

UC Irvine

Journal of Education and Teaching in Emergency Medicine

Title

Pediatric Sedation for Forearm Fracture

Permalink

<https://escholarship.org/uc/item/50h0t2g8>

Journal

Journal of Education and Teaching in Emergency Medicine, 4(1)

Authors

Niknafs, Nichole
Wray, Alisa

Publication Date

2019

DOI

10.5070/M541042369

Copyright Information

Copyright 2019 by the author(s). This work is made available under the terms of a Creative Commons Attribution License, available at <https://creativecommons.org/licenses/by/4.0/>

Peer reviewed

Pediatric Sedation for Forearm Fracture

Nichole Niknafs, DO* and Alisa Wray, MD, MAEd^

*Arrowhead Regional Medical Center, Department of Emergency Medicine, Colton, CA

^University of California, Irvine, Department of Emergency Medicine, Orange, CA

Correspondence should be addressed to Nichole Niknafs, DO at nicholeniknafs@gmail.com

Submitted: May 14, 2018; Accepted: August 3, 2018; Electronically Published: January 15, 2019; <https://doi.org/10.21980/J8CS7K>

Copyright: © 2019 Niknafs, et al. This is an open access article distributed in accordance with the terms of the Creative Commons Attribution (CC BY 4.0) License. See: <http://creativecommons.org/licenses/by/4.0/>

ABSTRACT:

Audience: Emergency medicine residents.

Introduction: Pediatric patients who present to the emergency department (ED) may sometimes require sedation for appropriate examination or treatment. Safely sedating a pediatric patient requires detailed training and knowledge about pediatric patients and their special needs, indications and contraindications for sedation, levels of sedation, medications used for sedation, pediatric airway management, adverse events with sedation, and discharge criteria after sedation.^{1,2,3} Physicians in the ED who will be performing sedations should have a systematic approach to sedation.¹ This simulation scenario allows learners to evaluate and manage a pediatric sedation, discuss risks and benefits as well as indications and contraindications of a sedation, get consent for sedation, and respond to adverse events during the sedation in a controlled environment, allowing them to make mistakes and correct behaviors without patient harm.

Objectives: At the end of this simulation, participants will: 1) review options for pain control in pediatric patients, 2) perform a pre-sedation history and physical exam, 3) review the indications and contraindications for pediatric moderate sedation, 4) understand components of consent, and get consent from the patient's parent, 5) list medication options for moderate sedation in a pediatric patient and review their appropriate doses, indications, contraindications, and side effects, 6) discuss management of moderate sedation complications, and 7) review criteria for discharging a patient after sedation.

Method: This is a high-fidelity simulation, followed by a debriefing session. It could be also run with moderate- or low-fidelity simulation or as an oral boards case.

Topics: Pain control, pediatrics, sedation, moderate sedation, pharmacology.



USER GUIDE

List of Resources:

Abstract	1
User Guide	2
Instructor Materials	4
Operator Materials	17
Debriefing and Evaluation Pearls	24
Simulation Assessment	36

Learner Audience:

Interns, Junior Residents, Senior Residents

Time Required for Implementation:

Instructor Preparation: 30 minutes

Time for case: 12-20 minutes

Time for debriefing: 30 minutes

Recommended Number of Learners per Instructor:

2-4

Topics:

Pain control, pediatrics, sedation, moderate sedation, pharmacology.

Objectives:

By the end of this simulation session, the learner will be able to:

1. Review options for pain control in pediatric patients.
2. Perform a pre-sedation history and physical exam.
3. Review the indications and contraindications for pediatric moderate sedation.
4. Understand components of consent, and get consent from the patient's parent.
5. List medication options for moderate sedation in a pediatric patient and review their appropriate doses, indications, contraindications, and side effects.
6. Discuss management of moderate sedation complications.
7. Review criteria for discharging a patient after sedation.

Linked objectives, methods and results:

Pediatric patients have, historically, been under-treated for pain and painful procedures.² Additionally pediatric patients can be at increased risk from sedating medications.¹ Emergency department (ED) physicians and members of the patient care team should be well-trained in sedation medications and adverse events prior to performing sedations on pediatric patients. This simulation allows learners to perform a pediatric sedation in a safe and controlled environment. Participants will

have to consider pain control options and select an initial medication during the simulation; alternatives can be reviewed and discussed during the debrief (objective 1). During the simulation the orthopedic specialist will request moderate sedation, and the learner will need to perform a pre-sedation history and physical. The indications, contraindications, and the important components of the pre-sedation evaluation can be reviewed during the debrief (objectives 2 and 3). Participants will need to properly get consent from the parents during the simulation, and important components of consent can be reviewed during the debrief (objective 4). Participants will select an appropriate sedation medication during the simulation and experience a corresponding complication which they will have to manage (objective 6). Alternative medications, complications, and management should be reviewed by the instructor during debriefing (objective 5). At the end of the case, participants will need to assess the patient and determine if the patient is appropriate for discharge (objective 7).

The simulation can be run multiple different times with different sedation medications and adverse events during the sedation. A confederate should be used to play the mother or father of the patient, who can prompt the learners to appropriately get consent for the sedation, discuss the risk and benefit, indications, and contraindications for the procedure and medications. Deliberate practice and repetition will help learners gain confidence in consenting and performing a moderate sedation. Instructors should allow sufficient time for debriefing to properly review the information outlined above.

Recommended pre-reading for instructor:

- We recommend that instructors review drug dosages for moderate sedation. Additionally, instructors could review any article on pediatric sedation (see references below).

Results and tips for successful implementation:

Initially this simulation was piloted with 16 emergency medicine residents ranging from first year to third year residents and completed in groups of four to six residents. The initial case had objectives that pertained to both fracture reduction and sedation. In addition, we utilized a confederate to act as the pediatric patient's parent, who asked frequent questions of the learners. The learners enjoyed the case; however, due to the broad scope of the original case and critical actions, it was difficult to attain the objectives that pertained to the fracture reduction, and learners missed key components necessary to perform a safe sedation. The case was subsequently re-written to focus of pediatric pain control and sedation.

