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Northwest Simulation Center—Sharpens Clinical and Communication Skills for Individuals and Teams

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Abstract

Many authorities have suggested that some variant of team training is likely to reduce human error in operating rooms, Emergency Departments, resuscitation teams and other settings within health care—where human interaction is common, and where breakdowns in communication and teamwork can have critical consequences. The Kaiser Sunnyside Medical Center Regional Simulation Center achieves this end. In particular, simulation prepares people for error-prone, high-risk, or unusual situations. Here, we will cite several scenarios and two actual protocols; five principles for managing critical events; results (2006 People Pulse favorability, 2007-2008 postsimulation survey favorability); Kaiser Permanente Northwest departments trained; strategic initiatives supported including service internalization; collaboration with local and regional community programs; and process transferability.

Introduction

Many authorities have suggested that some variant of team training is likely to reduce human error in operating rooms, Emergency Departments (ED), resuscitation teams and other settings within health care—where human interaction is common, and where breakdowns in communication and teamwork can have critical consequences.[1] These authorities cite the work done in aviation's crew-resource management; recommendations made by the Institute of Medicine's landmark report, *To Err is Human: Building a Safer Healthcare System,*[2] released in 2000; and the Joint Commission's comprehensive Patient Safety Plan.[1] Because of the success of the Kaiser Permanente Northwest (KPNW) Region's Perinatal Patient Safety Project[a] in training teams in standard communication—how to respond in critical patient events—and the need to practice these situations in a controlled environment, Kaiser Sunnyside Medical Center (KSMC) leadership approved and created a Regional Simulation Center (RSC). Here multidisciplinary teams sharpen their clinical and communication skills and practice managing escalating scenarios such as: mock codes, infant resuscitations, and malignant hyperthermia. Team communication skills are reinforced by using human factors tools such as Situation Background Assessment and Recommendation (SBAR) and Assertion and Situational Awareness. Simulation addresses individual technical performance and important elements of teamwork—listening, leadership, communication, respect, role clarity, and Crew Resource Management (CRM). In particular, simulation prepares people for error-prone, high-risk, or unusual situations.[3]

Objectives

Preventive measures to increase patient safety are grounded in scientific literature on team training, CRM, and critical thinking.[4] Because KPNW has specifically trained individuals and teams in Human Factors communication, reliable design, and managing escalating patient events, they reduced birth-related, potentially compensable events, claims, and lawsuits between 2002–2007. KPNW meets the key objectives of simulation training—reduce medical errors and improve patient safety—by using the RSC and by adding simulation mannequins as training tools (Table 1).

Table 1. Training activities to meet objectives
Staff work together and communicate more effectively
Teams simulate and debrief high-risk events
Realistic practice for emergencies
Disciplines train together
Areas identified for improvement

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Methodology

The RSC, constructed in fall 2006 by adjoining two small conference rooms into the Sim-Lab, is coordinated by one full-time Registered Nurse (RN), (trained in simulation), one part-time RN simulation nurse educator, and one full-time trained simulation operations specialist. The RSC team work with department staff, managers, clinical experts, and educators to construct simulation scenarios relevant to individual teams. The RSC team use a four-tiered approach in reaching their objectives with staff (Figure 1).

1. *Simulation Mannequins and Clinical Scenarios:* Simulations occur on one of four simulation mannequins—SimMan, SimBaby, (Laerdal Medical, Wappinger Falls, NY; www.Laerdal.com); Birthing Mother Noelle (and fetus), wireless Newborn HAL, and wireless Adult HAL (Gaumard Scientific, Miami FL; www.gaumard.com). The simulation nurse manages the scenario from a control booth, adjusting the mannequin's change in condition dictated by the scenario and the participant's interventions. Sim Man can mimic most any condition; his heart can emit 2500 different sounds, he has bowel sounds, pulses, temperature, blood pressure and he can speak through a wireless microphone system. The other mannequins have similar functions. RSC also has an inventory of low-fidelity mannequins for task training listed on their Web site (http://internal.or.kp.org/simlab; password protected) including: airway management, Neonatal Resuscitation Program recertification, and ED technician training. RSC Simulation Scenarios in 2007 are listed in Table 2, and two actual simulation protocols are detailed in the Sample Simulation Scenario Sidebars: Malignant Hyperthermia (MH) in the Post-Anesthesia Care Unit (PACU) and Precipitous Delivery in the ED and the Neonatal Resuscitation Program. Advantages of simulation training are noted in Table 3, and five principles for managing critical events are noted in Table 4.

