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Postoperative Handoff Communication: A Simulation-Based Training Method

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DEMOGRAPHICS

Module Title: Postoperative Handoff Communication

Scenario Names: Scenario 1: Postoperative Arterial Switch Handoff Communication

Scenario 2: Postoperative Atrioventricular Septal Defect Repair Handoff Communication

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Simulator: Neonatal High-Fidelity Simulator

Date of Development: June 2008 to February 2009

Learners:

1. Pediatric Intensive Care Unit (PICU) physicians (attending physicians and/or fellows)
2. PICU nurse practitioners
3. PICU bedside nurses
4. PICU respiratory therapists

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CURRICULAR INFORMATION

Educational Rationale

Inadequate communication and information availability are root causes of serious adverse events in hospitalized patients.[1] Handoff communication during the transition of care from one set of providers to another represents a point of vulnerability where valuable information can be distorted or omitted. The Joint Commission has endorsed improving handoff communication as a Patient Safety Goal.[2]

The transition of care of children from the operating room to the PICU represents a high-risk period where timely and accurate handoff communication is important.[3] The handoff of a pediatric postoperative cardiac surgery patient may be particularly prone to error due to high complexity and acuity.[4] Investigators have applied high-fidelity simulation to assess communication domains such as team training and decision making,[5-8] but there are no published data regarding the application of simulation to study handoff communication. The primary goal of these scenarios was to learn and practice techniques for accurate and efficient handoff communication for a high-acuity patient.

Learning Objectives

Primary—Handoff Communication

1. Listen effectively to handoff communication while managing a high-acuity patient.
2. Recognize the importance of halting communication to address patient care.
3. Apply closed loop communication techniques such as read back to verify communicated information.
4. Clarify unclear elements of information transfer by asking appropriate questions.
5. Synthesize and summarize the information included in the handoff.
6. Recognize and minimize nonessential distractions and interruptions.

Secondary—Medical Knowledge

1. Identify potential causes and therapeutic plans for vital sign changes and hemodynamic alterations after cardiac surgery.
2. Identify the procedure-specific complications and treatment options for arterial switch and atrioventricular septal defect repairs after cardiac surgery.

PREPARATION

Case Development and Training

A human factors expert from the Duke Human Simulation and Patient Safety Center assisted in developing the core concepts and design of the scenarios. Cases were modeled after actual patients cared for in the Duke Pediatric Cardiac Intensive Care Unit. The handoff content, sequence of simulator states, and possible responses to participant interventions were developed with input from faculty in pediatric cardiac surgery, pediatric cardiac anesthesiology, and pediatric intensive care.

Two actors were hired as confederates to represent cardiac surgeons and anesthesiologists in these scenarios. They were familiar with role-playing as patients in simulation but had limited experience performing as physicians. The facilitators conducted three separate hour-long training sessions with an emphasis on pace, vocabulary, pronunciation, and tone of their presentations. The facilitators and actors also participated in a dress rehearsal before the actual simulations.

Participants and Teams

Scenario participants were members of the multidisciplinary team in the PICU. Providers were organized into teams consisting of a critical care physician or nurse practitioner as team leader, nurses, and respiratory therapists.

Scenario Progression

Approximately 60 to 75 minutes were required for each scenario: 30 minutes for setup, 15 minutes for the actual simulation, and 15 to 30 minutes for debriefing. Each scenario was divided into four sections: the simulator setup, the case stem, the handoff content, and the patient states. The simulator setup was completed before beginning the simulations.

The facilitator relayed the case stem to the team before the simulation began. The stem was provided to reflect the fact that an intensive care unit team usually knows a small amount of information about a patient before he or she arrives from the operating room.

During the simulation, a confederate representing the pediatric cardiac surgeon and pediatric cardiac anesthesiologist from the operating room relayed the handoff content to the recipients from a written script. A facilitator (J.G.C.) assisted the confederate as necessary with timing, prompting, and questions from participants. Simultaneously, a second facilitator (D.A.T.) operated the simulator through the different patient states as listed in Tables 1 and 2. A third facilitator (K.P.M.) assisted with data collection and observation. If participants interrupted the handoff to address patient care, the confederate stopped presenting the information. He/she then asked the team leader at 1-minute intervals if the team was ready to resume the handoff. Once the team leader agreed, the confederate resumed communication. Multiple interruptions were possible. Once the confederate proceeded through the entire handoff and all the information had been relayed, he/she asked whether participants had any questions or needed clarification regarding the handoff. If the answer to the question was not in the handoff content, the confederate said that the question would be addressed later.