Depending on available resources, this simulation can be run as a low-, moderate- or high-fidelity simulation; additionally, it



USER GUIDE

could be run as an oral boards case. When running this case, we recommend utilizing a confederate to act as the patient's parent because the confederate can prompt the learners to ensure that they appropriately get consent for the sedation and are able to answer common questions surrounding sedations in the ED. We highly recommend that the scenario be run multiple times with different sedation medications available for use, forcing learners to try various medications, allowing deliberate practice, and exposing the learners to multiple possible adverse events. In our scenarios, we had the pharmacy or nurse state that they are out of certain medications to push the learner to try alternatives. For advanced learners, orthopedics or pediatric orthopedics may not be available, and the instructor could have the learners describe how to reduce the fracture.

References/suggestions for further reading:

1. Coté CJ, Wilson S. American Academy of Pediatrics, and American Academy of Pediatric Dentistry. Guidelines for monitoring and management of pediatric patients before, during, and after sedation for diagnostic and therapeutic procedures: Update 2016. *Pediatrics*. 2016;138(1): pii: e20161212. doi: 10.1542/peds.2016-1212
2. Barnes S, Yaster M, Kudchadkar SR. Pediatric sedation management. *Pediatr Rev*. 2016; 37(5):203-212. doi: 10.1542/pir.2014-0116
3. Koh JL, Palermo T. Conscious sedation: reality or myth? *Pediatr Rev*. 2007;28(7):243-248. doi: 10.1542/pir.28-7-243



INSTRUCTOR MATERIALS

Case Title: Pediatric Sedation for Forearm Fracture

Case Description & Diagnosis (short synopsis): An 8-year-old right-hand dominant male is brought in by paramedics after falling onto his left arm after jumping off a jungle gym. The patient's parents request immediate pain control prior to IV placement. The on-call orthopedist will request the participants perform moderate sedation for closed reduction with splinting. The learner should get consent from the parents for sedation, inform them of the risks and benefits, and consider the indications and contraindications for various medications. The patient will be sedated for reduction, but will have a side effect that the learner will need to manage appropriately. Side effects are: laryngospasm and emergence reaction if given ketamine; hypotension and apnea if given propofol; apnea if given etomidate; and vomiting if given fentanyl and versed. The patient will wake from sedation with improved pain; he will then need to be evaluated to determine if he is appropriate for discharge to follow up with pediatric orthopedics.

Equipment or Props Needed:

- High- or moderate-fidelity simulator
- Infusion pumps
- Bag valve mask
- Intubation/airway tray
- Normal saline
- Medications
- Non-invasive blood pressure cuff
- Cardiac monitor with two-lead electrocardiogram (ECG)
- Pulse oximeter
- End-tidal carbon dioxide monitor

Confederates needed:

Mother or father, and a nurse for sedation. The instructor running the simulation can be the voice of the child.

Stimulus Inventory:

- #1 Anteroposterior X-ray of left wrist
- #2 Lateral X-ray of left wrist
- #3 Oblique X-ray of left wrist
- #4 Post-reduction lateral X-ray of left wrist



INSTRUCTOR MATERIALS

- #5 Post-reduction oblique X-ray of left wrist
- #6 Post-reduction anteroposterior X-ray of left wrist
- #7 Post-reduction anteroposterior X-ray of left forearm
- #8 Post-reduction lateral X-ray of left forearm

Background and brief information:

8-year-old right-hand dominant male is brought in by paramedics after falling onto his left arm after jumping off a jungle gym. The patient had immediate pain in his left upper extremity and noted deformity. Paramedics were called and placed the deformed left upper extremity (LUE) in a cardboard splint and brought him to the ED. The scenario takes place in an ED at a tertiary care teaching hospital with pediatric orthopedics readily available to help with the reduction.

Initial presentation: The patient is brought to the ED on stretcher with his left upper extremity in a cardboard splint. He is crying and inconsolable.

How the scenario unfolds: Participants should immediately recognize that the patient is in a significant amount of pain. Unfortunately, nurses will have a difficult time starting an intravenous (IV) line given the patient's pain and anxiety. The patient's parents will request that the patient be given some form of pain medication prior to IV line placement. Participants should give the patient 1-2 mcg/kg intranasal fentanyl or consider other non-intravenous forms of pain medication such as oral or intramuscular medications. The patient will calm down significantly after the pain medication, allowing for X-rays to be performed and an IV line to be placed.

Participants should recognize the distal radius and ulna fractures and consult pediatric orthopedics for reduction and splinting. If participants do not consult pediatric orthopedics, the orthopedist will arrive in the ED stating that the orthopedist heard there was a fracture that needed to be reduced. Orthopedics will request that the patient be sedated for the procedure. Participants should prepare for the sedation by getting consent from the parents (discussing medication options, risks, benefits, indications, contraindications and alternatives), placing the patient on oxygen, and preparing end-tidal CO₂ monitor. If the presence of respiratory therapy is standard of care for sedations at the institution running the simulation, then participants should call them as well.

During the moderate sedation, the patient will have a side effect (see simulation table of events) and learners will need to manage the complication appropriately. The patient should



INSTRUCTOR MATERIALS

be monitored until awake enough to follow commands. Orthopedics will report that the repeat X-rays will show good alignment (if learners request them images are available), and the patient can then follow up with pediatric orthopedics as an outpatient. Once the patient is fully awake and tolerating food or liquids, the patient can be discharged.

Critical actions:

1. Provide pain control with intranasal, intramuscular, or oral pain medications (since no IV line is available).
2. Order appropriate imaging and recognize ulna and radial forearm fracture.
3. Obtain informed consent for moderate sedation from patient's parent.
4. Perform a pre-sedation history and physical exam (medical history, allergies, previous anesthetic complications, American Society of Anesthesiologists [ASA] classification, Mallampati class).
5. Order an appropriate sedation medication (including dosage).
6. Manage sedation complication (specifics will vary based on medication ordered – see simulation events table).
7. Re-evaluate the patient after the sedation and before discharge, and recognize appropriate criteria for ending the sedation and discharging the patient.



INSTRUCTOR MATERIALS

Case title: Pediatric Sedation for Forearm Fracture

Chief Complaint: Left arm pain

Vitals: Heart Rate (HR) 115 Blood Pressure (BP) 110/85 Respiratory Rate (RR) 18
Temperature (T) 37.5°C Oxygen Saturation (O₂Sat) 100% on room air

General Appearance: Well-nourished 8-year-old male, tearful and in significant distress secondary to pain

Primary Survey:

- **Airway:** intact
- **Breathing:** clear to auscultation bilaterally
- **Circulation:** 2 + pulses in all four extremities

History:

- **History of present illness:** The patient is an 8-year-old right-hand dominant male brought in to the ED by paramedics after falling onto his left arm jumping off a jungle gym. The patient had immediate pain in his left upper extremity and noted deformity. His parent called 911 and paramedics arrived and placed the deformed left upper extremity (LUE) in a cardboard splint and brought him to the ED. The patient was not given any pain medication en route.
- **Past medical history:** Born full term at 39 weeks via spontaneous vaginal delivery. He is up to date on vaccinations. No prior hospitalizations or ED visits. No medical problems.
- **Past surgical history:** No prior surgeries
- **Patient's medications:** None.
- **Allergies:** No known allergies
- **Social history:** Lives at home with his mother, father, two older siblings.
- **Family history:** No pertinent family history. No family members with reactions to anesthesia.

