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Orientation to the Operating Room: An Introduction to the Surgery Clerkship for Third-Year Medical Students

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Abstract

Introduction: The operating room is a complex environment in which individual team members perform specific tasks according to their role. A simulation activity was created to introduce medical students on the surgery clerkship to issues relating to patient safety, infection control, and regulatory requirements.

Methods: This activity takes place prior to general surgery rotation operative experiences, and addresses the need for students to practice roles they will perform while participating in patient care. The activity includes a simulated operation, an assessment, and a scripted debriefing. Among other tasks, students practice safe patient transfer and monitoring, donning sterile garb, preparing the surgical site, and being active participants in a sign-in and time-out. Students are assessed on assigned tasks, their ability to maintain sterility, and the degree to which they engage with their team. **Results:** Students reported the simulation helped them better understand how they could become involved on their first day in the operating room. Students also reported they were more confident when in the operating room. This finding also extended to students who had previously been in the operating room during a prior OB/GYN rotation. **Discussion:** Patient safety is paramount when in the operating room, and this simulation activity fills a current gap in student's practical knowledge as they prepare to enter their surgery clerkship. Giving medical students the information and skills needed to be safe and effective members of the operating team prior to entering the operating room is of benefit to the surgical team, students, and patients.

Keywords

Simulation, General Surgery, Surgery, Safety, Operating Rooms

Appendices

- A. Simulation Case.docx
- B. Simulation Logistics.docx
- C. Student Leadership Roles.docx
- D. Simulation Images.docx
- E. Critical Actions Checklist.docx
- F. Debriefing Materials.docx
- G. Simulation Evaluation Survey.docx

All appendices are peer reviewed as integral parts of the Original Publication.

Educational Objectives

After participation in this simulation exercise, participants will be able to:

1. Demonstrate the ability to don and doff sterile garb and maintain a sterile surgical field.
2. Actively participate in all patient safety activities such as the sign-in and time-out.
3. Demonstrate proficiency in role-appropriate tasks, such as applying sequential compression devices, assisting in draping, and safe patient transfer.

Introduction

The operating room (OR) setting, typically with multiple functions occurring simultaneously is a demanding environment in which to both work and learn. In addition, the OR environment is highly regulated with an intense focus on patient safety,^{1,2} as manifested in the increasing number of regulatory requirements, both national and local which impact the OR workspace. Further, the OR contains direct environmental hazards. This heightened focus on efficiency and safety poses a challenge for rotating medical students who must successfully integrate themselves as a member of the OR team to maximize their ability to learn during the surgery rotation.

OR culture has increasingly focused on safety due to the potential for severe injury to both patients and staff that may occur. A study funded by the Agency for Healthcare Research and Quality in 2006 found the rate of wrong site surgery was one in 112,994 operations in an analysis of three million cases.³ The

authors concluded that 62% of those wrong site operations were preventable if proper safety protocols were implemented and adhered to in the OR. Both the Joint Commission⁴ and the American College of Surgeons⁵ have published suggested safeguards against wrong site surgery and other adverse OR events. Hence, as members of the OR team during their rotation, it is important for the medical student to understand their role in the patient's safety and in health care quality.

This OR simulation was created for the third-year medical student's surgery clerkship and allows expectations to be set regarding personal and patient safety, sterile technique, teamwork, and the role the student fulfills as a confident member of the team. As a part of the Best Evidence in Medical Education Guide 4, describing aspects of simulation that will lead to effective learning,⁶ this simulation occurs in a controlled environment and allows for a structured debrief session and feedback for students.

Previous work in simulation has focused on specific operative skills^{7,8} or the management of various emergencies in the OR.⁹⁻¹² Our simulation does not focus on these concepts, but rather focuses on allowing students to be confident, competent, and safe team members in the OR when starting their surgery clerkship.

