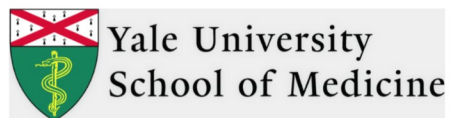


IMPROVING MRI SAFETY IN PEDIATRIC PATIENTS UNDERGOING SEDATION: IMPACT OF IN-SITU BIMONTHLY MULTIDISCIPLINARY SIMULATION TRAINING

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BACKGROUND & PURPOSE

In recent years, there has been an increase in sedation administration in conjunction for magnetic resonance imaging (MRI) (1). As such, there has been increased need to define an algorithm for safe management of sedation patient undergoing MRI. Particularly, there is a need for education surrounding Zone 4 in MRI and appropriate hazards and safety parameters with which different team members should be acquainted (2).

The purpose of this QI project was to identify gaps in practice management and increase personnel comfort in proper management of an unstable sedated pediatric patient while undergoing an MRI through creation of a recurring in-situ (in MRI suite) simulation training program.

(1) Wilson, S. R., et al. "Guidelines for the Safe Provision of Anaesthesia in Magnetic Resonance Units 2019." Anaesthesia 2019

(2) Practice Advisory on Anesthetic Care for Magnetic Resonance Imaging. Anesthesiology 2015



METHODS

- A multidisciplinary team was formed to address creation of a training program to improve MRI safety knowledge and MRI procedures.
 - Team included pediatric sedation physicians (intensivists), nursing from both sedation team and diagnostic imaging, child-life specialists, MRI staff (technologists and technologist aides), Radiology Quality and Safety leaders, and Simulation Lab instructors
- In 2018, an in-situ bi-monthly MRI simulation program was implemented on appropriate management of an unstable pediatric patient receiving sedation during an MRI (a high-acuity, low-frequency event). Scenarios simulated moving unstable patient out of Zone 4, role clarification (Figure I), identification of emergency equipment location, and activation of a code. Identification of potential safety threats and team debriefing occurred in real time. 30 minute block of scanner time created for training.
- Quality improvement tools in this project included process mapping (Figure II), and post-simulation debriefing (Figure III) to aid in recognizing potential failures, latent safety threats and barriers to following prescribed workflow.
- Approximately one year following implementation, a 11-question survey was distributed to all simulation participants to assess impact of simulation training (Figure IV).



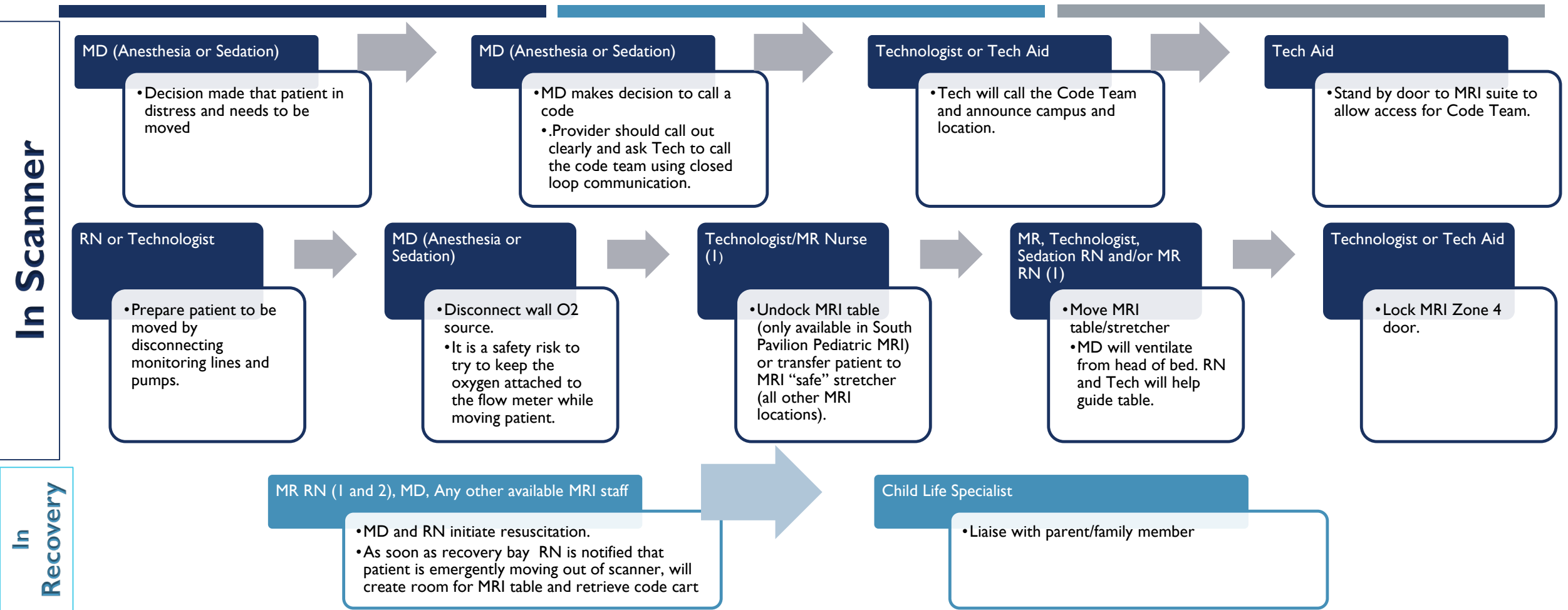
Figure I: Role clarity sheet created during QI project

