assessments) and by faculty (faculty assessments). All students completed survey questions based on attitude, knowledge, and perception (Table 1). These surveys were completed pre and post the educational intervention to determine significant changes in attitude, knowledge, and perception (see Appendix 1, Available at: http://links.lww.com/MD/F41).

The four steps of the deductive educational pathway are as follows:

Step 1, 2014:

The first step in our deductive approach was an obstetrics simulation curriculum that was incorporated into the Reproductive Sciences Course for second year medical students (MS2). The educational principles for the first step included flipped classroom and OSCE based obstetrical simulation. In 2014, the co-directors of the Reproductive Sciences course in collaboration with OBGYN residents developed an obstetrics simulation curriculum that was incorporated into the Reproductive Sciences Course for MS2. The first simulation was held in 2014 at William Beaumont Hospital Simulation Center, Royal Oak, Michigan. Faculty included OBGYN residents and generalists, MFM fellows and faculty, basic science faculty, nursing instructors, OBGYN nurses, a simulation technician, and an intrauterine device clinical specialist. Using a flipped classroom model, students received a pre-curriculum lecture on intrapartum obstetrics and fetal heart rate tracings and watched a brief video on labor. The simulation was performed with students in groups of 3 to 4 rotating through three stations for 20 minutes each. At the station on simulated vaginal delivery, each student was guided in delivering a baby by MFM faculty with a simulation technician support using SimMom (Laerdal). An OBGYN resident gave an interactive workshop on fetal heart rate (FHR) tracings. Another OBGYN resident taught and assessed students on cervical dilation using "blinded" and "open" cervical models. A debriefing session occurred at the end to answer questions and obtain constructive feedback. Students completed surveys on attitude and knowledge on obstetrics and FHR concepts before, immediately after, and 4 months after the curriculum. A perception survey was also completed immediately after and 4 months after the curriculum (Appendix 1, Available at: http://links.lww.com/MD/F41). A standard Simulation Learning Center technical assessment survey was completed immediately after the course, covering themes such as communication, achievement of goals, teaching styles, and realism.

Step 2 2015:

The second step in our deductive approach was an interprofessional obstetrics simulation curriculum involving nursing and medical students. The additional educational principles of the second step included the introduction of

Table 1

Evolution of an obstetrics and gynecology IPSE curriculum.

Item	2014	2015	2016	2017
Site	Hospital simulation center	School of nursing simulation center	School of nursing simulation center	School of nursing simulation center
Faculty	Simulation technician, MFM, OBGYN resident	Nurse instructor, OBGYN resident, MFM, midwife, obstetrics nurse, Basic Science faculty	Nurse instructor, MFM fellow, MFM, OBGYN generalist, OBGYN resident, IUD clinical specialist, Basic Science faculty	Nurse instructor, MFM fellows, MFM, OBGYN generalist, OBGYN resident, IUD clinical specialist, Basic Science faculty
Medical students	105	95	127	115
Nursing students	Did not participate	40	45	51
FHR Flip- classroom online	yes	yes	yes	yes
Pre-simulation lecture	Not Done	Not Done	yes	yes
Attitude questions	Pre, post, and 4 mo	Pre, post, and 8 mo	Pre and post	Not done
Knowledge questions	Pre, post, and 4 mo	Pre, post, and 8 mo	Pre and post	Not done
Procedures:				
Delivery simulation	Med students	Med students	Med students and nursing students	Nursing students taught neonatal resuscitation; Self and faculty assessment by OSCE
Fetal heart rate course	Med students	Med students, nursing students; faculty assessment by OSCE	Med students and nursing students; faculty assessment by OSCE	Med students only in a 60-min group-based workshop
Cervical blind & open models	Med students	Med students; faculty assessment by OSCE	Med students and nursing students; faculty assessment by OSCE	Med students & nursing students; Self & faculty assessment by OSCE
Obstetrical Procedures	Not Done	Not Done	Not Done	Med students and nursing students
Contraception Methods Station	Not Done	Not Done	Yes	Yes; knowledge quiz
IUD insertion Simulation	Not Done	Not Done	Yes	Yes; self and faculty assessment by OSCE
Nursing student feedback	Not done	Not done	Yes	Yes
Evaluation	End of course assessment	End of course assessment	End of course assessment	End of course assessment