Given the hands-on nature of working in an OR environment, we sought to use an appropriate instructional strategy. The OR simulation curricular design is guided by Kolb's experiential learning cycle.¹³ Kolb's theory states "Learning is the process whereby knowledge is created through the transformation of experience." To adequately "transform" the OR experience, the simulation environment and staff are a necessity. The OR simulation is the "concrete experience," which is the basis for "reflective observation." The students are asked to immediately reflect on the OR experience following the simulation during the in-person debrief discussion. The students also provide feedback on their experience 7 weeks following the simulation session in the form of a feedback survey.

The aforementioned feedback processes align with the next stage in Kolb's cycle, "abstract conceptualization." Following the OR simulation, the students join their clinical teams on the clerkship where they will be expected to apply the knowledge gained in the OR simulation to the actual OR. Prior to a real OR case, students will reflect on the roles they practiced during the OR simulation in conjunction with independent study of both the procedures and OR protocols to prepare for participation. These actions represent the stage of "active experimentation" on Kolb's framework. As students transition to more routine participation in the OR they continue to learn in the context of their role as an active participant on the operating team. The students will apply their knowledge from the OR simulation with this ongoing education from their precepting physicians and OR staff to iteratively translate these newly acquired skills and knowledge into clinical practice as they participate in the clinical environment. Kolb's learning cycle framework emphasizes the educational environment must "ensure critical and reflective, goal-directed action and evaluation of consequences of that action." This OR simulation provides an ideal learning experience, allowing students to learn and reflect on OR skills in a low-stakes student-centered simulation environment to better prepare them for the patient-centered high-stakes operating room.

Methods

The development of simulation and teaching materials for this activity were guided by Kern's six-step approach for curriculum development in medical education.¹⁴ We first performed a needs assessment. Through student feedback and clerkship evaluations, students indicated uncertainty regarding roles, responsibilities, and medical student appropriate tasks during their initial OR experiences. Surgical faculty were queried to identify specific deficiencies. While the clerkship had preexisting educational sessions in place (donning and doffing sterile gowns and gloves, lectures on safety, infection, and logistics in the OR), there were no focused activities to prepare students for their OR experiences. Additionally, there was a gap in the educational strategy used in the previous instructional approach, as this predominantly included lecture-based learning. The instructional approach was modified to utilize a more immersive, simulation-based approach.

The students' lack of readiness for participation in the OR in the first week of the surgery clerkship was identified as a primary opportunity for improvement and curricular development. Getting medical students involved from the start of their clerkship was of vital importance not only to their experience but for the efficiency of the surgical case. As inexperienced providers in the OR, the clerkship leadership felt students had the potential to negatively affect patient safety and clinical outcomes, especially in the area of infection control. We hypothesized that providing an opportunity for practice in a simulated environment without any potential impact on these patient safety concerns would improve student readiness for the OR. The medical students entering the required third-year surgery clerkship were identified as the target learners for this simulation.

Based on our focused needs assessment, we developed goals and objectives for this educational session utilizing simulation. The goals and objectives were subsequently used to guide the development of the simulation session (Appendix A). The simulation was created to give students an experience-appropriate set of tasks they would have the opportunity to perform as a part of the team in the OR, and provide them an opportunity to practice participating in patient safety practices such as the timeout and instrument count. In addition, it was a goal of the clerkship leadership to increase the confidence and comfort of the students as they entered their initial surgery experience.

Student Role

Students were welcomed with an overview of the simulation and its general logistics (Appendix B). In the event multiple simulated ORs were being utilized simultaneously, students were separated into groups for each of the ORs. These groups were random but attempts were made to evenly spread out students who have completed an OB/GYN clerkship. Efforts were made to restrict the group size to no more than five students to ensure students are afforded the opportunity to actively participate in the simulation. Students were then provided with the leadership role they are responsible for within the simulation. These roles were designed to give structure to the case and allow each student to be involved in a meaningful way. The leadership roles were explained and provided to them at random on their individualized leadership role assignment form (Appendix C). This form also contained information about the simulation patient.

Equipment/Environment

The implementation of this simulation required a number of resources. This simulation may be configured to utilize a single simulated OR or many simulated ORs run simultaneously to meet the needs of larger groups. The team leader was responsible for ensuring all resources and actors are in place and the simulation ran according to script. Coordination with the simulation staff was vital to ensure supplies and props are in place and functioning properly.