Secondary Survey/Physical Examination:

- **General appearance:** well appearing 8-year-old male in mild distress secondary to pain
- **HEENT:**
 - **Head:** within normal limits
 - **Eyes:** within normal limits



INSTRUCTOR MATERIALS

- **Ears:** within normal limits
- **Nose:** within normal limits
- **Throat:** within normal limits, able to visualize full uvula
- **Neck:** within normal limits, no midline cervical spine tenderness
- **Heart:** tachycardic, S1, S2, no murmurs, rubs or gallops
- **Lungs:** within normal limits
- **Abdominal/GI:** within normal limits
- **Extremities:** Patient will only participate in LUE exam after pain medication has been given.
 - Left upper extremity with distal-forearm deformity and angulation. Sensation intact throughout. Grip of left hand 5/5, thumbs up, ok sign, finger abduction/adduction are within normal limits. 2+ radial pulse. Capillary refill less than 2 seconds. The patient unable to participate in LUE wrist extension or flexion, elbow extension or flexion, or shoulder range of motion secondary to pain in forearm.
 - Right upper extremity: within normal limits; Lower extremities: within normal limits.
 - Most standard manikins do not allow for deformity of the limbs; we suggest having the parents/paramedics describe the deformity to the learners.
- **Back:** within normal limits, no midline thoracic or lumbar tenderness
- **Neuro:** within normal limits
- **Skin:** within normal limits, no abrasions or lacerations
- **Psych:** tearful and anxious



INSTRUCTOR MATERIALS

Results:

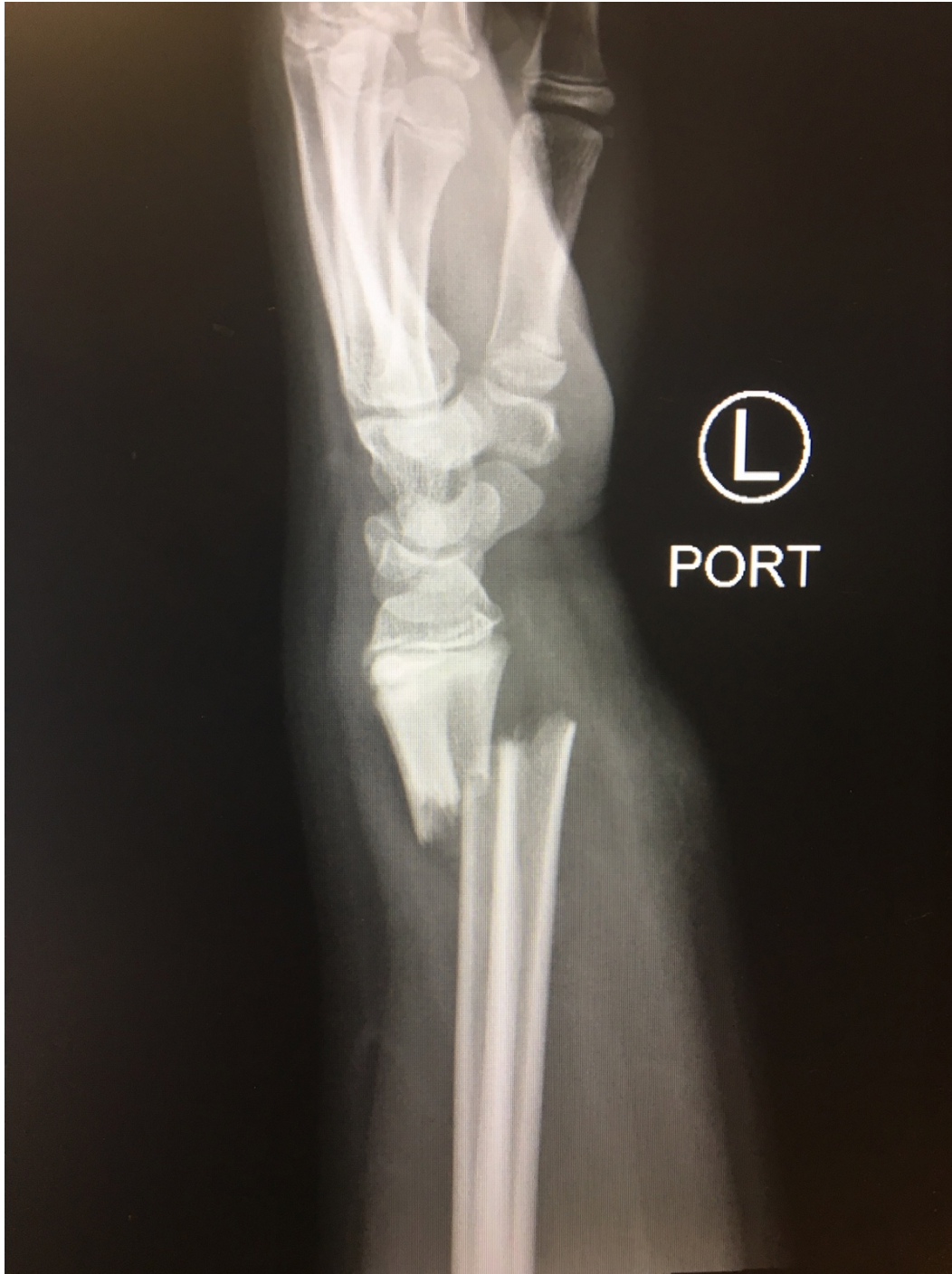
Prereduction anteroposterior X-ray of left wrist (author's own image)





INSTRUCTOR MATERIALS

Prereduction lateral X-ray of left wrist (author's own image)





INSTRUCTOR MATERIALS

Prereduction oblique X-ray of left wrist (author's own image)





