I. Pharmacology Simulation Scenario: Tension Pneumothorax

II. Target Audience: 1st and 2nd year medical students

III. Learning Objectives
A. Primary
   1. Develop a plausible differential diagnosis from the history and physical examination findings for the scenario.
   2. Choose a treatment plan to resolve the patient-simulator's condition.
B. Secondary
   1. Know the clinical findings associated with a tension pneumothorax.
   2. Know different types of local analgesia and their potential side effects in patients requiring needle compression and/or chest tube placement.
C. Critical Actions Checklist
   1. Performs a rapid primary survey assessment.
   2. Obtain IV access and connect patient to continuous cardiorespiratory monitoring.
   3. Perform a focused history.
   4. Perform a focused physical examination.
   5. Recognize the patient’s initial respiratory distress.
   6. Initiate treatment with supplemental oxygen.
   7. Recognize tension pneumothorax (based on hx and pe)
   8. Identify landmarks for needle decompression
   10. Administer local and possibly systemic analgesia.
   11. Perform immediate needle decompression.

Duration to critical actions: resuscitation to be completed within 20-30 minutes of starting the scenario

IV. Environment
A. Lab setup: 2 spaces, an Emergency Department trauma room with an adjacent conference room with live audio video feed. There was an instructor in each room.
B. Adult human patient simulator with available monitoring devices including cardiorespiratory monitor and pulse oximeter.
C. Props:
   1. IV lines
   2. Nasal cannula
   3. Face mask
   4. Non-rebreather mask
   5. Ambu-bag
6. Stethoscope
7. Oxygen tank
8. CXR: tension pneumothorax and a post decompression film (Appendix A and B)
9. Standard pocket pharmacology guide
10. Faux Medications
11. Decompression needle (18 guage)

V. Actors
   A. None

VI. Case Narrative
   A. Scenario Background (given freely)
      1. 55 year-old motorcycle rider moderate speed collision on freeway, helmeted, brought in by EMS. Complaining of left sided chest pain and shortness of breath.
      2. Hx: Coronary Artery Disease, 2 stents, Type 2 DM, Hypercholesterolemia, Smoker
      3. Meds: Zocor, Plavix, asa, metformin
   B. Scenario condition initially
      1. V/S: RR 28, HR 140, BP 160/80, O2: 93%
      2. Patient moaning, appears to be in pain
      3. Airway: patent
      4. Breathing: tachypnea, absent breath sounds on left
      5. Circulation: tachycardia, symmetric pulses
      6. Skin: numerous lacerations and abrasion on left chest
   C. Scenario branch points
      1. This patient presents initially with a left sided pneumothorax
      2. CXR (Appendix A) has already been obtained by the time the learners approach the patient.
      3. Patient begins to decompensate: BP drops, HR increases, GCS drops
      4. Oxygen administration does not improve patient’s condition
      5. If early detection of tension pneumothorax is not made, patient develops cardiovascular failure
      6. Requires needle decompression
      7. Admission

VII. Instructor Tips
   A. Instructor must be able to highlight key teaching points as the scenario develops.
   B. Laminated cue cards which contain the case narrative, suggested questions, and detailed information on the medications used in each scenario can be held by instructor (Appendix C).
   C. Use of Socratic method (comfortable with silence)
D. Instructor must make it interactive by encouraging participation with all 4 participants
   a. Connect simulator to cardiorespiratory monitor and pulse oximeter
   b. Connect oxygen tubing
c. Assess mental status, work of breathing, auscultation, color, and respiratory rate
d. Access dosing information from standard pocket pharmacology guide

E. Controlling the speed of decompensation is critical. Learners will benefit more from the experience if they are given adequate time to assess the situation and choose the appropriate treatment plan before the simulator develops cardiorespiratory failure.

VIII. Debriefing Method
A. Group debriefing consisted of two separate, simultaneous real time discussions amongst observers in the conference room (max of 10) and simulation participants in the simulation room (max of 4).
B. Key learning points outlined in the learning objectives were intentionally highlighted by the instructor in both rooms. In our experience, most students were very excited to perform the needle decompression and wanted to discuss management aspects for tension pneumothorax (needle decompression vs. tube thoracostomy). We chose not to spend a significant amount of time on these important topics and deferred these controversial topics to future clinical rotations that the students would be taking as 3rd and 4th year medical students (such as ER, surgery, and critical care).
C. After each scenario, a brief joint discussion involving both observers and participants was held. Some potential questions might include:
   1. What did the simulation participants do well?
   2. What was the one take home point from this case?
   3. What was discussed in the conference room that was not mentioned in the simulation room?