IPSE = interprofessional simulation-based education, IUD = intrauterine device, OBGYN = obstetrics and gynecology, OSCE = objective structured clinical examination, MFM = maternal fetal medicine.

interprofessional interaction and OSCE. In 2015, to further develop IPE, the simulation curriculum was re-located to the Oakland University School of Nursing simulation center. The time for each station was increased to 30 minutes. The nurse clinical skills instructor (author SV) was instrumental in curriculum re-design and the Noelle obstetrics simulator (Gaumard Scientific) was used for the simulated vaginal deliveries. NS were included but they only participated in the FHR station at which they gave a Situation, Background, Assessment, Recommendation (SBAR) report and asked for a management plan from the medical students. OSCE checklists completed by faculty were introduced in the FHR and cervical exam stations. Knowledge and Attitude surveys were offered pre, post, and 8 months after course. The Perception survey also occurred immediately after the course and after 8 months.

Step 3, 2016:

The third step in our deductive approach was expanding the interprofessional obstetrics simulation curriculum and adding gynecological simulation involving both nursing and medical students. In addition to the previous education principles, the third step focused on teamwork and interaction of medical and NS. In 2016, both medical and NS completed FHR, delivery, and cervical exam training, plus a new contraception and intrauterine device insertion station. In the delivery station, NS gave history and supported the delivery. Knowledge and Attitude surveys were only done pre & immediately post course. The Perception survey was done after the course. In 2014 and 2015, cervical clay models developed by clinical nursing instructors were used, to improve fidelity, in 2016 professional cervical models were purchased and used (Lifeform Replicas from Nasco, Fort Atkinson, WI).

Step 4; 2017:

The fourth step in our deductive approach was increasing procedural training and integration of NS. The additional educational principles of the fourth step included a focus on interprofessional student teaching, Patient Safety principles of teamwork and the introduction of OSCE self-assessment by both nursing and medical students. In 2017, new additions compared to previous years were:

(1) in the delivery station, NS resuscitated and assessed newborns with Apgar Scores and gave an SBAR report to the medical students,
(2) both medical and NS performed self-assessment and also received a faculty-assessment on IUD insertion practice and cervical examination stations,
(3) medical students performed self-assessment and also received a faculty-assessment in the delivery station,
(4) both nursing and medical students participated in a knowledge quiz on family planning and contraception methods,
(5) time for each scenario was increased from 30 to 45 minutes,

Table 2

Knowledge, attitude, and perception survey results - 2014.

	Pre-simulation (1) n=105	Immediate post (2) n=105	4 mo post (3) n=56	*P* value for 1 vs 2	*P* value for 1 vs 3	*P* value for 2 vs 3
Attitude questions	12.82±6.02	29.57±5.15	20.0±7.46	<.001	<.001	<.001
Knowledge questions	2.43±1.12	4.19±1.2	3.08±1.2	<.001	<.01	<.001
Perception survey	No survey	9.05±0.99	8.43±1.3	n/a	n/a	<.001

(6) the FHR module was removed from the simulation and conducted separately as a 60 minute flipped classroom case-based workshop. In this workshop, students divided into groups to investigate and interpret a specific FHR case, and presented their results to the whole group, and
(7) an additional station on Obstetric Procedures was introduced at which students had hands-on training with B-Lynch Suture, as well as postpartum hemorrhage management, forceps, vacuum extractors, scalp electrodes, and pressure catheters (Table 1).

The mean Likert scores of the pre and post survey scores were compared using t tests to determine significant differences. The subjective outcomes studied included self-perceived confidence comfort levels, and perception of the value of obstetrics simulation (Kirkpatrick's level 1 reaction). The objective outcomes were acquired knowledge including the knowledge tests and the final examination for the course including laboratory practical examination and National Board of Medical Examiners (NBME) examination (Kirkpatrick's level 2 learning). The behavioral outcomes were the communication, professionalism and procedural skills attainment (Kirkpatrick's level 3 behavior).