INSTRUCTOR MATERIALS

Post-reduction lateral X-ray of the left wrist (author's own image)





INSTRUCTOR MATERIALS

Post-reduction oblique X-ray of left wrist (author's own image)





INSTRUCTOR MATERIALS

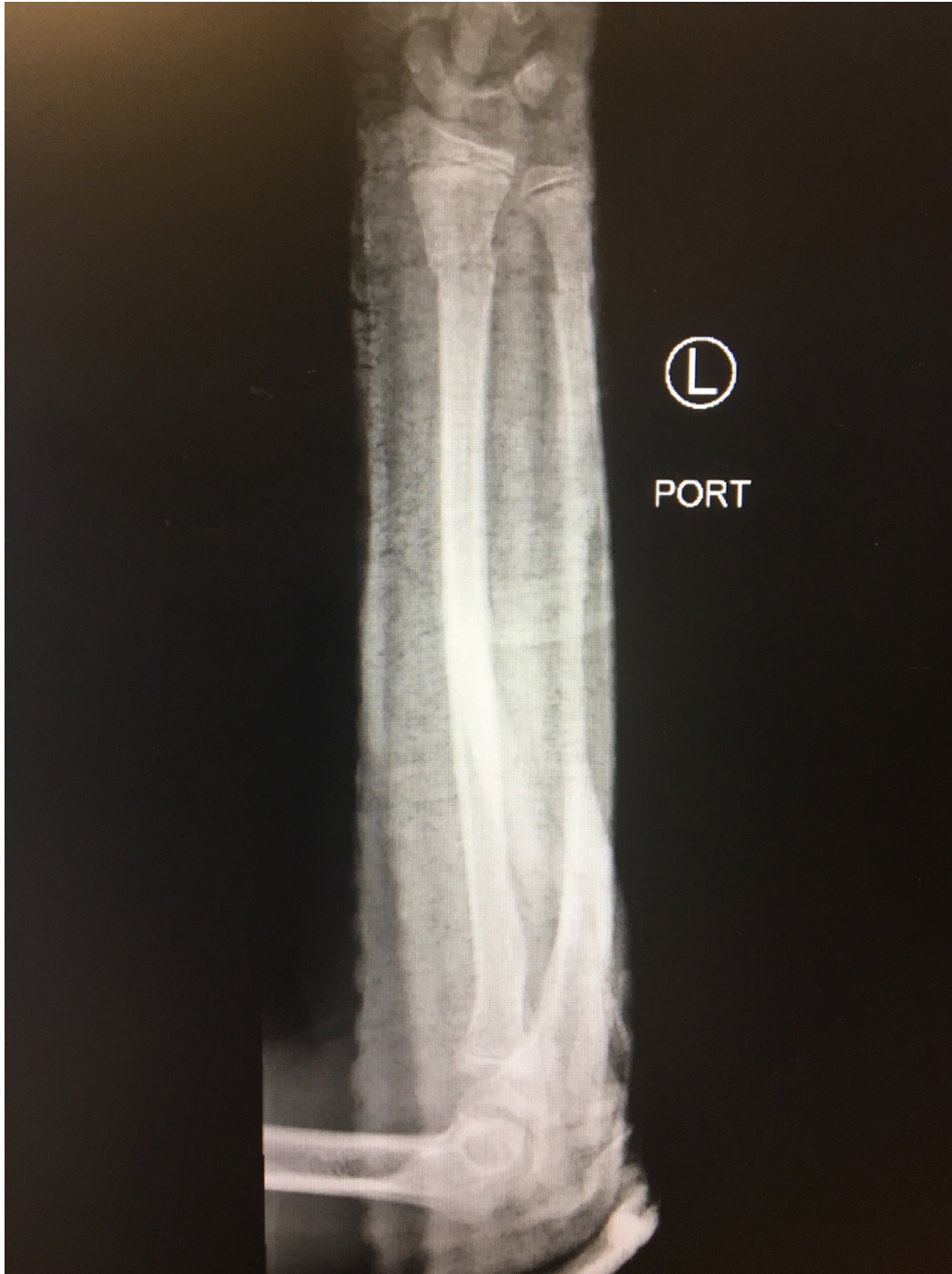
Post-reduction anteroposterior X-ray of left wrist (author's own image)





INSTRUCTOR MATERIALS

Post-reduction anteroposterior X-ray of the left forearm (author's own image)





INSTRUCTOR MATERIALS

Post-reduction lateral X-ray of left forearm (author's own image)





OPERATOR MATERIALS

SIMULATION EVENTS TABLE:

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
0:00 (Baseline)	Participant takes history from paramedics. Requests vital signs.	Patient arrives via ambulance, crying, complaining of pain to left upper extremity.	T 37.1 HR 117 BP 118/85 RR 18 O ₂ Sat 98% on RA
2:00	Participants attempt to perform physical exam.	Patient continues to complain of pain, crying, screaming, uncooperative with exam of extremity.	T 37.1 HR 126 BP 119/87 RR 18 O ₂ Sat 100% on RA
4:00	Participant should request pain medications. Possible medications include: <ul style="list-style-type: none"> • Intranasal (IN) fentanyl 1-2mcg/kg • IN or intramuscular (IM) ketamine 1mg/kg • Oral narcotics 	If participants request IV-line, patient yells "I don't want to be poked, no needles." Parent requests no IV line until patient is given pain control. Patient's pain improves after pain medication. If dosing of pain medications is not appropriate, pharmacy can call with appropriate dosing or nursing can state that the dose is incorrect.	T 37.1 HR 115 BP 109/75 RR 18 O ₂ Sat 100% on RA
5:00	Participant completes exam and orders X-ray	X-rays will be promptly available for review.	T 37.1 HR 115 BP 109/75 RR 18 O ₂ Sat 100% on RA
6:00	Participant recognizes displaced distal/radius fracture	Orthopedist responds to consult and is happy to perform the reduction and requests the participant perform moderate sedation for the procedure.	T 37.1 HR 115 BP 109/75 RR 18