Table 2. RSC simulation scenarios in 2007

ACLS and BLS Codes
Medical-Surgical Adult Sepsis
Malignant Hyperthermia in the PACU
MD, RN, RT Neonatal Resuscitation Team Training
OB/GYN Hemorrhage and Code
Emergency Department Neonatal and ACLS Code
Emergency Department Pediatric Code
Acute Coronary Syndrome

ACLS = Advanced Cardiac Life Support; BLS= Basic Life Support; PACU = Post Anesthesia Care Unit

Table 3. Advantages of simulation training [1]

Presentation of uncommon but critical scenarios in which a rapid response is needed, and where there are few means other than simulation to conduct systematic training to manage such critical events (eg, malignant hyperthermia, which occurs in every 40,000 anesthesia cases).
Errors are allowed and reach their conclusion so participants can see the results of their decisions and actions.
With mannequin-based simulators, clinicians can use actual medical equipment, exposing limitations in the human-machine interface.
Complete interpersonal interactions with other clinical staff can be explored in training for teamwork, leadership, and communication.

[1] Ashish J, Gaba DM. Incident reporting. In: Making health care safer: a critical analysis of patient safety practices AHRQ Publication No. 01-E058 [monograph on the Internet]. Rockville, MD: US Department of Health and Human Services, Agency for Healthcare Research and Quality; 2001 July [cited 2009 Mar 24]. Available from: www.ahrq.gov/clinic/ptsafety/chap4.htm.

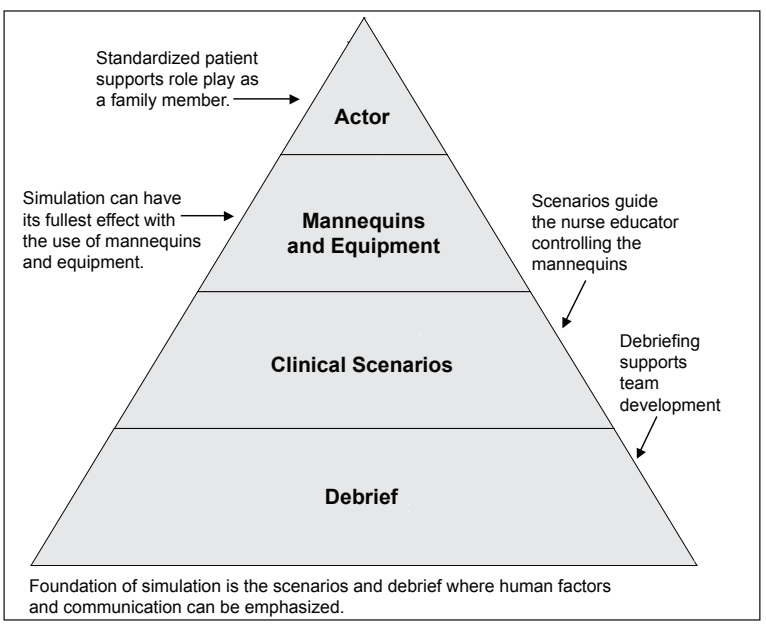

Figure 1. Four-tiered approach.

In a number of fields, simulation has been used in crew resource management training where the focus is on behavioral skills such as interteam communication during critical incidents.