Afterward, the simulation facilitators led subjects through the debriefing discussion points.

Equipment Needed

- Stethoscope
- Blood pressure cuff
- Electrocardiogram electrodes and cable

- Pulse oximeter
- Pacemaker with pacing wires
- Peripheral intravenous catheters (×2)
- 4.0-French/5.0-cm central venous line
- Laryngoscope and endotracheal tubes
- Ventilator and tubing
- Chest tube and chest drainage system
- Laboratory work specimen tubes, including an arterial blood gas syringe
- Medications in syringes
  - Normal saline
  - Epinephrine (10 μg/mL)
  - Calcium gluconate (100 mg/mL)
  - Sodium bicarbonate
  - Fentanyl
  - Midazolam
  - Vecuronium

1. Infusion pump (×3) or a multichannel pump
2. Infusions (two normal saline bags with tubing)
   - Epinephrine
   - Nitroprusside

SCENARIO 1: POSTOPERATIVE ARTERIAL SWITCH HANDOFF COMMUNICATION

Simulator Setup

- 4.0-mm cuffed endotracheal tube taped at 11 cm at the lips
- One left 20-French pleural chest tube and one right 16-French pleural chest tube
- Two atrial pacing wires and two ventricular pacing wires
- Pacemaker attached but turned off
- 4-French/5-cm right internal jugular central venous line
- One peripheral intravenous catheter in right antecubital space
- One peripheral intravenous catheter in left antecubital space
- Posterior tibial arterial line

- Pulse oximeter

Case Stem

You are called to the room where a patient will arrive momentarily after undergoing cardiac surgery. Thirty minutes ago, the anesthesiologist called the primary nurse and relayed the following information to the accepting team: “The patient’s name is Diaz. He is a 4 kg 9 day old who has just undergone an arterial switch for transposition of the great arteries. He is intubated and on epinephrine and nitroprusside. He has an internal jugular catheter, two peripheral intravenous catheters, and a peripheral arterial line.”

Handoff Content

Jorge Diaz is a 4-kg, 9-day-old male with transposition of the great arteries now status after an arterial switch operation. Intraoperative issues included difficulty with mobilization and implantation of the coronary vessels and hypoxia necessitating increased FiO_2 on the ventilator. After chest closure, he had more chest tube output than expected. The postoperative echocardiogram showed a dilated and hypertrophied right ventricle with normal function, a dilated left ventricle with mildly decreased systolic function, mild mitral insufficiency, and no residual atrial septal defect. His chest is closed. Thirty minutes ago, he received 200 mg of cefuroxime. Twenty minutes ago, he received 3 μg/kg of fentanyl and 0.3 mg/kg of midazolam for sedation and analgesia.

His past medical history includes the following:

- Transposition of the great arteries with a restrictive atrial septal defect, status after balloon septostomy on day of life zero
- Persistent right upper lobe lung collapse
- Current medications: none
- Allergies: allergic to tape, which causes a rash

States

For states of scenario 1, see Table 1.

SCENARIO 2: POSTOPERATIVE ATRIOVENTRICULAR SEPTAL DEFECT REPAIR HANDOFF COMMUNICATION

Simulator Setup

- 3.5-mm cuffed endotracheal tube taped at 12 cm at the lips
- Two atrial pacing wires and two ventricular pacing wires
- Pacemaker attached but turned off
- One left 16-French pleural chest tube and one right 20-French pleural chest tube
- 4-French/5-cm right internal jugular central venous line
- Peripheral intravenous catheter in left antecubital fossa

- Right radial arterial line
- Pulse oximeter

Case Stem

You are called to the room where a patient will momentarily arrive after undergoing cardiac surgery. Thirty minutes ago, the anesthesiologist called the primary nurse and relayed the following information to the accepting team: "The patient's name is Bowman. She is a 6 kg 4 month old who has just undergone an atrioventricular septal defect (AVSD) repair. She is intubated and on dopamine, epinephrine, and nitroprusside. For access, she has an internal jugular catheter, one peripheral intravenous catheter, and a peripheral arterial line."

