48 Simulation in the Heart Center

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Simulation is a tool for educational, quality, safety, advocacy, research, and competency assessment endeavors that has proven not only to improve learning and retention, but also to improve patient outcomes. Simulation replaces real-patient experiences with "guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner" (Gaba 2004). Simulation allows us to learn, practice, and test our knowledge as well as experiment and evaluate new systems, processes, and spaces safely. An error made in simulation is a potential error prevented in real life.

Simulation has applications in:

- **Education.** Simulation applies adult learning theories, making it an excellent tool for team training. As andragogy describes, adults learn by doing. According to Kolb's experiential learning circle, there are 4 key elements to adult learning: 1) *experience* (simulation participants are exposed to a simulated scenario close to a real-life situation and they perform based on previous learning), 2) *reflection* (during the debriefing phase, learners are guided through an exploration of their thought processes by the debriefer to analyze why they did what they did), 3) *conceptualization* (after analyzing their paradigms, adult learners adopt new perspectives, define optimal performance, and "take home" specific points), and 4) *experimentation* (participants apply new or modified behaviors and/or skills to future simulations and real-life situations).
- **Quality and safety.** There is evidence that various simulation activities can improve patient outcomes (e.g., cardiac arrest). In addition, by system testing, it is possible to identify possible latent threats and intervene before they reach patients, potentially also improving their outcomes.
- **Advocacy.** Mainly focused on the training of family members of children that are technology dependent (e.g., tracheostomies, gastrostomy tubes).
- **Research.** All simulation-based research is performed in liaison with the TCH Simulation Center. The vast majority of studies are related to education, advocacy, or quality and safety research projects.
- **Competency assessment.** This area has not been formally introduced yet.

The goal of the simulation group at TCH is to improve patient safety outcomes by implementing evidence-based simulation activities following best practice. Simulation activities are performed either in situ or at the TCH Simulation Center. For the purpose of this chapter, we will focus on the in situ simulation activities that take place in the Heart Center. The main focus and type of in situ simulation activities at the Heart Center are:

- **Multidisciplinary team training.** These sessions are in situ / point of care (POC) sessions that include all different disciplines involved in the care of cardiac patients (e.g., physicians, nurses, respiratory therapists, ECMO specialists, physical and occupational therapists). These sessions may have different objectives: 1) *cognitive* (wide range of different cardiac emergencies and related complications), 2) *technical* (spanning from code cart and defibrillator use to invasive procedures, such as intubation or vascular access), and 3) *behavioral* (crisis resource management and leadership skills directed to improve effective communication, situational awareness, mental modeling, resource

utilization, and role assignment to optimize team performance). These sessions take place 3-4 times weekly.

- **Just-in-time simulation.** POC simulation is performed with the treating team of an acute-care or intensive-care patient to practice any possible event that the patient may encounter. The objective is to improve patient care and team performance at the time, should that complication happen in real life. These sessions are embedded in the multidisciplinary team training activities.
- **Simulation-based system testing.** In situ simulation activities to train and/or evaluate new processes and new spaces, such as a new ECMO-CPR algorithm, or the opening of a new unit. These sessions take place as needed. Failure Modes and Effect Analysis (FMEA) scoring-based reports are created after each session and then submitted to leadership so processes can be improved before a possible failure reaches one of the patients. These sessions include the whole Heart Center.
- **Advocacy.** Sessions for the training of health care providers and families in the care of patients who are technology dependent (e.g., tracheostomies, VADs).
- **Technical skills stations.** These sessions are usually single discipline and the skills taught vary based on the discipline involved. For example, using task trainers, the anesthesia fellows are taught techniques for obtaining vascular access, securing difficult airways, performing a focused cardiac assessment using transthoracic echocardiography (FATE), and achieving one-lung ventilation.

Two basic rules are followed in simulation: 1) the basic assumption is that all participants are intelligent, are doing their best, and are willing to learn; and 2) confidentiality (actions that take place in the simulation environment are not shared, and those actions will not impact performance evaluations for the participants). The main objective is to provide a safe learning environment.

Following a simulation activity, there is always a debriefing. Debriefing is where the real learning happens. Different debriefing techniques (e.g., advocacy and inquiry, plus/delta, direct feedback, rapid-cycle deliberate practice) are used, based on the level of expertise of the participants, the allocated time for the simulation activity, and type of activity performed.