The RSC provides an incredible opportunity for clinicians and staff to learn by experience. Poor critical event management often results in delayed diagnosis and ineffective treatment processes, even when clinical knowledge and skills are adequate. According to the Center for Medical Simulation,[5] effectively managing a critical event

Table 4. Five principles for managing critical events
Role Clarity: An event manager delegates responsibilities to the team members while paying attention to workflow. Other team member(s) define their role responsibilities and do not change roles without an explicit discussion with the event manager.
Communication: All communication flows through the event manager who reliably repeats all information for the benefit of the entire team. All verbal communication should be closed-looped—the teller gives information to the listener who repeats what s/he heard and understood; the teller then confirms that information. All communication is directed to an individual by name.
Personnel Support: The event manager is responsible for calling for help when needed. Because task loading tends to cause one to forget to call, it is important to summon help early in the event evolution.
Resources: Team members must be familiar with all of the equipment and supplies necessary to manage the event. Understanding the infrastructure of the environment and institutional systems is also important.
Global Assessment: Frequent verbal status reports, reviewed by the event manager, is the best mechanism for avoiding fixation, promoting clarity of a situation, and prompting new ideas.

requires attention to five principles (Table 4) in addition to timely diagnosis and appropriate medical treatment. These principles relate to clinicians' individual behaviors and to the group dynamics of the clinicians and their individual behaviors.

2. *Equipment and Materials:* The RSC is outfitted with medical equipment, which includes a code cart with defibrillator. Cabinets and the control booth were recycled from a recent remodel of the KSMC ED. The control booth allows the simulation educator to monitor and control the patient's vital signs in line with the scenario and in response to the actions of the clinical team. S/he may advance the scenario or recover the patient on the basis of team responses. Supporting equipment includes: a video camera, computers to preprogram and run the scenarios, and a television monitor used to immediately replay completed scenarios to the team during debriefing (Table 5).
3. *Standardized Patient:* The "standardized patient" is an actor who often plays a role as a family member of the patient (mannequin). The standardized patient reacts in real time to the patient's clinical signs and to the actions of the health care team. This person will ask and answer questions, and make observations and comments to the team. There are times when the standardized patient adds tension to the simulation, increasing what could be an already stressful situation. For example, a "standardized patient" often plays the role of the distraught parent in a pediatric or newborn resuscitation simulation. The objectives of including a "parent" or "family member" is to increase awareness of family-centered care principles, to illustrate the effects of distractions on clinical care, and to use crew resource management concepts to meet the family members' needs.
4. *Debriefing:* All participants of each videotaped simulation debrief directly after the simulation. Topics discussed are: communication, leadership and roles, crisis resource management, system improvements, highly reliable team characteristics, handoffs and SBAR, human factors and situational awareness, and best clinical practices and standards.

After simulation and debriefing, individuals complete an evaluation, noting its value and relevance, the value of the debriefing, and improved patient-care skills. Surveys from the first year of the RSC, were analyzed compared to baseline measurements.

Results

2006

A 2006 job satisfaction survey (People Pulse) question asked: "Do you receive the training necessary to do your current job well?" to which 71% of respondents

Poor critical event management often results in delayed diagnosis and ineffective treatment processes, even when clinical knowledge and skills are adequate.

Sample Simulation Scenario: Malignant Hyperthermia in the Post-Anesthesia Care Unit

Intended Audience: PACU RNs, CRNAs, MDs, other PACU personnel

Brief Description of Scenario: Postoperative patient post-transurethral bladder tumor resection arrives in PACU. Patient then has a laryngospasm, is given succinylcholine for emergent intubation, which triggers a malignant hyperthermia (MH) crisis. MH crisis is treated and the patient is transferred to the ICU.

Scenario Objectives: Participants will demonstrate:

1. Knowledge of MH triggering agents
2. Recognition of a symptoms and appropriate interventions for MH
3. Effective communication using SBAR
4. Effective Crisis Resource Management
5. Effective Dantrolene preparation and administration
6. Effective hand-off procedure
7. Knowledge of current transfer policy of patients from PACU to ICU

Description of patient: In surgical gown with foley catheter in place with small amount of dark urine, IV LR infusing, patient moaning, just arrived in PACU postprocedure.

Pertinent Medical History: Post-transurethral bladder tumor resection, smokes one pack per day, family history of death during surgery in Russia.

ICU = Intensive Care Unit; MH = malignant hyperthermia; PACU = Post-Anesthesia Care Unit; SBAR = Situation Background Assessment and Recommendation

responded favorably. This encouraged further development of the RSC.

