Clinical Practice Simulation for Blood Transfusion Reactions: An Interprofessional Approach

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ABSTRACT

When an acute blood transfusion reaction occurs, clear communication, teamwork, and knowledge of the roles and responsibilities of each member of the healthcare team are essential. In this clinical practice simulation exercise, an interprofessional approach was used to teach appropriate recognition and response to an acute blood transfusion reaction. Students were given the opportunity to practice skills, apply knowledge, and effectively collaborate as they provided patient care. Realistic staging, interprofessional debrief sessions guided by expert faculty members, and reflective writing assignments were used to enhance the teaching-learning of this activity. Students responded very positively in their evaluations of the simulation and felt that they were better prepared to deal with a critical event and to interact with each other because of their participation in the simulation.

ABBREVIATIONS: ACNP - Acute Care Nurse Practitioner, BSN - Bachelor of Science in Nursing, BP - Blood pressure, CNA - Certified Nurse Assistant, CoN - College of Nursing, HR - Heart Rate, IPE - Interprofessional education, MLS - Medical laboratory science, RN - Registered Nurse, SBAR - Situation, Background, Assessment, Recommendation,

INDEX TERMS: Patient simulation, Medical Laboratory Science, Nursing, Interprofessional Relations, Acute Hemolytic Transfusion Reaction

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INTRODUCTION

Medical errors lead to significant morbidity and mortality among hospitalized patients.[1] Preventable adverse events caused by medical errors can be reduced through effective implementation of safety checks, standardized communication, and proper training.[2] The US Institute of Medicine recommends interprofessional education (IPE) for patient-centered, team-based care to address concerns over medical errors and to improve the overall quality of healthcare.[3,4] IPE prepares students for future team-based practice by providing an opportunity for students to gain understanding of each other's professional roles and scope of practice as they learn to work together to solve complex medical problems.[5,6]

Simulation is a teaching methodology that allows students to develop and practice skills in a safe learning

environment without risk to patients.[7-9] Simulation-based training has been extensively used in high-risk professions such as aviation, and is increasingly used in healthcare education programs with positive learning outcomes.[10-12] Simulation education reinforces a culture of safety[13] by teaching interprofessional students how to effectively communicate and collaborate as they provide patient care.[3,5,14-16]

A simulated approach was used to teach an interprofessional team of healthcare students to recognize and manage a blood transfusion reaction. Post-simulation debriefing provided students an opportunity to discuss, reflect, assess, and receive feedback on their performance.[9,17-18]

MATERIALS AND METHODS

We created a high fidelity, mannequin based, immersive scenario with realistic physical surroundings and scenario components designed to promote student engagement and learning in a simulated hospital environment. High-fidelity simulation is the creation of realism, such that it allows the student to "suspend disbelief." It is the purposeful and deliberate creation of a realistic environment, including believable patient responses to interventions. High-fidelity medical simulation was selected as a teaching methodology for its capability to provide hands-on technical skill practice as well as a realistic setting in which to practice interprofessional communication.[9,14,16]

A total of 170 students from three healthcare programs at the University of Utah participated in the IPE simulation experience over two semesters. Students from Medical Laboratory Science (MLS), Bachelor of Science in Nursing (BSN), and Acute Care Nurse Practitioner (ACNP) programs were scheduled in groups of 8-10 participants. Each IPE experience lasted two hours including pre-brief, simulation, and debrief sessions. Groups rotating through the first semester included students (n= 94) from each of the three programs when possible (Table 1). Due to the scheduling of ACNP clinical hours during the second semester, however, the ACNP role was played by a faculty member substitute when students were unavailable.

In response to recommendations from the US Institute of Medicine,[3,4] a University of Utah Health Sciences initiative prompted the development and implementation of IPE for health science students. This collaboration between the MLS program and the College of Nursing (CoN) addressed goals of understanding each other's roles and improving communication skills through implementation of a simulated transfusion scenario.