Senior simulation instructors also apply their simulation debriefing techniques for the debriefing of real-life events. All codes in the CICU are debriefed in two modalities:

- **Warm debriefings**. Debriefings within an hour of the event with focus on team and clinical performance.
- **Cold debriefings**. Debriefings within a week of the event with focus on crisis resource management, facility issues, clinical performance issues, process or system issues, and resource issues. The data obtained from the cold debriefings are used to develop FMEA scoring-based reports that are taken back to the safety and Heart Center leadership. Any patient safety event or potential safety threat is studied, and action plans to address them are made.

Suggested Readings

Gaba DM. The future of simulation in health care. Qual Saf Health Care 2004;13(Suppl 1):i2-i10.

Stocker M, Burmester M, Allen M. Optimization of simulated team training through the application of learning theories: a debate for a conceptual framework. BMC Med Educ 2014. April 3;14:69

Kolb DA. Experiential learning: Experience as the source of learning and development (Vol. 1). Prentice-Hall; 1984.

49 Cardiac Developmental Outcomes

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Thanks to medical and surgical advances, children with CHD now receive treatment early in life and most of them survive into adulthood and thrive. However, children with CHD are at greater risk for and have higher rates of developmental delays and behavior and learning disorders than the general population. The prevalence and severity of developmental disorders and disability (DD) and developmental delays increases with the complexity of CHD.

The TCH Heart Center Cardiac Developmental Outcomes Program (CDOP) serves children with CHD by providing neurodevelopmental monitoring, screening, and assessments to diagnose and treat neurodevelopmental disorders. The program aims to enhance children's opportunities in life by focusing on medical, developmental, and social health to help them reach their maximum individual potentials. The program provides family-centered care, where the child's parents and caregivers are directly involved in the child's assessment and interventions to enhance her/his developmental progress. The program also helps families find resources that support their child's developmental needs in their local communities. The CDOP follows the guidelines established by the AHA and provides patients with CHD with the neurodevelopmental care they need. Patients that are at particular risk for impaired development include:

- Children with CHD that require open heart surgery during infancy
- Children with cyanotic heart lesions not requiring open heart surgery during infancy
- Children with CHD and other comorbidities including prematurity, genetic syndromes, chromosomal abnormalities, history of mechanical support (ECMO or VAD), heart transplantation and/or prolonged hospitalization

CDOP Clinic

The CDOP Clinic provides children referred to program with neurodevelopmental and neuropsychological assessments, monitoring, referral to subspecialties, and therapeutic and ancillary services in a family-centered environment.

The CDOP Clinic team is composed of developmental pediatricians, psychologists, medical social work, and a program coordinator. Infants and children are evaluated and monitored starting at 6 months of age and continuing at 12, 18, and 24 months. Follow-up thereafter occurs yearly or as clinically indicated.

Outpatient referral patients receive a full baseline neurodevelopmental assessment and may be referred for further evaluation to psychology, medical social work, and/or other ancillary services. Follow-up after initial evaluation would be as medically indicated.

The clinic team helps families find resources in their communities that help to support their child's developmental needs. Written reports are provided to parents and referring physicians.

CDOP Referral Criteria

- CHD requiring cardiac surgery at less than 6 months of age

- Heart transplant recipients
- History of mechanical support / ECMO
- Catheterization procedure
- Any child with CHD and developmental, behavioral and/or school concerns
- Children with CHD from birth to 18 years of age

The following are exclusions to CDOP referral:

- Down Syndrome (Developmental Pediatrics has a specialty clinic for these children)
- PDA ligation only

Referral Process

Inpatient Referral

Inpatient infants with CHD who have undergone cardiac surgery at <6 months of age should be referred to CDOP after transfer out of the CICU to an acute care floor. The program coordinator identifies those patients that meet criteria for inclusion in the program.

The process is as follows:

1. The resident or advance practice provider enters a consult order to Developmental Pediatrics (Epic).
2. The program coordinator introduces CDOP to parents, gives educational material, and offers to schedule the 6-month evaluation appointment at the CDOP outpatient clinic.
3. A developmental pediatrician/neurologist evaluates patient before discharge.
4. Outpatient evaluations at 6, 12, 18, and 24 months of age will take place at the CDOP clinic after discharge. Follow-up thereafter will be yearly or as clinically indicated.

Outpatient Referral

Patients with CHD and developmental, behavioral, and/or school concerns can also be referred as outpatients. The process is as follows:

1. TCH requesting providers enter an outpatient referral to the CDOP (Epic). Non-TCH providers send a referral to the CDOP via fax. For parent self-referral, the family calls the program coordinator requesting an evaluation.
2. The program coordinator calls the family and confirms criteria for CDOP, introduces program, and offers first available appointment for an evaluation.