The following equipment was required to effectively execute OR simulation. See simulation images in Appendix D for further guidance:

- Simulated Operating room (1): See Appendix D.
- Debrief Space (1): Any space that will accommodate the faculty and student comfortably.
- Pre-op/PACU Space (1): See Appendix D.
- Anesthesia Machine (1): Inhaled anesthetics need to be installed.
- Anesthesia Medication Cart (1): Bag-valve mask (1), labeled medication vials (2-3), laryngoscope (1), endotracheal tube (1), 10cc syringe (3), 18g needle (2).
- Mayo Stand (1): Mayo stand with sterile cover. Instruments specific to stated procedure may be present.
- Instrument Table (1): Large back table with basic operative instrument tray and other equipment

including gowns, light handle covers, suction tubing, electrocautery tool.

- Simulated OR Tables/Patient Transport Cart (1): See Appendix D.
- IV Poles (2): Used for draping and intravenous infusions.
- Circulating Nurse Station (1): This can be a workstation on wheels, a separate desk, or a bedside table depending on space.
- Mannequin (1): Moulage not needed. Mannequin should have one 18g IV in the right arm with fluids hanging and a wristband that includes a hospital ID number, name, and date of birth. Do not place bouffant cap on patient, let the students complete that task.
- Operative Equipment (1 kit): Should contain Alice clamps (2), electrocautery grounding pad (1), electrocautery pen and holder (1), electrocautery machine (1), basin with surgical towels (4-8), laparotomy drape (1), surgical gowns (6-8), mayo stand cover (1), 1 ¾ sheet (1), minor basic tray (1), trocar (3), laparoscopy instruments (3), sterile gloves (assorted sizes), surgical masks (1 box), bouffant caps (1 box), non-latex exam gloves (assorted sizes), skin preparation stick (2).

Personnel

Personnel planning was the most difficult portion of this exercise, as the number of individuals and their specialties can pose a challenge for recruiting. All positions were to be filled. We had several personnel who are crosstrained so in the event a position is unable to be successfully filled, that position could have an experienced person to play the role and maintain the high quality of the simulation session. Ideally, the person playing each role has the appropriate corresponding clinical background.

The following personnel were needed to effectively run the OR simulation:

- Surgeon (attending/≥ PGY2 surgical resident) (1): Plays attending surgeon role.
- Nurse/surgical technologist (1): Plays circulating nurse role.
- Nurse/surgical technologist (1): Plays scrub nurse/technologist role.
- Anesthesia provider (MD/CRNA/Anesthesia Resident) (1): Anesthesia provider.
- Simulation exercise team leader (1): Team leader.
- Simulation technologist (1): Simulation technologist.

Assessment

Next, we developed an approach for the assessment of learner outcomes as well as evaluation of the event. This included a critical action checklist (Appendix E). This assessment tool was developed by the clerkship faculty and staff, and was used by the simulation technicians and actors to ensure the students are progressing through the case in a timely manner and are meeting all stated objectives. The simulation exercise was considered to be formative in nature.

The students filled out a postencounter survey within 1 week of participation. This information was used by the clerkship leadership to provide continuous improvements to the simulation.

Debriefing

As a component of the simulation session, we developed a debriefing guide (Appendix F) to be used by the facilitators to enhance reproducibility across different simulation sessions. We identified several specific actions during pilot simulation sessions related to the objectives that students either performed well or were opportunities for improvement.

The debriefing took place immediately following the conclusion of the case. All participants from each OR (students, physicians, nurses, etc.) gathered in a debriefing space and participated in a group debriefing facilitated by the surgeon. The debriefing session, used as a formative assessment, highlighted the opportunity debriefing can bring to medical education by identifying performance gaps.¹⁵ When those

gaps were identified, it provided faculty the opportunity to investigate the basis for those performance gaps and provide resources to close them. The education approach utilized was the scripted debriefing model described by Eppich and Cheng.¹⁶ Their framework of reactions, description, analysis and summary, along with the work of Cheng, Hunt, Donoghue, et. al., provide the basis for the adapted scripted debriefing tool.¹⁷

Results

We were able to develop a simulation that meets the needs of our students, the clerkship, and the institution. In addition, an evidence-based scripted debriefing was developed as a formative assessment tool. The scripted debriefing tool is easily adaptable and simple to use, even with faculty who are new to the simulation.