Table 1. Simulation Session Schedule: First Semester (n=94)

Day	Event	Start Time	End Time	Total Student Participants	MLS	BSN	ACNP
1	1	0800	0950	10	3	6	1
	2	1000	1150	9	2	6	1
2	3	0800	0950	9	2	6	1
	4	1000	1150	9	2	6	1
	5	1300	1450	8	2	6	0
	6	1500	1650	9	2	6	1
3	7	0800	0950	10	2	7	1
	8	1000	1150	10	2	7	1
	9	1300	1450	10	2	7	1
	10	1500	1650	10	2	7	1

Example: Event 1 Groups A and B Assignments

Group A	Group B
1 MLS plays family member in part 1 of scenario, laboratorian in part 2. 3 BSN play active roles in part 1 of scenario while Group B BSN observe.	1 MLS plays laboratorian in part 1 of scenario, family member in part 2. 3 BSN play active roles in part 2 of scenario while Group A BSN observe.
ACNP plays same role in parts 1 and 2 of scenario	

Faculty members from MLS and the CoN met biweekly for six months to plan, schedule students, write the simulation scenario, and design pre- and post-simulation activities. Laboratory values and reference intervals appropriate for the blood transfusion scenario were contributed by four faculty members from the MLS department. The scenario was reviewed by four faculty from the CoN, one faculty member from each of the University of Utah College of Pharmacy and School of Medicine, and by a University of Utah Hospital Nurse Educator. The final draft of the patient's pre-operative and post-operative clinical condition and charted information, including laboratory values, was reviewed by a physician of internal medicine. Student fees as well as program and department funds covered costs. Roll-out occurred over two years, during which teaching-learning techniques were improved, and a plan for sustainability and curriculum integration was developed.

The IPE simulation sessions occurred in the advanced preparation studio of the Intermountain Healthcare Simulation Learning Center (IHSLC) in the College of Nursing, University of Utah, Salt Lake City, Utah. This facility is a 12,600 square- foot virtual hospital used by undergraduate and graduate students as a clinical practice site for the University of Utah Health Sciences, and has a well-established operational system. Critical support systems such as space, staff, resources, and supplies are in place for implementing a successful simulation program.[19,20] A simulation technology specialist ensured the simulation room was set up correctly with necessary supplies and equipment. Equipment included a high-fidelity mannequin with capability for pre-programmed and "on the fly" physical responses to student actions and interventions.

Supplies and equipment were used for both student skill demonstration and to enhance realism through scene staging. For example, telephones were available in both the simulated patient care area and simulated laboratory space. See Table 2 for a complete list of supplies and equipment.

The simulation technology specialist operated the IT equipment and high-fidelity mannequin during the simulation, made adjustments to the setup between scenarios, and prepared the mannequin and room before and after each event. At least one faculty member from each program was present for each session. The faculty's role was to guide the technology specialist to manage the mannequin's physiological and emotional responses to student action or lack of action during the changing clinical situation.

Table 2. Supplies and Equipment

Simulated patient care area
Personal protective equipment
Laboratory test and blood product order forms
Emesis basin with simulated emesis
Blood administration tubing
I.V. pumps
Simulated urine
Catheter and urine bag
Telephone
Simulated laboratory
Personal protective equipment
Refrigerator for simulated donor blood products
Cross-match tags
Patient history files
Reagent antisera
Hemagglutinin viewer
Microscope
Tube racks
Phlebotomy equipment
Telephone

Faculty from each program developed individualized pre-work for the students, carefully designed to allow for experiential learning. This outcome was achieved by adequately preparing the students for the scenario without disclosing the events of the scenario itself. Although the pre-work was tailored to meet the unique needs of each program of study, some material was assigned to all students to provide a common background of basic concepts. For example, all students received materials on blood transfusions. In addition, all students viewed pre-recorded videos of end-of-shift reports for RNs, ACNPs, and MLS personnel that included appropriate information regarding the patient's condition. Examples of pre-work designed to meet individual program needs included:

- BSN students given information on post-operative sepsis and pulmonary emboli,
- ACNP students asked to create a set of orders for a new post-operative patient,
- MLS students given a complete set of the patient's pre-operative and post-operative laboratory values and asked to correlate them with the patient's current clinical presentation.

The Simulation Experience

During a 30 minute pre-briefing period, inter-professional learning objectives were addressed by asking the students to summarize their respective program of study and describe the scope of their professional practice. The students were then divided into groups for a simple and enjoyable team-work activity, followed by a faculty-led debriefing that reinforced communication skills to enhance teamwork.

After the team-work activity, the learning objectives (Table 3) of the simulation experience originally introduced in the pre-work were reintroduced, and students were given an opportunity to ask questions regarding the pre-work, the patient's condition, and patient chart information. In order to promote practice of clinical reasoning skills, the cognitive learning objective of recognizing a critical event was not revealed to students until the conclusion of the second scenario. Roles appropriate to each student's discipline were assigned (Table 4). Because of the large BSN to MLS ratio, the BSN students were divided into two groups: "Group A" actively participated in Scenario 1 while "Group B" observed from the debrief room, and then "Group B" was given the opportunity to play the active roles in Scenario 2 while "Group A" observed their performance. Thus, each BSN student was provided opportunities to play a role and to observe.