Team Member	Role	Team Member	Role
MD Provider	<ul style="list-style-type: none"> <input type="checkbox"/> Make decision to move patient out of scanner <input type="checkbox"/> Make decision to call a code. Call-out to Tech using closed loop communication. <input type="checkbox"/> Disconnect Self-Inflating BVM from O2 source <input type="checkbox"/> Move MRI Table from Scanner to Recovery Bay with others staff <input type="checkbox"/> Lead Code / Assign Roles 	MR RN (2)	<ul style="list-style-type: none"> <input type="checkbox"/> Assist in recovery bay with management <input type="checkbox"/> Retrieve Code Cart
Sedation RN	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare to move patient out of scanner <ul style="list-style-type: none"> <input type="checkbox"/> Disconnect monitors and support devices <input type="checkbox"/> Move MRI table/stretchers from Scanner to Recovery Bay with other staff 	Technologist	<ul style="list-style-type: none"> <input type="checkbox"/> Notify RN to clear recovery Bay <input type="checkbox"/> Call Code Team by dialing 155 <input type="checkbox"/> Undock MRI Table or help transfer to MRI safe stretcher. Assist with preparing for transport from scanner <input type="checkbox"/> Move MRI stretcher/table from Scanner to Recovery Bay <input type="checkbox"/> Lock MRI Door
MR RN (1)	<ul style="list-style-type: none"> <input type="checkbox"/> Prepare to move patient out of scanner <ul style="list-style-type: none"> <input type="checkbox"/> Disconnect monitors and support devices <input type="checkbox"/> Help undock MRI Table or transfer patient to stretcher <input type="checkbox"/> Move MRI stretcher/table from Scanner to Recovery Bay with other staff 	Tech Aid	<ul style="list-style-type: none"> <input type="checkbox"/> Stand by door to MRI suite to allow access for Code Team
		Child Life Specialist	<ul style="list-style-type: none"> <input type="checkbox"/> Liaise with Parent / Family Member

ALL STAFF MEMBERS INVOLVED IN THESE CASES IDENTIFIED WITH SPECIFIED ROLE DEFINED AND PRACTICED DURING SIMULATION TRAINING



Figure II: Process map created for management of sedated patient in MRI suite (Zone 4)



GOAL IS TO SMOOTHLY TRANSFER FROM 4 INTO ZONE 2/3 WITH EACH TASK ASSIGNED TO DIFFERENT TEAM MEMBERS FOR CLARITY, EFFICIENCY, AND SAFETY



Figure III: Debriefing structure

Introductions	Facilitator: We are going to debrief together about the scenario that we just went through. My role is to help guide the discussion but not dominate. I need to have everyone participate to get the most benefit from this exercise
Reactions	<p>Facilitator: How do you all feel now that it is over?</p> <p>Participants respond</p> <ul style="list-style-type: none"> ▪ Facilitator: Good thoughts and input, Now let's discuss how you communicated during the scenario
Understanding / Code Response	<p>Facilitator: First let's discuss what the team did right</p> <ul style="list-style-type: none"> • Did you use all of your resources? • Did everyone communicate effectively? • Were team roles defined and was there leadership? <p>When should we call for help? When is the correct time to exit scanner</p>
Understanding / Medical Management	<p>Facilitator to Team Leader:</p> <ul style="list-style-type: none"> • What were your thoughts about the risks of this procedure and how did that guide your sedation plan? • When the patient developed airway difficulties what were you thinking should be the next steps? • At what point did you recognize that aspiration was developing and triggering laryngospasm? • At what point did you recognize need to remove patient from Scanner room/zone 4 towards zone 2
Summary	<p>Facilitator: What were the 2 or 3 take home points from this scenario?</p> <ul style="list-style-type: none"> • Emphasis on recognizing decompensating patient. • Once patient decompensated/thinking code needs to be called should immediately begin process of exiting scanner. • Were roles clear on who does what during this scenario to ensure safe evacuation of patient from MRI Zone 4? <p>Importance of clear communication both within the team and to the family (one voice idea)</p>

DEBRIEF GUIDE UTILIZING A LEARNER-CENTERED APPROACH WITH A 3D MODEL OF DEBRIEFING (DEFUSING, DISCOVERING, AND DEEPENING). THIS GUIDE IS USED BY QI MEDICAL LEADER FROM RADIOLOGY DURING SIMULATION TRAINING