Handoff Content

Tracy Bowman is a 6-kg, 4-month-old female who underwent an AVSD repair today. Intraoperatively, she had a junctional rhythm at approximately 200 beats per minute that resolved with sedation. She also had slightly elevated blood pressures during the case. Her postoperative echocardiogram showed a left atrioventricular valve with mild regurgitation and mild stenosis; her right atrioventricular valve had trivial insufficiency; and there was good function bilaterally. Her chest is closed. Fifteen minutes ago, she received 90 mg of vancomycin. Ten minutes ago, she received 2 μg/kg of fentanyl for analgesia and sedation. She also received an additional 2 μg/kg of fentanyl and 0.1 mg/kg of midazolam four times since coming off bypass.

Her past medical history includes the following:

- Trisomy 21
- AVSD with mild pulmonary hypertension and mild congestive heart failure
- Hypothyroidism
- Urinary tract infection treated with amoxicillin that finished 2 days ago
- Current medications: omeprazole, digoxin, and furosemide
- Allergies: cephalosporins, which cause a rash

States

For the states of scenario 2, see Table 2.

DEBRIEFINGS

We conducted a debriefing after each simulation focusing on the following debriefing discussion points:

- Dividing attention between handoff communication and essential patient care.
- Strategies to address and clarify unclear communication between team members.
- Interruptions and distractions during handoff communication and techniques to address them.

- Teamwork during a complex handoff.
- Realism and educational value of practicing handoff communication in simulation.

In general, senior physicians, staff nurses, and respiratory therapists endorsed the educational value of the scenarios, whereas junior faculty and staff remarked on the value of delineating team roles and practicing hierarchical communication in a simulated environment. Representative comments from participants are listed in Table 3.

LESSONS LEARNED

We learned a number of important lessons while applying this methodology. First, a multidisciplinary team of intensive care unit faculty and staff is necessary to both maintain realism and recreate group dynamics during a complex handoff. We suggest that each team of participants consist of at least a critical care physician or nurse practitioner as team leader, two to four bedside nurses, and one respiratory therapist. Facilitators may vary team composition to reflect the typical group who receives a cardiac surgery patient from the operating room at their institution.

Second, we chose actors to deliver information to limit variations in handoff reporting at the discretion of the facilitators to achieve specific educational goals and objectives. Although actors did provide the necessary consistency, seeking ones familiar with medical terminology and acting experience as medical providers would have saved time in the preparation and development phase of this initiative and also could have potentially made the scenarios more realistic. We considered utilizing actual surgeons and anesthesiologists instead, but their availability was considerably more limited. A third option involves recruiting medical students, residents, or other health care providers interested in participating in educational and research initiatives. This approach would likely decrease preparation time and benefit realism and is a potential method for future investigations.

Third, dress rehearsals are essential not only to train confederates but also to accustom facilitators to their duties. It took approximately three sessions to ensure that the timing and technical aspects of the simulations would proceed smoothly. Although we found that we were able to conduct these simulations with two facilitators, a third facilitator was instrumental for data collection. An alternative to additional personnel would be video documentation of the simulations with retrospective review of the taped scenarios.

Finally, the benefits of in situ simulation in our project versus simulation in a dedicated center must be considered. The benefits and drawbacks of this issue are beyond the scope of this report, but the location of the simulated experience is an important matter.

These issues represent important practical details that we learned during the development and implementation of this project. We hope that these suggestions will advance the study of handoff communication in simulation.

CONCLUSIONS

These novel cases describe a method to simulate postoperative handoff communication in a controlled setting. Such simulations are important for practicing handoff techniques and educating the multidisciplinary team in communication, teamwork and a wide range of other topics in a protected environment. In addition, scenarios of this nature may also be applied for research and quality improvement. As we continue to advance the field of simulation, systematic analysis of the impact of these initiatives is crucial to improve patient safety and clinical outcomes.