This simulation experience has been successfully implemented with medical students entering their third-year surgery clerkship continuously over the previous 2.5 years for 14 discrete implementations. Of the estimated 400 students who have participated in this event, 237 have been surveyed with the current tool (Appendix G). This tool has been updated, as the survey has been modified based on clerkship needs and student feedback. Overall, students have found this simulation useful to their learning, subjective comfort, and confidence (Table 1).

Table. Postsimulation Survey Responses (N = 327)

Question	Percentage		
	Strongly Agree/Agree	Strongly Disagree/Disagree	Neutral
After completing this simulation I know tasks I can do upon arrival to get involved with the surgical case.	85.23	3.38	11.39
Discussing OR topics with staff contributed to my comfort going forward.	93.72	0.52	5.76
I feel comfortable going into the OR with my team.	88.48	0	11.52
Asking questions to OR staff was valuable for learning.	94.77	0	5.23
After completing this simulation I feel confident being involved with preparation of the patient for an operation.	79.75	3.37	16.88
Please respond only if you have completed the OB/GYN clerkship: This simulation is useful even after completion of my OB/GYN clerkship. ^a	84.06	15.94	0

^an = 138

This experience has been used exclusively in the surgery clerkship at a single institution. The faculty and staff implementing this case are from a number of disciplines including: surgery, anesthesiology, simulation, nursing, and surgical technology. The faculty in this scenario are surgeons with experience in academic medicine and medical education.

Discussion

Medical students entering the surgery clerkship need to be aware of both intraoperative safety procedures and team dynamics when in the OR. These skills are important beginning with the first operative case they participate in, and the margin for error is small. This simulation addresses the need for a kinesthetic experience prior to entering the high-stakes environment of the OR. This simulation allows students to learn to be a functioning part of the OR team and affords them the opportunity to make mistakes in a safe environment.

The surgical faculty expect medical students to be ready to participate in the OR from the first day on service. While we could instead allow students to be oriented to the OR by the faculty, we believe our approach using simulation is superior for a number of reasons. First, our simulation creates uniform and consistent messaging in the delivery of content. This ensures all patient safety items are addressed. Second, mistakes made in simulation have no financial or patient safety impacts. Simulation has been shown to improve patient outcomes,^{18,19} improve skill mastery,²⁰⁻²² reduce complications,²³ and reduce

hospital costs.²⁴ Simulation allows for an opportunity to provide practical information and problem-solving situations in a safe environment. Third, based on our experiences and the feedback from students, providing a simulation prior to their first OR experience gives students the confidence they need to get involved from that start of the clerkship. Simulation has been shown in the literature to increase confidence in clinical situations^{25,26} as well as comfort.²⁷⁻²⁹ While confidence does not directly translate to skill acquisition, data show that medical students who participate in simulated activities have more opportunity for actual patient experiences during a clerkship and have more confidence when performing those activities.³⁰

This simulation has been a multidisciplinary effort from its inception. The design and implementation utilized experts in the fields of surgery, nursing, surgical technology, and simulation. Using expertise from multiple disciplines has directly contributed to the ability to meet the stated objectives. Overall, students found the simulation contributed positively to their preparation for the OR environment and to their perceived comfort.

This simulation has evolved over time based on student feedback and the needs of the surgery clerkship. The simulation initially involved a suturing task during the operation phase of the simulation. This was found to be time-consuming and distracted from the learning objectives. This was subsequently removed from the simulation and taught in a freestanding session. Consequently, more time was allotted for teaching about sharps safety, instrument passing, and the challenges involving incorrect antibiotics and incorrect instrument count, as these were felt to be areas of potential error in the OR environment. This improved the flow of the case and kept students more engaged throughout the simulation.