Figure IV: Participant Survey

- Please indicate your role:
- Approximately how many MRI sedation simulations have you observed?
- Did participating in an MRI simulation session allow you to identify a gap in your practice that could have potentially harmed a patient?
- Please explain how the session was able to help identify a gap that could have potentially harmed a patient:
- Did the simulation exercise address potential barriers to safely moving a sedated patient out of MRI Zone 4?
- Please explain why you felt the simulation did or did not address potential barriers to safely moving a sedation patient out of MRI Zone 4:
- Prior to participating in the simulation session(s), please indicate how comfortable you felt in the management and correct work-flow of a medical emergency for a sedated patient while in MRI:
- After participating in the simulation session(s), please indicate how comfortable you feel in the management and work-flow of a medical emergency for a sedated patient while in MRI:
- Please indicate your agreement with the following statement:
 - Participation in the MRI sedation simulations has helped me gain a better understanding of my role in managing this type of event.
- Please indicate your agreement with the following statement:
 - Participation in the MRI sedation simulations has helped me gain a better understanding of where resuscitation equipment is located in MRI (i.e. code carts, wall O2).
- Free Comment Section:

ELEVEN QUESTION SURVEY ADMINISTERED ONE YEAR POST SIMULATION INITIATION

SURVEY RESULTS ON BENEFITS OF IN-SITU SIMULATION PROGRAM

- 19, at least partially completed, survey responses received (9 PICU physicians, 3 radiology quality and safety team members, 2 MRI technologists, 1 MRI technologist aide, and 4 sedation team nurses).
- Improvement in comfort on the proper workflow in managing an unstable sedated patient in MRI was seen in 70% (12/17) of respondents, with most (53%, 9/17) changing from comfortable to very comfortable after simulation training (Table I).
- 63% (10/16) reported that the simulations helped identify a gap in practice that could have potentially harm patients.
- 94%(16/17) agreed that the simulation addressed potential barriers to safely moving a sedated patient out of MRI Zone 4.
- 88% (14/16) agreed or strongly agreed that the simulations helped clearly define roles in an emergency and improved awareness of resuscitation equipment location in MRI.
- 74% (14/19) of respondents better understood their roles after completion of the simulation and better understood resuscitation equipment location in MRI.

Workflow Comfort Level Before Simulations	Workflow Comfort Level After Simulations
Comfortable	Comfortable (1/17=6%)
Comfortable	Very Comfortable (9/17=53%)
Uncomfortable	Very Comfortable/Comfortable (3/17=18%)
Very Comfortable	Very Comfortable (4/17=24%)

TABLE I – REPORTED COMFORT LEVELS OF PROPER WORKFLOW TO FOLLOW IN MANAGEMENT OF AN UNSTABLE PEDIATRIC PATIENT IN MRI UNDERGOING SEDATION BEFORE AND AFTER PARTICIPATING IN AT LEAST ONE IN-SITU MRI SIMULATION.



LESSONS LEARNED

- Bimonthly MRI-pediatric sedation in-situ simulations are well received by all team members involved in pediatric MRI sedation cases and allow training in high acuity low frequency patient safety events with improved awareness of roles
- Creation of multi-disciplinary team training simulation model in MRI is feasible, with 100% of survey participant's reporting feeling comfortable or very comfortable in the proper patient management workflow after simulation training.
- Practice gaps and patient safety threats identified/corrected as result of the simulations included malfunctioning intercom system preventing communication between MRI and nursing prep hold, deficiencies in oxygen supply during patient transfer, and poor signage on location of resuscitation equipment in MRI.
- As a result of this intervention a pre-procedure MRI checklist (Figure V) was also implemented at YNHH.
- In the future we plan to expand the training throughout the Yale New Haven Health System to increase MRI safety, improve patient comfort, and better define role clarity for managing medical emergencies in MRI.



FIGURE V: CHECKLIST DESIGNED BASED ON WHAT WE LEARNED FROM SIMULATION TRAINING

Pre-MRI checklist for set-up (before patient is brought into the scanner)

- o Introduction of each staff member. Any new anesthesia/sedation team staff new to MRI?
- o Iradmad pumps and anesthesia machine are in zone 4 and operational
- o All needed ancillary MRI equipment needed for case in zone 4 (Blades, stethoscope)

MRI Safety Review

- o Standard MRI Practices- Empty pockets, personal items (new IDs are OK)
- o Review MRI patient emergency evacuation plan and roles to remove patient from zone 4 to zone 2
 - o ANY unstable patient requiring escalation in case is removed from zone 4
 - o Is table detachable/where is stretcher, O2 wall locations, etc.

Before any patient is brought into the scanner

- o Time out
- o Any patient specific needs to address