OPERATOR MATERIALS

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
	Participant informs parents of results and consults pediatric orthopedist.	If orthopedics is not consulted, they will call and say they heard there was a fracture that needed reduction.	O ₂ Sat 100% on RA
7:00	<p>Participants get parent's consent for sedation including:</p> <ul style="list-style-type: none"> • Risks • Benefits • Medication selection and possible side effects • Alternatives <p>Participants complete a pre-sedation history and physical.</p> <p>Once the parent consents, participants should request that nursing and respiratory therapists be present (depending on hospital protocol)</p>	<p>If appropriate consent is not obtained, parents can prompt physicians for more information until they have received a full appropriate consent</p> <p>If pre-sedation history and physical are not obtained, the nurse can prompt the participant to do so.</p> <p>Instructors can state that respiratory therapy is available (if required by hospital policy) but do not need to provide an additional confederate because the participants will be required to manage complications on their own.</p>	
8:00	<p>Participants should order a medication for sedation.</p> <p>Possible options include:</p>	<p>Prior to sedation, learners should place the patient on 2L nasal canula (NC), end-tidal CO₂ monitor.</p> <p>If participants do not request appropriate monitoring, nursing can prompt them with "what monitoring would you like for the sedation?"</p>	<p>T 37.1 HR 123 BP 119/86 RR 18 O₂Sat 100% on 2L NC</p>



OPERATOR MATERIALS

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
	<ul style="list-style-type: none"> • Ketamine 1-2 mg/kg IV • Ketamine 2-4mg/kg IM • Fentanyl 1-2mcg/kg IV + Versed 0.02-0.1mg/kg IV • Propofol 1-2mg/kg IV • “Ketafol” typically 1:1 Ketamine 0.5mg/kg + Propofol 0.5mg/kg IV • Etomidate 0.15mg/kg IV 	<p>If participant dosing is incorrect, pharmacy can call or nursing can notify the participants, “I don’t think that dose is correct.”</p> <p>Sedation medications are given, and the patient is adequately sedated.</p>	<p>ETCO₂ 36 with normal waveform</p>
<p>Ketamine 10:00</p>	<p>Participant manages the complication.</p>	<p>Patient has laryngospasm. O₂sat will drop to 70%.</p> <ul style="list-style-type: none"> • Participants should recognize the hypoxia and provide bag valve mask (BVM) ventilations until oxygen saturation improves. The patient will initially be difficult to ventilate, but it will resolve after about 30 seconds at which point the oxygen saturation will increase to 100%. • If participants do not bag, the patient’s O₂sat will drop to 30% and nursing will prompt the participant to provide bag valve mask ventilations. <p>During sedation orthopedist will reduce the fracture and place splint.</p> <p>Patient will have an emergence reaction: when waking up he becomes agitated, anxious, crying, hysterical and talking about monsters in the room.</p> <ul style="list-style-type: none"> • Participants should recognize the emergence reaction and treat with benzodiazepines at which point the reaction will resolve. 	<p>T 37.1 HR 123 BP 140/96 RR 18 O₂Sat 70% on 2L NC ETCO₂ 12 with flat waveform</p> <p>BVM: T 37.1 HR 123 BP 140/96 RR 18 O₂Sat 100% with BVM ETCO₂ 42 with normal waveform</p> <p>No BVM:</p>



OPERATOR MATERIALS

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
		<ul style="list-style-type: none"> If benzodiazepines are not ordered, he will continue to cry and parent should prompt the participant to “Do something!” <p>The child will start waking up and ask why the doctor has three eyes. Participant should recognize the sedation is over when the patient is alert and following commands. The nurse can prompt the participant if needed with “Are we done with the sedation?”</p>	<p>T 37.1 HR 123 BP 140/96 RR 18 O₂Sat 30% on 2L NC ETCO₂ 12 with flat waveform</p> <p>During emergence reaction: T 37.1 HR 143 BP 140/96 RR 18 O₂Sat 100% on 2L NC ETCO₂ 38 with normal waveform</p>
Fentanyl/ Versed 10:00	Participant manages the complication.	<p>Patient will start to vomit.</p> <ul style="list-style-type: none"> Participant will need to roll patient to the side, suction, and order an antiemetic. If patient is not rolled to the side, the patient will desaturate to 70% due to aspiration. Subsequently, rolling the patient on the side will resolve the hypoxia, and oxygen saturation will return to 100%. If antiemetic is not ordered, nursing should prompt the participant (“Do you want me to give him medication for the vomiting?”) <p>During sedation orthopedist will reduce the fracture and place splint.</p> <p>The child will start waking up and ask why the doctor has three eyes. Participant should</p>	<p>T 37.1 HR 123 BP 119/86 RR 18 O₂Sat 100% on 2L NC ETCO₂ 38 with normal waveform</p> <p>Without rolling on side: T 37.1 HR 123 BP 119/86 RR 18</p>



OPERATOR MATERIALS

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
		<p>recognize the sedation is over when the patient is alert and following commands. The nurse can prompt the participant if needed with “are we done with the sedation?”</p>	<p>O₂Sat 70% on 2L NC ETCO₂ 38 with normal waveform</p>
<p>Propofol 10:00</p>	<p>Participant manages the complication.</p>	<p>Patient will become apneic requiring bagging. Patient’s oxygen saturation will drop to 70%.</p> <ul style="list-style-type: none"> • Participants should recognize the hypoxia and provide bag valve mask ventilations. The hypoxia will improve to 100% with 30 seconds of bagging. • Additionally, patient’s repeat BP will return hypotensive at 50’s/20’s; patient should be given a bolus of fluids 20cc/kg. • If patient is not bagged or given fluids nursing will prompt the participant. <p>During sedation, orthopedist will reduce the fracture and place splint.</p> <p>The child will start waking up and ask why the doctor has three eyes. Participant should recognize the sedation is over when the patient is alert and following commands. The nurse can prompt the participant if needed with “Are we done with the sedation?”</p>	<p>Without BVM or fluid bolus: T 37.1 HR 123 BP 55/29 RR 18 O₂Sat 70% on 2L NC ETCO₂ 12 with flat waveform</p> <p>With BVM but no fluid bolus: T 37.1 HR 123 BP 55/29 RR 18 O₂Sat 100% on 2L NC ETCO₂ 46 with normal waveform</p> <p>With fluid bolus but no BVM: T 37.1 HR 123 BP 102/61 RR 18 O₂Sat 70% on 2L NC ETCO₂ 12 with flat waveform</p>