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Table 1.

States for Scenario 1: Postoperative Arterial Switch Handoff Communication

State	Patient Status	Learner Action	
Called to room	• In ICU room, on bed, supine, sedated • VS: sinus rhythm with HR 160, RR 28, BP 75/55 (arterial line), 70/50 (cuff), SpO_2 99%, $ETco_2$ 40 mmHg, CVP 7 cm H_2O • Ventilation: PSIMV: rate 28, PiP 23 cm H_2O, PEEP 5 cm H_2O, FiO_2 100% • Infusions: epinephrine 0.03 μgkg^{-1} min^{-1}, nitroprusside 1 μgkg^{-1} min^{-1}	• Attaches patient to ECG monitor, pulse oximeter, and BP cuff • Attaches patient lines to CVP transducer and a-line transducer • Attaches ETT to ventilator tubing	Trigger to enter state: • Start of session
Hypertension	• BP rises to 120/70 (arterial line) over 1 min	• Notes hypertension • Administers sedation • Increases nitroprusside • Decreases epinephrine	Operator: • Patient is hypertensive secondary to pain • If sedation is administered, BP returns to 75/55 • If nitroprusside infusion rate is increased or epinephrine is decreased, BP decreases to 40/25 and HR increases to 190 Trigger to enter state: • Simulation time 1:30 min Teaching points: • Recognition and considerations for etiology of postoperative hypertension • Acute management of hypertension secondary to pain
Hypoxia	• SpO_2 decreases to 82% over 2 min	• Notes hypoxia • Increases FiO_2 on ventilator • Increases PiP or PEEP on ventilator • Disconnects patient from ventilator and attempts BMV	Operator: • Patient is hypoxic due to right upper lobe lung collapse • If FiO_2, PiP, or PEEP are increased, or if BMV is initiated, SpO_2 increases to >95% over 30 s Trigger to enter state: • Simulation time 3:30 min Teaching points: • Recognition of and considerations for etiology of hypoxia • Acute management of lung collapse in an intubated patient • Applying information provided during handoff communication in the acute management of the post-operative patient
Hypotension	• BP decreases to 40/25 and CVP decreases to 5 cm H_2O over 1 min	• Notes hypotension • Administers volume • Decreases nitroprusside • Increases epinephrine • Administers calcium	Operator: • Patient is hypotensive secondary to continued blood loss • If volume is administered, BP increases to 75/55 and CVP increases to 7 over 30 s • If nitroprusside is turned off, epinephrine is increased, or calcium is administered, state remains unchanged Trigger to enter state: • Simulation time 5:00 min Teaching points: • Recognition and considerations for etiologies for postoperative hypotension • Acute management of decreased preload • Applying information provided during handoff communication in the acute management of the postoperative patient

Fio_2 indicates fraction of inspired oxygen.

VS, vital signs; HR, heart rate; RR, respiratory rate; BP, blood pressure; SpO_2, saturation of oxygen by pulse oximetry; $ETCO_2$, end-tidal carbon dioxide; CVP, central venous pressure; PSIMV, synchronized intermittent mandatory ventilation, pressure limited; PiP, peak inspiratory pressure; PEEP, positive end-expiratory pressure; FiO_2, fraction of inspired oxygen; ECG, electrocardiogram; a-line, arterial line; ETT, endotracheal tube; BMV, bag-mask ventilation; JET, junctional ectopic tachycardia.

Table 2.