3. Results

3.1. 2014

In 2014, of 105 students who participated in the curriculum, 95 completed the pre and immediate post simulation survey. Fifty-six completed the 4-month post survey. For the knowledge questions on obstetrics and FHR, students obtained a mean pre-score for correct answers of 12.82 (SD=6.02), with post-simulation mean score increasing to 29.57 (5.15), $P<.001$. At 4 months the score was 20 (7.46), a significant decrease from the post-simulation score but still significantly higher than the baseline pre-simulation score. Similarly, for the attitude questions, students' comfort level with obstetrical procedures increased significantly immediately post simulation but had decreased at 4 months. Again, the 4-month post-simulation score was significantly lower than the immediate post-simulation score but was still significantly higher than the baseline pre-simulation score. The perception survey was conducted post-curriculum with a mean score of 9.05 (0.99). When repeated 4 months later, the mean score dropped slightly, but significantly, to 8.43 (1.3), $P=.001$ (Table 2). The Simulation Learning Center standard technical assessment was completed immediately after the course only in 2014. On a Likert scale of 1 to 4 results were: Objectives were communicated = 3.37 (0.61); Teaching methods adequate = 3.86 (0.35); Instructors Knowledge = 3.95 (0.23); Clinical content =3.84 (0.37); and Realistic program = 3.85 (0.36). Written comments were also analyzed. When asked to comment on "what went well," 86% of students gave a positive comment and 14% no comments. There were no negative comments. On "what needs to be improved." 74% felt improvement was required. The majority of the improvements suggested were to provide more time at each station. On "what should be discarded," only 3% felt anything should be discarded and over 60% reported nothing needed to be changed.

3.2. 2015

In 2015, 95 MS2 participated. The mean scores for the FHR OSCE (0–1, for OSCEs met/yes = 1; partially = 0.5; not met/no = 0) were: identifies FHR baseline = 0.97, identifies FHR variability= 0.73, provides accurate identification of periodic pattern = 0.73, identifies FHR category = 0.67, orders appropriate medical interventions = 0.93, communicates respect with IP health team = 0.91, professionalism reflected in IP interactions = 0.91. The comfort level scores with obstetrical procedures compared to baseline significantly increased post-simulation and were still significantly increased at 8 months compared to baseline. The 8-month score was however significantly lower than the immediate post simulation score. For the knowledge questions on obstetrics and FHR, students mean post-curriculum score increased significantly from pre-simulation. By 8 months it was not significantly different from baseline and was significantly lower than the immediate post simulation scores. This indicated the 8-month knowledge scores had returned to the baseline. As in 2014, the perception scores were significantly decreased at 8 months when compared to the post-simulation scores (Table 3). Forty-one NS participated, and provided feedback, but they did not participate in the surveys.

Table 3

Knowledge, attitude and, perception survey results - 2015.

	Pre-simulation (1)	Immediate post (2)	8 mo post (3)	*P* value for 1 vs 2	*P* value for 1 vs 3	*P* value for 2 vs.3
Attitude questions	12.2±0.63	28±0.62	16.13	<.001	.001	<.001
Knowledge question	2.57±0.09	3.24±0.11	2.37±0.12	.001	ns	.001
Perception survey	No survey	8.07±0.13	6.8±0.36	n/a	n/a	<.001

For knowledge and attitude: n=95 pre-simulation, n=78 immediate post simulation, n=54 at 8 months post.
For perception: n=84 immediate post simulation and 49 at 8 months post simulation.

Table 4

Knowledge, attitude and perception survey results - 2016.

	Pre-simulation (1) n = 127	Immediate post simulation (2) n = 127	*P* value for 1 vs 2
Attitude questions	20.78 ± 0.78	38.78 ± 0.55*	<.001
Knowledge question	4.90 ± 0.55	6.46 ± 0.15	<.001
Perception survey	No survey	8.85 ± 0.086	n/a

3.3. 2016

In 2016, 127 medical students participated in the curriculum. They only completed surveys pre and immediately post-simulation. The results were similar to the previous years, which showed a statistically significant increase in attitude and knowledge questions immediately post simulation (Table 4). Forty-five NS participated in 2016. They gave general feedback during the debriefing session and written comments. Nursing student feedback included that they enjoyed cervical examination practice and the IUD insertion practice, they appreciated new experiences with exposure to contraception and family planning, but they wanted to be more involved.

