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                    | Not Done                    | Not Done                    |
| 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 & 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 & nursing students; Self & 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 & nursing students; faculty assessment by OSCE | Med students and nursing students |
| Obstetrical Procedures      | Not Done                    | Not Done                    | Not Done                    | Not Done                    |
| 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,
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 without being 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).

### 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 2

**Knowledge, attitude, and perception survey results - 2014.**

|                    | Pre-simulation (1) | Immediate post (2) | 4 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 ± 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                 | <.01                 |
| Perception survey  | No survey         | 9.05 ± 0.99       | 8.43 ± 1.3    | n/a                  | n/a                  | <.001                |

### 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 ± 6.03       | 28 ± 6.02         | 16.13         | <.001                | .001                 | <.001                |
| Knowledge questions| 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.
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 IDE 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 4

| Assessment                        | Pre-simulation (1) | Immediate post simulation (2) | 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               |

### Table 5

| 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                  | 9 ± 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.
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 OB/GYN 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 OB/GYN simulation, particularly proximate to or within the clerkship. Furthermore, we assessed relationships between simulation and interest in OB/GYN 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 OB/GYN 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.

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**References**

[1] Satin AJ. Simulation in obstetrics. Obstet Gynecol 2018;132:199–209.

[2] Khan N, Shahnaz S, Gomathi K. Currently available tools and teaching strategies for the interprofessional education of students in health professions literature review. SQU Medical J 2016;16:e277–85.

[3] Miller GE. The assessment of clinical skills/competence/performance. Acad Med 1999;65:63–7.

[4] Reeves S, Perrier L, Goldman J, et al. Interprofessional education: effects on professional practice and healthcare outcomes (update). Cochrane Database Syst Rev 2013;28;CD002213.

[5] Allard M, Lafleur A, Richard F, et al. How medical students edited an osce study guide and why should you? Int J Med Students 2018;6:78–82.

[6] Bernard AW, Ceccolimi G, Fenn R, et al. Medical students review of formative OSCE scores, checklists, and videos improves with student-faculty debriefing meetings. Med Educ Online 2017;22:1324718.

[7] Patricio MF, Julião M, Fareleira F, et al. Is the OSCE a feasible tool to assess competencies in undergraduate medical education? Med Teach 2013;35:503–14.

[8] Kirkpatrick DL, Craig RL. Evaluation of training. Training and development handbook: a guide to human resource development New York: McGraw-Hill; 1967.

[9] Ericsson KA. Deliberate practice and the acquisition and maintenance of expert performance in medicine and related domains. Acad Med 2004; 79 (10 Suppl):S70–81.

[10] Holstrom SW, Downes K, Mayer JC, et al. Simulation training in an obstetric clerkship: a randomized controlled trial. Obstet Gynecol 2011;118:649–54.

[11] Nitsche JF, Shumard KM, Fino NF, et al. Effectiveness of labor cervical examination simulation in medical student education. Obstet Gynecol 2015;126(suppl 4):13–20S.

[12] Jude DC, Gilbert GG, Magrane D. Simulation training in the obstetric and gynecology clerkship. Am J Obstet Gynecol 2006;195:1489–92.

[13] DeStephano CC, Chou B, Patel S, et al. Huespchen N: A randomized controlled trial of birth simulation for medical students. Am J Obstet Gynecol 2015;213: 91.e1–7.

[14] Bou Nemer L, Kalin D, Fiorentino D, et al. Estes CM: the labor games. Obstet Gynecol 2016;128(suppl 1):1–55.

[15] Lerner V, Higgins EE, Winkel A. Re-boot: simulation elective for medical students as preparation bootcamp for obstetrics and gynecology residency. Cureus 2018;10:e2811.
[16] Oxelmark L, Amore T, Carlzon L, et al. Students’ understanding of teamwork and professional roles after interprofessional simulation—a qualitative analysis. Adv Simul 2017;2:8.
[17] Goolsarran N, Hamo C, Lane S, et al. Effectiveness of an interprofessional patient safety team-based learning simulation experience on healthcare professional trainees. BMC Med Educ 2018;18:192.
[18] Partecke M, Balzer C, Finkenzeller I, et al. Interprofessional learning – development and implementation of joint medical emergency team trainings for medical and nursing students at universitätsmedizin greifswald. GMS J Med Education 2016;33:2366–5017.
[19] Functions and structure of a medical school. Standards for Accreditation of Medical Education Programs Leading to the MD Degree Available at: https://med.virginia.edu/ume-curriculum/wp-content/uploads/sites/216/2016/07/2017-18_Functions-and-Structure_2016-03-24.pdf Accessed 10 Sept 2019.