OPERATOR MATERIALS

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
			With BVM and fluid bolus: T 37.1 HR 123 BP 102/61 RR 18 O ₂ Sat 100% on 2L NC ETCO ₂ 43 with normal waveform
Etomidate 10:00	Participant manages the complication.	<p>Patient will become apneic and stop breathing.</p> <ul style="list-style-type: none"> • Participants should be monitoring for apnea with the end-tidal CO₂, and should recognize the apnea and provide bag valve mask ventilation. Apnea will resolve after 30 seconds. • If participants do not provide ventilations, the patient's oxygen saturation will drop to 70% until patient is ventilated appropriately. Oxygen saturation will increase to 100% after 30 seconds of bagging. • If patient is still not ventilated, nursing should prompt the participant. <p>During sedation orthopedist will reduce the fracture and place splint.</p> <p>The child will start waking up and ask why the doctor has three eyes. Participant should recognize the sedation is over when the patient is alert and following commands. The nurse can prompt the participant if needed with "Are we done with the sedation?"</p>	<p>Before BVM: T 37.1 HR 123 BP 119/86 RR 18 O₂Sat 100% on 2L NC ETCO₂ 12 with flat waveform</p> <p>With BVM: T 37.1 HR 123 BP 119/86 RR 18 O₂Sat 100% with BVM ETCO₂ 42 with normal waveform</p> <p>Without BVM: T 37.1 HR 123 BP 119/86 RR 18 O₂Sat 70% on 2L NC</p>



OPERATOR MATERIALS

Minute (state)	Participant action/ trigger	Patient status (simulator response) & operator prompts	Monitor display (vital signs)
			ETCO ₂ 12 with flat waveform
12:00 (Case Completion)	Participant or orthopedist requests post-reduction films.	Post-reduction films available and show adequate alignment. Nurse reports to participants that the patient tolerated juice. Parent wants to know if they can go home.	T 37.1 HR 107 BP 114/66 RR 18 O ₂ Sat 100% on 2L NC ET CO ₂ 34 with normal waveform

Diagnosis:

Displaced distal radius and ulnar fracture requiring moderate sedation for reduction

Disposition:

Home



DEBRIEFING AND EVALUATION PEARLS

We recommend using the following worksheet “Pain Control and Moderate Sedation Worksheet” to guide the debrief. Each participant can be given a blank worksheet to fill out during the discussion.

The answers are included on the “Pain Control and Moderate Sedation Worksheet Key.”



DEBRIEFING AND EVALUATION PEARLS

Pediatric Pain Control and Moderate Sedation Worksheet

Possible pediatric pain control medications:

	Route	Dosing
Tylenol		
Ibuprofen		
Hydrocodone		
Ketorolac		
Fentanyl		
Morphine		
Ketamine		



DEBRIEFING AND EVALUATION PEARLS

Indications for pediatric sedation in the emergency department:

Contraindications for moderate sedation in the emergency department:

Types of sedation:

	Response to Stimuli?	Airway?	Breathing?	Circulation?
Minimal Sedation				
Moderate Sedation				
Deep Sedation				
General Anesthesia				

Pre-sedation history and physical exam should include:



DEBRIEFING AND EVALUATION PEARLS

Mallampati Score:

(label the image below with I-IV)



Image source: Jmarchn. Mallampati Score. Wikimedia Commons.
<https://commons.wikimedia.org/wiki/File:Mallampati.svg>. CC BY-SA 3.0.

ASA Classification:

What is it? _____

ASA 1	
ASA 2	
ASA 3	
ASA 4	
ASA 5	
ASA 6	



DEBRIEFING AND EVALUATION PEARLS

Possible sedation medications:

	Dosing	Side Effects	Onset	Offset	Reversals
Versed					
Fentanyl					
Etomidate					
Ketamine					
Propofol					
Ketofol					

Set Up:

What equipment do you need?

What medical professionals must be present during the sedation?



DEBRIEFING AND EVALUATION PEARLS

When is the sedation considered over and when can the patient be discharged?



DEBRIEFING AND EVALUATION PEARLS

Pediatric Pain Control and Moderate Sedation Worksheet Key

Possible pediatric pain control medications

	Route	Dosing
Tylenol	Oral (PO) Rectal	15 mg/kg
Ibuprofen	PO	10 mg/kg
Hydrocodone	PO	0.1-0.2mg/kg
Ketorolac	Intravenously (IV) Intramuscular (IM)	0.5mg/kg (max 15mg if IV, 30mg if IM) Not approved for <2 years old
Fentanyl	IV, IM, Subcutaneously (SQ), Interosseous (IO) Intranasal (IN)	0.5-2mcg/kg 2mcg/kg
Morphine	IV, IM, SQ, IO	0.1-0.2mg/kg
Ketamine	IM	0.1mg/kg



DEBRIEFING AND EVALUATION PEARLS

Indications for moderate sedation in the emergency department:

Lumbar puncture, suturing, fracture/dislocation reduction, wound debridement, chest tube placement, or any other brief painful procedure.

Contraindications for moderate sedation in the emergency department:

Absolute contraindications are rare, but physician should consider the risks and benefits in patients with multiple co-morbidities with a high ASA classification, complicated procedures that may require prolonged sedation, or patients with a history of anesthesia complications who may be better managed by anesthesia in the operating room.

Previously recent (between 2-6 hours depending on material) oral intake was a contraindication for moderate sedation but recent studies and guidelines suggest that for emergent and urgent procedures NPO status does not change risk of aspiration.^{4,5}

Types of Sedation

	Response to Stimuli?	Airway?	Breathing?	Circulation?
Minimal Sedation	Normal, cognitive function minimally impaired	Patent	Unchanged	Unaffected
Moderate Sedation	Depressed, responds purposefully to verbal commands	Patent	Spontaneous ventilation unchanged	Unaffected
Deep Sedation	Not easily aroused, responds to painful stimuli	May require assistance	May be inadequate	Unaffected
General Anesthesia	Unable to arouse the patient	Requires assistance	Affected, typically requiring positive pressure ventilation	May be affected

Pre-Sedation History and Physical Exam Should Include:

Past medical history, surgical history, medications, allergies, previous reactions to anesthesia and last meal, as well as determination of the patients ASA Status (American Society of Anesthesiologists Physical Status Classification, see below). Physical exam should include a thorough examination of the airway and respiratory status including: assessment of craniofacial abnormalities, Mallampati classification, facial symmetry, mouth



DEBRIEFING AND EVALUATION PEARLS

opening, mandibular size, neck range of motion/flexion/extension, assessment of dentition, assessment/auscultation of respiratory tract, assessment/evaluation of the patient's cardiovascular system and gastrointestinal system including hepatic and renal status (since many medications are metabolized or excreted via the hepatic or renal systems).