2007

In November of 2006, the RSC moved into a conference room formerly used for storage and created a fully operational, high-fidelity simulation laboratory. Approximately 666 physicians, nurses, respiratory therapists (RTs), CRNAs, CNAs, students and technicians trained using simulation in 2007.

The postsimulation survey used by the RSC for the period February 2007—January 2008 evaluated four components (Table 6). Using a ranking methodology of 1-5, poor to excellent, a numerical value was substituted for analysis (poor = 1 and excellent = 5). Six hundred sixty-six participants were surveyed about the scenario in which they were involved. Overall, teams felt the most positive about the value of the debriefing session—4.6 average, in 8 of 11 scenarios (Table 7).

Many comments gathered from the KPNW RSC post-

Table 5. Regional Simulation Center equipment list

Human patient simulators (Mannequins—includes warranty)	**Features**
SimMan – 1 $42,000.00	Adult, advanced patient simulator with realistic anatomy and clinical functionality, including intubatable airway, multiple ECG rhythms, defibrillation and pacing capabilities, IV fluid and drug administration, and interactive voice.
SimBaby – 2 One in lab and one portable $46,000.00 for each	A computerized advanced patient simulator the approximate size and weight of a nine-month-old infant. It features realistic intubatable airway, cyanosis, several ECG rhythms, intraosseous and IV access.
Megacode Kid Advanced $6700.00	Used for training in a wide range of advanced pediatric emergencies. Includes realistic intubatable airway, multiple ECG rhythms, defibrillation and pacing capabilities, intraosseous access and drug administration.
HAL Mobile Team Trainer $28,000.00	A completely wireless adult computerized mannequin. HAL has the capabilities similar to SimMan, and can be used in the actual clinical environment. Scenarios using HAL can be controlled with a computer tablet at distances up to 300 meters.
Noelle $17,000.00	A wireless, full-sized adult mannequin that gives birth and can display a range of potential delivery complications.
Noelle S575 with newborn $43,000.00	A wireless, full-sized adult mannequin that features obstetrical scenarios controlled by a computer tablet. Mother and fetus each have patient monitors and can mimic a variety of normal and complicated intrapartum and postpartum situations, including cesarean section.
Baby HAL S3010 $24,000.00	Wireless, has its own patient monitor and is the approximate length and weight of a newborn. Baby HAL has features similar to SimBaby, with the addition of an umbilical pulse, and umbilical access.
Task trainers	**Features**
Pediatric intraosseous leg $600.00	Right leg of a one-year-old for intraosseous access practice. Also has a simulated femoral artery and vein in the upper thigh.
Central Line Man System $4800.00	A realistic anatomical model complete with internal landmarks, allows practice of subclavian, supraclavicular, and interjugular access techniques. The tissue responds to ultrasound imaging for needle guidance.
Trauma Man System $21,000.00	An anatomical human body form designed to practice surgical procedures including cricothyroidotomy, chest tube insertion, pericardiocentesis, diagnostic peritoneal lavage and IV cutdown.
Airway management task trainers	**Features**
Gaumard S312 $550.00	One-year-old pediatric upper torso-airway trainer with anatomically accurate, intubatable airway.
Gaumard S315 $1600.00	Adult upper torso-airway trainer with anatomically accurate, intubatable airway
Laerdal Deluxe Difficult Airway Trainer $2400.00	Adult upper torso mannequin, capable of multiple difficult airway scenarios, including laryngospasm.
Laerdal Airway Management $1600.00	Trainer mounted on a practice board, this mannequin can be used to demonstrate and practice intubations, ventilation, suction, and bronchoscopy.
Other equipment	Birthing bed, hospital bed, infant warmer, code cart with defibrillator, wardrobes for mannequins, video cameras and television monitors, control booth.