Challenges and Limitations

An exercise of this size is not without challenges. Recruiting discipline-appropriate actors is the most frequently encountered difficulty. It is important for the purposes of fidelity to have individuals who work in the roles they are assigned. This simulation ideally requires professionals who usually have a number of simultaneous clinical priorities and we budget 3 hours for this simulation. In order to work through these challenges, there are occasions where clinically trained staff are substituted. The actors are given an overview, a script, and a list of critical action points to follow during the simulation.

This simulation is limited in its time and scope. The objective is not to be an all-encompassing orientation to the surgical environment, rather an opportunity to ensure the students can participate effectively in the sign-in and time-out in the OR, maintain sterility of themselves and the surgical field, and learn ways to become active participants in routine patient care while in the OR. Intentionally, students are not taught advanced surgical instrumentation or techniques, as this may reflect a level of learning above that of a third-year medical student. This simulation could be expanded to include these objectives. However, given existing time constraints, experiences outside of those stated above are not covered during this session.

Components of this educational experience may be specific to our institution. While the sign-in procedure is a relatively universal concept in surgical patient safety, the specific language and process that is covered in this session may be institution specific. Additionally, our case has been constructed to allow students to simulate the specific tasks they are likely to assist with during OR care leading up to the initial incision. These permissible actions may differ with various institutional standards and we encourage anyone who adapts this simulation to include institution-specific items, ensuring congruence with curriculum and hospital-specific objectives for the learners.

The simulation as described is designed to be implemented at the beginning of the clerkship. This may

raise challenges for programs who use shorter clerkships and need to maximize the time students spend in the clinical environment. While this approach has worked well for our needs, this simulation could similarly be implemented prior to the start of the clinical rotations. This preclinical implementation may have an added benefit of ensuring that students on other rotations with OR experiences have uniform instruction and aren't missing out on critical information. While this alternative approach may suit the needs of some programs, we believe that our approach utilizing a just-in-time training construct³¹ has a higher impact and benefits the students by providing them the knowledge and experiences they will need just prior to assisting in the OR. Furthermore, the inclusion of this material during the preclinical years while students are highly focused on learning basic science material in preparation for module and the Board exams, may not be the optimal time to cover the material.

For those looking to adapt this simulation to help prepare students in preparation for other operative experiences, only minor changes are necessary. For example, medical students on the surgery clerkship could be replaced with medical students on an OB/GYN clerkship with a few small revisions to the patient history, mannequin, and case type. Students on an anesthesia rotation can also benefit from the case progression process that is instilled in this simulation. In addition to the process and general flow of an OR case, many skills such as maintaining a sterile field and sterile garb, participating in a timeout, and appropriate professional team dynamics are transferrable to other areas of medicine.

The use of a student survey evaluation tool provides only the student's perception of the value of the simulation exercise and cannot objectively assess actual improvements in skills or knowledge acquisition. However, the student does represent the end-user in this construct and the value they find in the experience is an important outcome despite its subjective nature.

Planned Revisions and Future Opportunities

This simulation is a continuously evolving project, with providing the best experience for students and promoting patient safety its foremost priorities. Learner feedback is critical in keeping this experience relevant to the needs of the students and is taken into account after every simulation. The simulation evaluation survey has the ability to be revised to assess more objective criteria by potentially posing questions beyond subjective experiences, including questions in knowledge acquisition and application.

The simulation has two planned revisions, one is to add a verification of proficiency for indwelling urinary catheter placement, the other is an exercise to improve efficiency in gathering data relevant to an inpatient surgical population in the electronic medical record. The opportunity to add these exercises simultaneous to the activity arises due to the desire to keep the number of students in the simulated OR at a reasonable number and use multiple simulation runs.

There are many opportunities for this simulation to be adapted to specific needs. In future work, this simulation could be used to assist in the familiarization of students to surgical attire and processes unique to specific surgical subspecialties such as orthopedic, urologic, and neurologic surgical procedures. In addition, this simulation has the ability to challenge students and residents with acute decompensation of a patient in the operating room. The ability to recognize decompensation and perform emergent procedures could be safely tested in an adapted version of this simulation.

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