Mallampati Score:

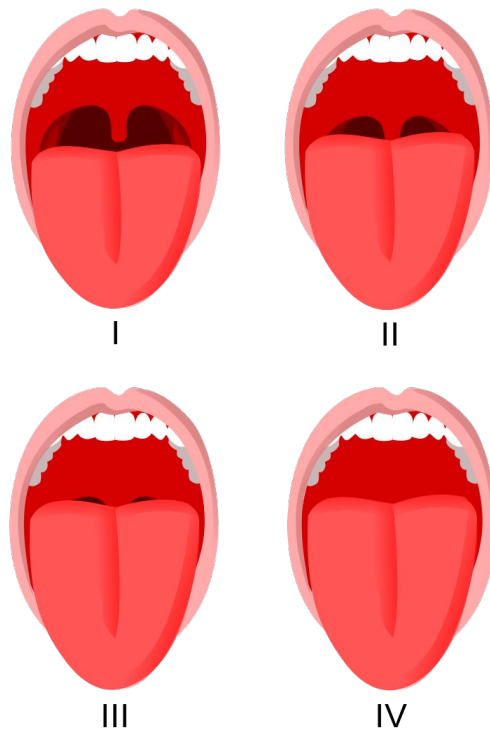


Image source: Jmarchn. Mallampati Score. Wikimedia Commons.
<https://commons.wikimedia.org/wiki/File:Mallampati.svg>. CC BY-SA 3.0.

ASA Classification:

What is it? A system for assessing the fitness of a patient before surgery.

ASA 1	Normal healthy patients
ASA 2	Patients with mild systemic disease; smoker, mild alcohol, pregnancy, well controlled diabetes (DM), hypertension (HTN), mild lung disease, etc.
ASA 3	Patients with severe systemic disease that is limiting but not incapacitating; DM, poorly controlled HTN, coronary artery disease, chronic obstructive pulmonary disease, end-stage renal disease, hepatitis, pacemaker, heart failure with ejection fraction less than 40%, congenital metabolic disorders, etc.



DEBRIEFING AND EVALUATION PEARLS

ASA 4	Patients with disease that is threatening to life, such as recent stroke, myocardial infarction, automatic implantable cardioverter-defibrillator, heart failure with ejection fraction less than 20%.
ASA 5	Morbid patients not expected to live more than 24 hours; aortic dissection, abdominal aortic aneurysm, ischemic bowel, brain bleeds, etc.
ASA 6	Brain dead, organs are removed for donation.

Possible Sedation Medications:

	Dosing	Side Effects	Onset	Offset	Reversals
Versed	0.02-0.1mg/kg initially Repeat at 25% the initial dose q5 minutes Approximately 5mg total dosing max	<ul style="list-style-type: none"> • Amnesia • Anticonvulsant • Sedation • Respiratory depression 	2-5 mins	30-60 mins	Flumazenil but probably better to just support the patient until offset
Fentanyl	1-2mcg/kg slow IV push (over 1-2 mins) Repeat at 30 mins	<ul style="list-style-type: none"> • Analgesia • Minimal cardiovascular effects • Hypotension rare • Respiratory depression • Nausea, vomiting 	1-2 mins	30-60 mins	Narcan
Etomidate	“Half Dose” 0.1-0.2mg/kg slow IV push (over 30-60 seconds)	<ul style="list-style-type: none"> • Anesthesia • No analgesia • Myoclonus • Adrenal suppression • Lowers seizure threshold • No hypotension • Slightly reduces intracranial/intraocular pressure 	<1 min	3-5 mins	none
Ketamine	1-2mg/kg IV bolus slow push	<ul style="list-style-type: none"> • Dissociative and amnestic • No airway suppression • Laryngospasm • Hypertension • Emergence delirium 	1 min	10-20 mins	None Benzodiazepines for Emergence Delirium



DEBRIEFING AND EVALUATION PEARLS

	2-4mg/kg IM bolus Re-dose at 0.5-2mg/kg IV				
Propofol	1-2mg/kg IV bolus slow push Re-dose 0.5-1mg/kg q 5mins	<ul style="list-style-type: none"> • Analgesia and amnesia • Burning with injection • Hypotension, CV and respiratory depression • Anti-seizure • Quick wake up 	1-2 mins	5-10 mins	none
Ketofol	1:1 mixture of propofol and ketamine 1-2mg/kg IV bolus, slow push Re-dose at 0.5-1mg/kg q 5 to 10 mins	<ul style="list-style-type: none"> • Analgesia and amnesia • Less hypotension • Still some respiratory depression • Reeducation in emergency delirium 	1-2 mins	10-15 mins	none

Set Up:

What equipment do you need?

SOAP IM Acronym

- S: Suction
- O: Oxygen
- A: Airway Equipment
 - Oral airway
 - Endotracheal tube, blades, video laryngoscopy if needed
 - Nasopharyngeal airway
 - Bag valve mask
- P: Pharmacy/Medications
 - Sedation medications
 - Reversal medications
- I: IV Access
- M: Monitoring
 - Pulse oximetry



DEBRIEFING AND EVALUATION PEARLS

- Capnography (End-tidal CO₂ monitor)
- Continuous heart rate, respiratory rate
- Every 3-minute blood pressure

Who must be present during the sedation?

(INSTRUCTOR NOTE: The following are likely hospital dependent; please edit to meet your hospital's guidelines)

- Two medical professionals standard
 - Hospital interpretation varies: some require one physician to be responsible for the sedation/airway while another is responsible for the procedure.
 - Many hospitals allow for the physician to do the procedure with a nurse acting as the second medical professional.
- Nurse
- Some hospitals require respiratory technician to be present.

When is the sedation considered over and when can the patient be discharged?

The sedation is generally considered over when the patient is awake enough to follow commands.

Patients are safe for discharge once they return to their baseline: alert and oriented, ambulating, and tolerating oral intake.

Pediatric Sedation Worksheet References:

1. Coté CJ, Wilson S, American Academy of Pediatrics, and American Academy of Pediatric Dentistry. Guidelines for monitoring and management of pediatric patients before, during, and after sedation for diagnostic and therapeutic procedures: update 2016. *Pediatrics*. 2016;138(1): pii: e20161212. doi: 10.1542/peds.2016-1212
2. Barnes S, Yaster M, Kudchadkar SR. Pediatric sedation management. *Pediatr Rev*. 2016; 37(5):203-212. doi: 10.1542/pir.2014-0116
3. Koh J L, Palermo T. Conscious sedation: reality or myth? *Pediatr Rev*. 2007;28(7):243-248. doi: 10.1542/pir.28-7-243
4. Thorpe RJ, Bengler J. Pre-procedural fasting in emergency sedation. *Emergency medicine journal: EMJ*. 2010; 27(4):254-61.
5. Godwin SA, et al. Clinical policy: procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 2014;63(2):247-58.