Table 6. Survey questions
1. The value of the simulation exercises for you
2. The relevance of the simulation scenario to your clinical practice
3. The value of debriefing session(s)
4. Our success at providing a "safe learning environment"

simulation evaluation supported the personal value of simulations. Examples include: "These exercises were really helpful, I feel more comfortable handling the initial 241 scenarios," (participant of a 241 code, which indicates a newborn in distress). Another responded, "The SimMan made things so real that I almost forgot he wasn't a real patient." Many others expressed more confidence in speaking up in code situations if there is unclear leadership or direction given. Participants said they valued the experience of participating in simulations, the ability to become more focused in their jobs and to relieve anxiety about certain escalating situations prior to practicing their drill. A newly graduated nurse commented, "Simulation may be the next or only time a nurse gets to practice something s/he learned in nursing school."

2008

Approximately 864 clinicians and staff trained using simulation in 2008.

In support of the KPNW internalization efforts in Cardiovascular Services and Behavioral Health and Addiction Medicine services, teams from both disciplines used or planned to use the RSC to conduct scenario sessions to test readiness prior to "go-live" opening. Five such scenario sessions were conducted for Brookside—a free-standing residential treatment facility. These simulations included a cardiac arrest in a group therapy session, an anaphylactic reaction to a medication, a patient leaving against medical advice, admission procedures, and an escalating behavioral situation. Simulations were also conducted in the new Cardiac Catheterization Laboratory to test systems prior to opening.

Objective data was gathered during the cardiac resuscitation drill. The scenario used a patient exhibiting signs of shortness of breath and tightness of chest during a group therapy session in one of the Behavioral Health unit's group therapy rooms. As the staff became aware of the medical emergency, and a Code 99 was announced, support staff from KSMC responded. Many opportunities for system improvements were identified during the debrief session: correcting emergency response time, staff finding their way to the emergency site, signage, locked security doors, equipment needs, and physical plant adjustments. Finding these challenges during the simulation allowed them to be addressed before the Residential Treatment Facility (RTF) opened.

In July and August 2008, KSMC completed a massive training endeavor with over 25 Mock Code 99 drills involving 100 people from the inpatient critical care units, medical-surgical units, and the entire Code 99 team. The goal was to involve as many of the staff as possible, on the various units. This endeavor facilitated the highest level of teamwork within a true Code 99 situation.

As of March 31, 2009, 403 staff have participated in simulation.

Discussion

Quality of Care and Patient Safety

An RSC serves an essential function in the creation, maintenance and improvement of quality of patient care and patient safety by providing training opportunities for staff. Comments and scores on evaluation surveys obtained during postsimulation self-assessment demonstrated that staff feel the simulation training is of definite value in improving their job performance and their confidence in performing a procedure and in providing patient care.

KSMC staff experiences confirm other reports in the scientific literature, for example in simulation-based orientation training for first-year pediatric critical-care fellows in the US, students viewed simulation training for common pediatric critical care management as effective for improving self-efficacy.[6]

Table 7. Average survey scores[a]

Scenario	General team	ACLS mock code	Med-Surg septic mock code	RN, RT, MD team	Malignant hyperthermia	MD, RN, RT neonatal resuscitation	OB/GYN mock code	ED neonatal and ACLS mock code	ED peds code	Acute coronary	Med-Surg mock code
Average of all questions in each survey	4.5	4.5	4.6	4.4	4.5	4.7	4.7	4.5	4.6	4.5	4.4

[a]on a scale of 1-5 (1 = poor; 5 = excellent)
ACLS = Advanced Cardiac Life Support; ED = Emergency Department; RT = Respiratory Therapist

Regional Initiatives

The use of the RSC is connected to regional goals and supports regional and national strategic initiatives. In particular, the RSC supported the KPNW internalization efforts in Cardiovascular Services and Behavioral Health and Addiction Medicine services, and for the new RTF prior to opening. Simulations were conducted in the new Cardiac Catheterization Laboratory to test systems prior to its opening. Simulation sessions have occurred in preparation for the opening of the Cardiovascular Intensive Care Unit, planned for 2009. Finally, more simulation scenarios are being developed for use by surgical teams involved with the Highly Reliable Surgical Team project and the Reliable Emergency Departments projects.