States for Scenario 2: Postoperative Atrioventricular Septal Defect Repair Handoff Communication

State	Patient Status	Learner Action	
Called to room	• In ICU room, on bed, supine, sedated • VS: Sinus rhythm, HR 130, RR 20, BP 71/50 (arterial line), 75/50 (cuff), SpO_2 99%, $ETco_2$ 40 mm Hg, CVP 12 cm H_2O • Ventilator: PSIMV rate 20, PiP 25 cm H_2O, PEEP 5 cm H_2O, FiO_2 40% • Infusions: epinephrine 0.02 $\mu g kg^{-1} min^{-1}$, nitroprusside 1 $\mu g kg^{-1} min^{-1}$	• Attaches patient to ECG monitor, pulse oximeter, and BP cuff • Attaches patient lines to CVP transducer, a-line transducer • Attaches ETT to ventilator tubing	Trigger to enter state: • Start of session
Hypoxia	• SpO_2 decreases to 85% over 1 min	• Notes hypoxia • Increases FiO_2 on ventilator • Administers sedation/ paralysis • Increases PiP or PEEP	Operator: • Patient is hypoxic secondary to pulmonary hypertension • If FiO_2 is increased or sedation/paralysis is administered, SpO_2 increases to 95% over 1 min • IfPiP/PEEP are manipulated, state remains unchanged Trigger to enter state: • Simulation time 1:30 min Teaching points: • Recognition and differential diagnosis for hypoxia in the postoperative patient • Acute management of pulmonary hypertension in an intubated patient • Applying information provided during handoff communication in the acute management of the postoperative patient
Tachycardia	• Rhythm changes to supraventricular tachycardia; HR suddenly increases to 205	• Notes tachycardia • Administers sedation • Decreases epinephrine • Administers volume • Attempts to overdrive pace	Operator: • Patient is tachycardic secondary to junctional ectopic tachycardia (JET) • If sedation is administered or epinephrine is decreased, JET resolves and HR returns to 130 over 30 s • If volume is administered, state remains unchanged • If pacemaker turned on, HR remains unchanged (unable to capture) Trigger to enter state: • Simulation time 3:00 min Teaching points: • Recognition and differential diagnosis for postoperative tachycardia • Acute management of JET • Applying information provided during handoff communication in the acute management of the postoperative patient
Hypotension	• BP decreases to 40/25 over 2 min; CVP remains at 12 cm H_2O	• Notes hypotension • Decreases nitroprusside • Increases epinephrine • Administers calcium • Administers volume • Orders echocardiogram	Operator: • Patient is hypotensive secondary to diastolic dysfunction and decreased contractility • If nitroprusside is decreased, epinephrine is increased, or calcium is administered, BP increases to 71/50 • If volume is administered, BP remains unchanged and CVP rises to 14 • If echocardiogram is ordered, report suggests minimal pericardial effusion Trigger to enter state: • Simulation time 5:00 min Teaching points: • Recognition and differential diagnosis for postoperative hypotension • Acute management of decreased contractility

FiO_2 indicates fraction of inspired oxygen.

VS, vital signs; HR, heart rate; RR, respiratory rate; BP, blood pressure; SpO_2, saturation of oxygen by pulse oximetry; $ETCO_2$, end-tidal carbon dioxide; CVP, central venous pressure; PSIMV, synchronized intermittent mandatory ventilation, pressure limited; PiP, peak inspiratory pressure; PEEP, positive end-expiratory pressure; FiO_2, fraction of inspired oxygen; ECG, electrocardiogram; a-line, arterial line; ETT, endotracheal tube; BMV, bag-mask ventilation; JET, junctional ectopic tachycardia.

Table 3.

Representative Comments Received During Debriefings

Domain	Examples
Dividing attention	Attending: "You realize how much multitasking you're trying to do when you're listening. You literally have 3 other perceived obligations during that time."
Handoff roles	Nurse: "It would be better with assigning roles for nurses. Then you can get in there and start doing things." Nurse: "As the primary nurse, I trust who I pick to do things while I'm writing things down."
Communication hierarchy	Nurse: "I don't feel as comfortable saying, You're a surgeon, you need to stop talking right now." Nurse: "It's the status, the age, the experience."
Distractions	Attending: "It makes you aware of how noisy the handoffs are in real life. Usually it's a madhouse with pagers and overhead announcements … There's minutes, huge sections of time, when I wasn't listening."
Realism	Nurse: "I thought the scenario was similar to a kid coming back who was fairly unstable when he arrives." Nurse: "It was pretty consistent. The patient acuity was about right."
Education/practice	Fellow: "As far as practicing your ability, it was about as heavy as you could get." Respiratory therapist: "It was great. It was a lot more fun than I thought it was going to be."