SIMULATION ASSESSMENT

Pediatric Sedation for Forearm Fracture

Learner: _____

Assessment Timeline

This timeline is to help observers assess their learners. It allows observer to make notes on when learners performed various tasks, which can help guide debriefing discussion.

Critical Actions

1. Provide pain control with intranasal, intramuscular, or oral pain medications (since no IV line is available).
2. Order appropriate imaging and recognize ulna and radial forearm fracture.
3. Obtain informed consent for moderate sedation from patient's parent.
4. Perform a pre-sedation history and physical exam (medical history, allergies, previous anesthetic complications, ASA classification, Mallampati class).
5. Order an appropriate sedation medication (including dosage).
6. Manage sedation complication (specifics will vary based on medication ordered – see simulation events table).
7. Re-evaluate the patient after the sedation and before discharge, and recognize appropriate criteria for ending the sedation and discharging the patient.

0:00



SIMULATION ASSESSMENT

Pediatric Sedation for Forearm Fracture

Learner: _____

Critical Actions:

- Provide pain control with intranasal, intramuscular, or oral pain medications (since no IV line is available).
- Order appropriate imaging and recognize ulna and radial forearm fracture.
- Obtain informed consent for moderate sedation from patient's parent.
- Perform a pre-sedation history and physical exam (medical history, allergies, previous anesthetic complications, ASA classification, Mallampati class).
- Order an appropriate sedation medication (including dosage).
- Manage sedation complication (specifics will vary based on medication ordered – see simulation events table).
- Re-evaluate the patient after the sedation and before discharge, and recognize appropriate criteria for ending the sedation and discharging the patient.

Summative and formative comments:



SIMULATION ASSESSMENT

Pediatric Sedation for Forearm Fracture

Learner: _____

Milestones assessment:

	Milestone	Did not achieve level 1	Level 1	Level 2	Level 3
1	Emergency Stabilization (PC1)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Recognizes abnormal vital signs	<input type="checkbox"/> Recognizes an unstable patient, requiring intervention Performs primary assessment Discerns data to formulate a diagnostic impression/plan	<input type="checkbox"/> Manages and prioritizes critical actions in a critically ill patient Reassesses after implementing a stabilizing intervention
2	Performance of focused history and physical (PC2)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Performs a reliable, comprehensive history and physical exam	<input type="checkbox"/> Performs and communicates a focused history and physical exam based on chief complaint and urgent issues	<input type="checkbox"/> Prioritizes essential components of history and physical exam given dynamic circumstances
3	Diagnostic studies (PC3)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Determines the necessity of diagnostic studies	<input type="checkbox"/> Orders appropriate diagnostic studies. Performs appropriate bedside diagnostic studies/procedures	<input type="checkbox"/> Prioritizes essential testing Interprets results of diagnostic studies Reviews risks, benefits, contraindications, and alternatives to a diagnostic study or procedure
4	Diagnosis (PC4)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Considers a list of potential diagnoses	<input type="checkbox"/> Considers an appropriate list of potential diagnosis May or may not make correct diagnosis	<input type="checkbox"/> Makes the appropriate diagnosis Considers other potential diagnoses, avoiding premature closure



SIMULATION ASSESSMENT

Pediatric Sedation for Forearm Fracture

Learner: _____

	Milestone	Did not achieve level 1	Level 1	Level 2	Level 3
5	Pharmacotherapy (PC5)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Asks patient for drug allergies	<input type="checkbox"/> Selects an medication for therapeutic intervention, consider potential adverse effects	<input type="checkbox"/> Selects the most appropriate medication and understands mechanism of action, effect, and potential side effects Considers and recognizes drug-drug interactions
6	Observation and reassessment (PC6)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Reevaluates patient at least one time during case	<input type="checkbox"/> Reevaluates patient after most therapeutic interventions	<input type="checkbox"/> Consistently evaluates the effectiveness of therapies at appropriate intervals
7	Disposition (PC7)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Appropriately selects whether to admit or discharge the patient	<input type="checkbox"/> Appropriately selects whether to admit or discharge Involves the expertise of some of the appropriate specialists	<input type="checkbox"/> Educates the patient appropriately about their disposition Assigns patient to an appropriate level of care (ICU/Tele/Floor) Involves expertise of all appropriate specialists
9	General Approach to Procedures (PC9)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Identifies pertinent anatomy and physiology for a procedure Uses appropriate Universal Precautions	<input type="checkbox"/> Obtains informed consent Knows indications, contraindications, anatomic landmarks, equipment, anesthetic and procedural technique, and potential complications for common ED procedures	<input type="checkbox"/> Determines a back-up strategy if initial attempts are unsuccessful Correctly interprets results of diagnostic procedure



SIMULATION ASSESSMENT

Pediatric Sedation for Forearm Fracture

Learner: _____

	Milestone	Did not achieve level 1	Level 1	Level 2	Level 3
20	Professional Values (PROF1)	<input type="checkbox"/> Did not achieve Level 1	<input type="checkbox"/> Demonstrates caring, honest behavior	<input type="checkbox"/> Exhibits compassion, respect, sensitivity and responsiveness	<input type="checkbox"/> Develops alternative care plans when patients' personal beliefs and decisions preclude standard care
22	Patient centered communication (ICS1)	<input type="checkbox"/> Did not achieve level 1	<input type="checkbox"/> Establishes rapport and demonstrates empathy to patient (and family) Listens effectively	<input type="checkbox"/> Elicits patient's reason for seeking health care	<input type="checkbox"/> Manages patient expectations in a manner that minimizes potential for stress, conflict, and misunderstanding. Effectively communicates with vulnerable populations, (at risk patients and families)
23	Team management (ICS2)	<input type="checkbox"/> Did not achieve level 1	<input type="checkbox"/> Recognizes other members of the patient care team during case (nurse, techs)	<input type="checkbox"/> Communicates pertinent information to other healthcare colleagues	<input type="checkbox"/> Communicates a clear, succinct, and appropriate handoff with specialists and other colleagues Communicates effectively with ancillary staff