3.4. 2017

In 2017, the program trained 116 medical and 51 NS. Both groups participated in all surveys and tests. The outcome measures we analyzed were IUD insertion self-assessment, IUD insertion faculty assessment, cervical examination scores, and the contraception knowledge quiz. Statistical analysis showed no significant differences between medical student and nursing student scores (Table 5). There was a significant difference between the medical students' self-assessment score and the faculty-assessment score at the delivery simulation (8.63 ± 0.82 and 8.93 ± 0.30; $P < .001$).

The end-of-course evaluation has 8 items and included the item: "variety of instructional methods used," on a Likert scale of 1-5, this score on this item increased from 3.91 in 2015 to 4.22 by 2017. This was the highest score of all the 8 items on the end-of-course evaluation in 2017. Furthermore, students' comments revealed that the IPE simulation was the highlight of the course and of high value to students' learning on the course.

The mean NBME exam score for the Reproductive Sciences course was 85.62% (0.51) and the practical laboratory exam score 86.73% (0.57). A correlation analysis was performed between NBME scores with outcome measures, and the only significant finding was a weak correlation between NBME scores and IUD insertion self-assessment (rho= 0.22, $P = .02$). Scores for professionalism and communication by medical students that addressed IPE engagement (eg, demonstrates willingness to listen to nursing student) were nearly perfect ranging between 0.99 and 1 (range of scores = 0-1).

Table 5

Medical student versus nursing student OSCE scores - 2017.

Assessment	Medical students n = 115	Nursing students n = 51	*P* value
IUD insertion self-assessment	8.84 ± 0.49	8.84 ± 0.52	ns
IUD insertion faculty –assessment	9 ± 0.0	8 ± 0.0	ns
Contraception station quiz	9.09 ± 1.5	9.26 ± 1.5	ns
Cervical assessment total	13.1 ± 2.61	12.67 ± 2.47	ns
Cervical dilation assessment	5.18 ± 0.97	5.16 ± 0.9	ns
Cervical effacement assessment	4.18 ± 1.39	4.02 ± 1.31	ns
Cervical station assessment	3.67 ± 1.44	3.42 ± 1.34	ns

OSCE = objective structured clinical examination.

4. Discussion

We have described a longitudinal interprofessional simulation-based education (IPSE) program as it evolved between a school of nursing and a school of medicine. It developed over 4 years to be inclusive of the needs of both nursing and medical students as well as expanding from intrapartum obstetrics to several other aspects of OBGYN.

A major focus of this simulation session was the teaching of core competencies of Professionalism, Practice-Based Learning and Improvement, Interpersonal & Communication skills, and Interprofessional Collaboration. OBGYN trainees had a major role in development and sustainability of the program. Residents participated using the resident-as-teachers model and to meet ACGME resident research requirements. In the first year, OBGYN residents facilitated 2 of the 3 stations. MFM fellows became involved in the latter 2 years and facilitated 2 stations. From a scholarly perspective, 3 OBGYN residents and one medical student presented successive updates of this curriculum at professional conferences or used the data for their research requirements. A review of the literature shows that most previous reports were designed by faculty with no GME lead role.[10–13] Similar to our study, but without the longitudinal approach, Nemer et al created a "Labor Game" by using the resident-as-teacher model with students on OBGYN clerkship rotating through 7 simulated obstetrics stations. Points were awarded at each station, and the student with the highest score won.[14]