Additional Activites

The RSC and its staff provide educational opportunities for organizations and groups throughout the greater Portland, OR and Vancouver, WA areas, such as simulation activities for local nursing programs allowing student nurses to practice what they are learning in the classroom and provide a systems approach to real-time clinical learning. KPNW also hosts a bimonthly simulation roundtable to provide opportunities for area simulation educators to network. The roundtable is supported by grants from the state of Oregon. In addition, the KSMC Coordinator for Regional Simulation Operations is a member of the governing council of the Oregon Simulation Alliance (OSA). Activities of the OSA include providing simulation training courses and apprenticeships, increasing public awareness of the value of simulation, and hosting an annual Sim Summit Conference. Participants from Oregon, Washington, and Idaho attend this conference to learn multidisciplinary approaches to simulation. Clinical teams on the KSMC campus often use the RSC as action items of *Sentinel Event Root Cause Analysis* work to improve team communication. Because the Sim Lab is mobile it regularly travels to KP medical and dental offices for staff emergency preparedness training. Sim Lab staff also participate in citywide disaster training, providing mannequins, and standardized patients for the drills.

Transferability

Because the RSC was built on a "shoestring" budget with the costs for furniture controlled by recycling furniture and materials from areas undergoing remodels

Sample Simulation Scenario: Precipitous Delivery in the Emergency Department and Neonatal Resuscitation Program

Intended Audience: ED Consortium, new graduate RNs

Brief description of scenario: G4P3, age 34 years, presents in ED in active labor, SROM clear fluid, bloody show, states strong urge to push. Spontaneous vaginal delivery occurs on ED stretcher without maternal complications. Infant requires stimulation and PPV, and recovers.

Scenario Objectives: Participants will demonstrate:

1. Recognition of signs of impending birth
2. Appropriate skill in delivering baby
3. Appropriate Neonatal Resuscitation Program skills
4. Appropriate care and safety for mother and baby following delivery
5. Resource management, teamwork, and communication skills.

Description of Patient: Patient is in labor, wearing street clothes, in active labor. Patient is unaccompanied. SROM obvious, positive bloody show on towel between legs.

Pertinent Medical History: Normal prenatal course, no problems. Baby has been active. Labor began several hours ago, SROM within the last hour, clear fluid. UCs now every three to four minutes, getting stronger, patient has urge to push, has bloody show.

Progressive Outline:

Noelle – Initial State: Head is crowning – prior to scenario, let head deliver until "Turtle sign." Wet towel with bloody show inside underpants.

Baby HAL – Initial State: Cyanotic, HR = 80, RR = 0, limp. After about 20 seconds of PPV, baby recovers: Pink, HR = 120, RR = 40, active, crying.

ED = Emergency Department; G4P3 = Gravida 4, Para3 (gravida is number of pregnancies, para is number of live births); HR = heart rate; PPV = positive pressure ventilation; RR = respiratory rate; SROM = spontaneous rupture of membranes; UCs = uterine contractions.

and from the Region's surplus warehouse, it is a model for low-cost start-up. RSC also gained momentum from the Perinatal Patient Safety Reliability project and now can serve as an added demonstration of simulation value. Space, staff wages, and the mannequins are the true costs of developing such a "laboratory"; however, KP is also investing in the resource of human patient simulators. The staff of the KPNW RSC is available to consult with any KP Region or hospital looking to add their own simulation center. Their internal KP Web site is on the KP Northwest homepage: http://internal.or.kp.org/simlab (password protected). ❖

[a] For more information about the Perinatal Patient Safety Project, please see: Nunes J, McFerran S. The Perinatal Patient Safety Project: New Can Be Great! Perm J 2005 Winter;9(1):25-7; Nunes J, McFerran S. 2004 Lawrence New Project Award Winner: Perinatal Patient Safety Project. Perm J 2005 Spring;9(2):28-33; Sandoval J, McDonald J, Graham S. 2005 Lawrence Transfer Award Winner: The Southern California Perinatal Patient Safety Project. Perm J 2006 Summer;10(2):29-36.

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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Attend to the Details

Even a trained student should attend to every detail, if he wishes to master with assurance and speed each aspect of his profession which he has already learned by the general method.

— On the Affected Parts, *Galen of Pergamum, 129-200, Roman physician and philosopher of Greek origin*