Table 3. Learning Objectives

Domain	The student will:
Cognitive	Recognize signs and symptoms of a transfusion reaction.[a] Display appropriate clinical decision making skill. Display effective communication and leadership skill.
Psychomotor	Perform patient care within the scope of the student's professional role. Demonstrate safe, effective, and high quality patient care.
Affective	Demonstrate therapeutic communication with the patient and patient's family.

[a]This learning objective is not made known to the student until the conclusion of Scenario 2.

Scenario 1 begins with the patient complaining of nausea. The family member expresses concern while the patient is being assessed. Within a few minutes, the patient appears to have vomited blood. This in addition to the patient's post-operative hemoglobin level, decreasing blood pressure and increasing heart rate, prompts the ACNP to order a STAT CBC and to call the laboratory. The MLS student in the laboratory responds to the phone request for the blood draw, positively identifies the patient, and identifies an appropriate site to perform phlebotomy. Within minutes, the ACNP recognizes that the turnaround time for the STAT CBC is anticipated to take longer than what the patient's current clinical situation permits in terms of hemodynamic support, and orders a unit of blood (crossmatched prior to the patient's surgery) to be dispensed from the blood bank.

Table 4. Student Roles and Assumptions

ACNP Students

You have completed all of your training and are the primary care provider for this patient.

MLS Students

1st MLS: You have completed all of your training and will work in the clinical laboratory.

2nd MLS: You will act in the role of the patient's family member (confederate).

BSN Students

CNA: You are an experienced and high functioning CNA. You will support the floor nurse in caring for the patient within your scope of practice.

Staff Nurse: You have recently passed the NCLEX exam (RN licensing exam) and have full privileges to act in the role of a Registered Nurse. This is your only patient right now.

Charge Nurse: This is a busy floor with medical, surgical, and orthopedic patients. You have a highly experienced staff.

Observer(s): Note how effective or disruptive the experience was for you. Your observations will be recorded individually and be made available for review during the debrief.

The first scenario ends once the simulated donor blood is brought into the patient's room and is immediately followed by a debrief session. After the first debriefing Scenario 2 begins, resuming where Scenario 1 ends. The donor blood bag and crossmatch checks are performed at the patient's bedside. The unit of blood is hung and the transfusion is begun. The patient starts exhibiting signs of an acute hemolytic transfusion reaction. This prompts the nursing students to immediately stop the transfusion and contact the laboratory. The MLS student in the laboratory advises the nursing students regarding the protocol and requirements of the post-transfusion reaction investigation. This action concludes Scenario 2. A final debrief session is conducted to conclude the simulation session.

Debrief sessions generally last twice as long as the scenario. Some questions used in both debrief sessions (Table 5) are developed specifically to address the learning objectives of the simulation experience, while other questions are "customized" at the discretion of the faculty in response to specific actions of the participants. A conversational technique known as "debriefing with good judgment" is employed in the debrief session to clearly and directly assess and instruct the students in a nonthreatening environment and to reduce defensiveness on behalf of the student.[17]

The students' understanding of key concepts is assessed by faculty through discussion in the pre- and post-simulation debriefings. In addition to faculty members, student colleagues (those who were not participating in a scenario) observed the simulation scenario and provided feedback to scenario participants during the debriefing sessions.[21] At the conclusion of the simulation the students are given a writing assignment to self-reflect and summarize the experience.

The participants evaluate their satisfaction with the experience and the effectiveness of the teaching-learning by completing a short survey with a Likert scale rating and open-ended questions. Following each session, after the participants are dismissed, faculty members immediately review the evaluations and debrief the learning experience together.

RESULTS

The following observations of MLS students were most frequently noted as areas of strength: positive patient identification prior to phlebotomy, correct specimen labeling procedures, verification of the patient's transfusion history prior to dispensing blood products, correct read-back procedure of cross-matched blood, and correct interpretation of the transfusion reaction. The following items were noted as areas of weakness: initial hesitancy to enter the patient's room to perform the blood draw, knowledge of the correct order of specimen tubes to draw, proper reporting of critical laboratory values using the SBAR (Situation, Background, Assessment, and Recommendation) technique, appropriate read-back procedure to verify reported information, and failure to document notification of the critical value.