IX. Pilot Testing and Revisions
A. The initial class involved up to 15 students in the simulation room with one faculty member. This inhibited individual participation. The quality of interaction was significantly improved when the class was divided into two smaller groups, each led by a separate faculty facilitator. While there was significant overlap in the content discussed during the 2 real time discussions, material that was not addressed in both rooms was explored in the joint debriefing session. Students were given the opportunity to teach the other group members advanced knowledge not addressed by the other group, which promoted active learning.
B. The group in the simulation room emphasized clinical skills in more detail while the group in the conference room used the clinical assessment time to focus on pharmacologic principles.
C. Number of participants: 4 in Simulation Room, 10 watching live feed
D. Performance expectations: review lecture material prior to simulation experience
E. Evaluation form completed by each learner (Appendix D)
F. Evaluation form completed for each student by both faculty facilitators (Appendix E)

X. Author Affiliations
   A. Jimmy Beck, MD
      Physical Diagnosis Department
      Loma Linda University School of Medicine
      Loma Linda, Ca
Appendix A – Tension Pneumothorax CXR
Appendix B – Decompressed Pneumothorax
Facilitator Cue Card #1

Patient Name: Bob Honda Scenario: Tension Pneumothorax

55 year-old motorcycle rider s/p moderate speed collision on freeway, helmeted, brought in by EMS. He is complaining of left sided chest pain and shortness of breath. This patient initially presented with a pneumothorax on then left. BP drops, HR increases, GCS drops and he develops a tension pneumothorax and requires needle decompression.

Hx: Coronary artery disease- 2 stents, Type 2 DM, Hypercholesterolemia, Smoker

Meds: Zocor, plavix, ASA, metformin

RR 28 HR 140 BP 160/80 O2: 93%

Questions:

- How do you identify a tension pneumothorax?
- What are the different types of analgesia and their potential side effects in a trauma patient?
- Discuss the anatomy of chest tube insertion and discuss the actual procedure.
  1) Locate 2nd intercostal space, midclavicular line
  2) Sterilize area with betadine using circular motion
  3) Insert 18 gauge needle over the top curve of the lower rib

Scenario Meds: Lidocaine, fentanyl, morphine

Facilitator Cue Card #2

Lidocaine:

Action: Class Ib antiarrhythmic; suppresses automaticity of conduction tissue, blocks both the initiation and conduction of nerve impulses by decreasing the neuronal membrane's permeability to sodium ions, which results in inhibition of depolarization with resultant blockade of conduction.

Onset: 1-3 minutes. Duration: up to 10 minutes

Dosage: 4 mg/kg subcutaneous dose

Side Effects: Arrhythmias, rash, allergic reaction
Facilitator Cue Card #3

**Fentanyl:**
Action: Binds with stereospecific receptors at many sites within the CNS, increases pain threshold, alters pain reception, inhibits ascending pain pathways.

Onset: Immediate. Duration: 20 minutes.

Dosage: 0.5-2 mcg/kg/dose (slow IV push)

Side Effects: Bradycardia, respiratory depression, CNS depression, hypotension

Facilitator Cue Card #4

**Morphine:**
Action: Binds with stereospecific receptors at many sites within the CNS, increases pain threshold, alters pain reception, inhibits ascending pain pathways.

Onset: Immediate. Duration: 10-20 minutes.

Dosage: 1-6 mg IV (as single dose)

Side Effects: Nausea, vomiting respiratory depression, hypotension (through venous and arterial vessel dilation)
Appendix D

Pharmacology Simulation Lab Student Evaluation

Name ____________________  Date ____________________

1) List two strengths of today’s lab?
   --
   --

2) List two things that we as facilitators could do differently to improve this experience?
   --
   --

3) Self-assessment: Do you believe you performed as well as your peers, better than your peers, or worse than your peers? Please explain your response.

4) Overall comments on the lab
Appendix E

Pharmacology Simulation Lab Faculty Evaluation

Student Name____________________                                 Date____________________

<table>
<thead>
<tr>
<th>Category</th>
<th>Evidence</th>
<th>Rating (1-3)</th>
</tr>
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<tbody>
<tr>
<td>Motivation</td>
<td>- Actively participated when with manikin</td>
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<tr>
<td></td>
<td>- Actively participated during debrief sessions</td>
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<td></td>
<td>- Asked good questions</td>
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<td></td>
<td>- Facilitated peer involvement</td>
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<tr>
<td>Preparation</td>
<td>- Demonstrated adequate understanding of basic sciences</td>
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<tr>
<td></td>
<td>- Performed well on pre-test</td>
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<tr>
<td>Problem Solving</td>
<td>- Proposed reasonable diagnostic and tx options</td>
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<tr>
<td>Professionalism</td>
<td>- Punctual</td>
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<tr>
<td></td>
<td>- Professionally dressed</td>
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<tr>
<td></td>
<td>- Showed respect for facilitator/peers during discussions</td>
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General Comments________________________________________________________
                                                                                          
                                                                                          
                                                                                          
Faculty_______________________
Faculty_______________________