Most previous reports of simulation for medical students in OBGYN have focused training around the third-year medical students OBGYN clerkship.[10,11,14] This is in contrast to our curriculum in which we focused on MS2 with the simulation occurring in the fall, approximately 7 to 8 months prior to starting clinical rotations. Our goal was to provide early exposure and experience to clinical concepts and procedures, which could lead to more integration of basic science concepts and better preparedness for the clinical rotation. Furthermore, unlike most previous reports that focused mainly on obstetrical procedures,[10,11,14] we expanded our curriculum to Gynecology in the last 2 years to include stations on family planning, contraception, and IUD insertion. Lerner et al also provided an extensive OBGYN simulation that in addition to obstetrics procedures included IUD insertion, hysteroscopy/cystoscopy, colposcopy/LEEP, and circumcision. However, this comprehensive two-week simulation-based elective course only trained 10 post-OBGYN clerkship third- and fourth-year medical students as a transition to OBGYN residency.[15]

Of all the stations, the concept of FHR patterns was the most challenging for the students, especially variability, periodic patterns, and tracing category. As a result, this station was removed from the IPSE and expanded into a PBL workshop to help students learn FHR tracing concepts better. For the 3 years that we performed assessments, we demonstrated that students' knowledge increased immediately after simulation; knowledge had diminished but was still significantly retained at 4 months post simulation but had dissipated by 8 months post-simulation. Students' comfort level or confidence in the OBGYN procedures also increased immediately post training and decreased but was

still significantly higher than baseline at both 4- and 8- months post simulation. This data suggests that, for these skills and procedures, confidence is better retained than knowledge. As demonstrated in our study, a review of the literature consistently demonstrates the immediate post simulation significant increase in knowledge and comfort level.[11,12,14,15] Holmstrom et al showed that students receiving simulation training were significantly more confident in performing a vaginal delivery immediately after assessment than control students; however, these differences narrowed by 4 weeks. Simulation students also scored significantly higher on examinations 4 weeks post-intervention.[10] DeStephano et al compared a high-fidelity birth simulator versus low-tech birth simulator on performance and exam scores at the end of the OBGYN clerkship, finding similar performance gains and scores for both forms of simulation.[13] Our literature review did not reveal any other study reporting post-simulation long-term knowledge or comfort level gains after 6 weeks. Thus, our study with 8-month outcome results supports the utility of OBGYN simulation, particularly proximate to or within the clerkship. Furthermore, we assessed relationships between simulation and interest in OBGYN by our perception survey. Results showed a very high interest immediately post-simulation but this decreased significantly at both 4 and 8 months. Many of the students' narrative comments stated that "they had forgotten" and "it was a long time ago". This finding suggests that interest in a program generated immediately post-intervention may be very short lived.

IPSE enables students from different professions to practice teamwork and communication skills in a controlled environment.[16–18] The Liaison Committee on Medical Education standards, 7.9 on Interprofessional Collaborative Skills, supports the inclusion of IPSE in the medical school curriculum.[19] Similar to other studies, our IPSE consisted of medical and NS assessing both teamwork and communication. Additionally, we explored further possibilities of IPSE by creating a scenario in which medical students were able to learn from NS. NS had already learned newborn assessment, unlike the medical students, hence in the delivery simulation station, NS demonstrated Apgar score assessment to the medical students. Furthermore, we allowed NS to learn and perform the same procedures as medical students and were able to show no difference in proficiency between NS and medical students.

There were a number of limitations to this study. There were no controls and randomization was not performed; because of the LCME accreditation requirements and the known benefits of IPSE, we felt it would have been unethical not to offer the curriculum to all the students. Additionally, data collection evolved and was varied, nor could we compare the anonymous survey results from this IPSE with performance in the OBGYN clerkship. Lastly, since this study was conducted at only one institution, results may not be generalizable. On the other hand, strengths included the use of 4 consecutive student classes; an interprofessional approach in curriculum development, faculty instruction and student participation; use of the flipped classroom model; and programmatic improvement based on student feedback.

5. Conclusions

Over a 4 year period, our IPSE expanded to include nursing, physician and resident faculty instructors working with medical students and NS jointly. The session improved students' short-term medical knowledge, comfort, and perception with some long-term persistence noted at 4 to 8 months. The program evolved to include OSCE assessments, which showed that students struggled more with learning complex processes like fetal heart rate interpretation. Medical students were more critical of their learning compared to their evaluation by faculty. Communication and professionalism of the medical students in their interaction with NS was stressed and assessed, and NS had the opportunity to teach medical students.

Author contributions

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