Table 5. Debrief Questions Form

General:
- What went well?
- Can someone give me a quick summary?
- What did you observe during the simulation?

Objective: Display appropriate clinical decision making skill.
- Describe your comfort level in managing this situation.
- Describe the specific clinical decisions you had to make.
- Discuss how you obtained the information needed to make decisions.

Objective: Display effective communication and leadership skill.
- Was communication clear?
- Describe some of the effective communication techniques used with the patient, family member, and other team members.
- Did you get the information you needed in a timely and organized fashion?
- Who was the leader? How could you identify the leader? How was that decided? Did that change?
- How did the leader and team members respond to feedback?
- Discuss with one another how you collaborated.
- When did you see delegation occur? Was the delegation appropriate? Why or why not?

Objective: Perform patient care within the scope of the student's professional role.
- How did each member contribute to the management of the situation?
- What did you learn about one another's roles?
- What did you learn about your role in the team?
- How does this experience transfer into your future practice?

Objective: Demonstrate safe, effective, and high quality patient care.
- How did you know you needed help?
- Discuss specific safety considerations in this case.
- What immediate actions were taken?
- Describe the process of obtaining blood products and ensuring their safety for administration.
- Were all the steps and precautions made to provide safe patient care?
- Did you notice anything that had potential for error? What safeguard could be put into place to prevent a potential for error?

Objective: Demonstrate therapeutic communication with the patient and patient's family.
- Who supported the family member and patient? Why did this individual take on that role?
- Describe the feelings you had dealing with this patient's emotional and educational needs.
- Imagine yourself as the patient or family member. Do you feel your needs would have been met as played out in this scenario?

Final Question: How might this experience transfer into your future practice?

The BSN students demonstrated quick recognition of the patient's condition and followed up with strong SBAR communications to the ACNP. Initially, the students communicated in a therapeutic way with the patient and family members, but as the intensity of the clinical situation increased, those communications happened less frequently, most notably with the family member. Faculty communicated through the mannequin and with the family member portrayed by a student, using an earpiece, to encourage questions that required responses from the BSN students. Limitations demonstrated by the BSN students included: inadequate skill in setting up blood tubing correctly, unfamiliarity with policies and procedures for securing donor blood and uncertainty of post-transfusion reaction steps.

An interesting observation made of the BSN and ACNP students was a blurring of roles. In one instance, one of the less confident BSN students was having difficulty setting up the blood tubing. Seeing the difficulty, the ACNP, who was in the room, took over setting up the blood tubing. From that point on, the BSN student consistently took directions from the ACNP even when the action was part of the RN's role. Faculty corrective actions to prevent this included: revision of pre-work, having the ACNP student respond on the phone rather than in person, and faculty acting as a unit educator to assist with any perceived lack of skills of the BSN student.

The response of the ACNP student depended on the student's prior nursing experience. Students with limited critical nursing experience were hesitant to assume the ACNP role; however, most of the students identified the problems and ordered the appropriate medical therapy.

Overall, evaluation indicated that the simulation experience was well received by students in each of the programs. Student ratings suggested that the experience effectively increased their understanding of interdisciplinary communication, each other's roles, importance of interprofessional collaboration, and sound clinical-decision making (Figure 1).

Lessons Learned

One of the lessons we learned was the importance of anticipating and planning for times when the scenario may not go as intended. Dieckmann, et al. presents the notion of "scenario life saver" as a strategy for how and when to alter the scenario so that learning is facilitated.[22] During the progression of the scenario, it became clear that we had not anticipated a wide variation of skill in the mechanics of setting up a blood transfusion. Some students displayed an "unexpected action" of setting up the blood administration tubing so that simulated blood flowed into the normal saline bag rather than into the patient. This delayed the progression of the scenario and required correction so the objectives of the simulation session could be realized. The corrective action was in the form of a faculty member acting as the "unit nurse educator," who noticed the problem and helped the BSN to manage the situation. Additionally, faculty took action to adjust the pre-work to include review of the proper procedure for hanging blood. An extra 30-minute buffer was included in scheduling each scenario in order to accommodate for the unexpected.

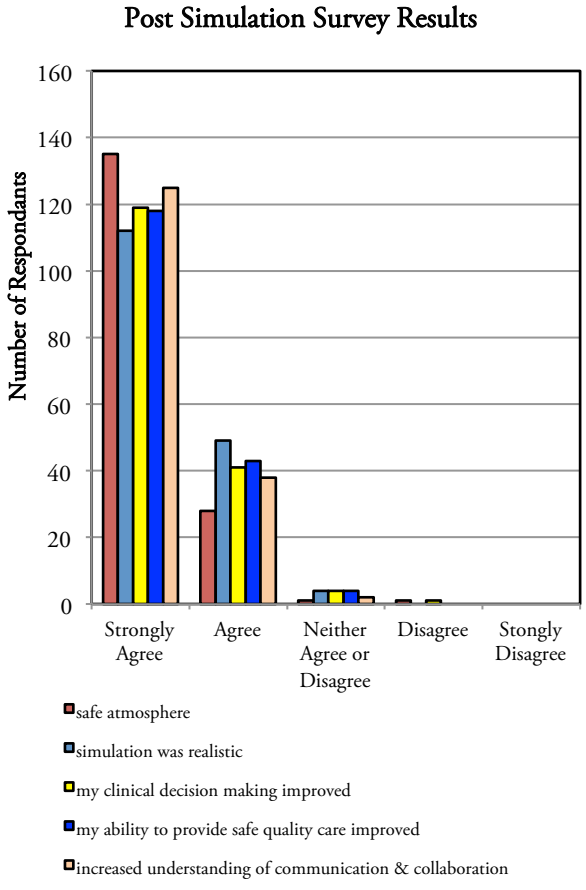

Figure 1. Significant results (5 of 17 items) from students who completed the evaluation; n=165 of 170. Evaluation return rate = 97.1%.

The second lesson learned was that students came to the experience with little prior understanding of the individual contributions of each discipline to clinical outcomes. As previously mentioned, part of the pre-scenario activities included students reviewing their education and scope of practice as well as participating in a short team "ice breaker" activity; the intent of these activities was to help them to understand one another's roles and responsibility and to initiate the teamwork process. Although it was successful as an introduction, we realized that we needed to devote more time and focus to those activities in order to add more depth to their understanding of each other.

Interprofessional experiences present several logistical challenges. Scheduling students, faculty, space, and resources is one of the greatest challenges to overcome when planning simulation.[20] Scheduling the scenarios to accommodate students from each of the participating programs of study is a challenge because of limitations in the availability of students and faculty, the use of the IHSLC, and determining the correct point in the curricula when all students have developed sufficient knowledge and skills required by the simulation.

Developing the scenario in such a way that all students feel engaged was a priority. The imbalance between the number of BSN, MLS, and ACNP students required that we clearly construct the activities, roles, and expectations for each. The plans include: utilizing observers, having students switch roles in the second scenario, and refining pre-scenario instruction concerning their role as ACNP, charge nurse, CNA, RN, or MLS.

Finally, our last, and perhaps most important lesson was that we found the interprofessional learning activity had increased all of the students' awareness of an area of healthcare delivery that they had not experienced before. The MLS students indicated they had never seen what occurs at the patient's bedside after the donor blood leaves the laboratory and the nursing students gained awareness of the time and safeguards involved in the preparation of blood products. The experience allowed our students to learn a great deal about one another's roles, the complexity of a critical event; the depth of knowledge, skill, and abilities that each team member brings to the situation, and how we can best work together to keep our patients safe.

DISCUSSION

In recent years, IPE has moved to the forefront of innovative approaches to medical education. Although ongoing research is needed to determine if simulation-based training and IPE in healthcare education transfers to an actual clinical setting and improves[22] the quality of patient care and professional communication,[3] it has been suggested that IPE should be a core element of the next generation of patient safety curriculum for all health science schools.[15]

Steps that protect patient safety during the pre-analytical, analytical, and post-analytical phases of compatibility testing and blood transfusion are of utmost concern. Traditionally, the pre-transfusion phases involving specimen collection and testing have not been emphasized within the nursing curriculum. Likewise, the administration and monitoring of a blood transfusion have not been previously demonstrated to MLS students. These two key factors were addressed in our scenario and provided opportunities for participant discussion and interprofessional learning. Several key communication points were written into the scenario that required the participants to draw upon their understanding of each other's roles, utilize each other's knowledge and training as resources, correctly perform procedures, and communicate safely and effectively in order to protect the safety of the patient. If interprofessional understanding and cooperation are emphasized and integrated into professional healthcare education programs, the division among healthcare disciplines may decrease with greater awareness of each other's roles.

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