

UNC Simulation Lab UNC School of Medicine

Training Program for “Operator” Level For The Human Patient Simulator, (HPS)--- Both Adult and Child Simulators

Participants in this program agree to abide by all policies and procedures of the Clinical Skills and Patient Simulation Center. Failure to do so will result in suspension of this privilege---this is at the sole discretion of the Simulation Coordinator.

On site, supervised participation in this program is required to receive the ‘**Operator**’ level certification. This training will be done only by the Simulation Coordinator. Successful completion will require passing an assessment at the end of the training.

Maintenance of Certification: (Currency and Proficiency)

The assessment will stand as a measure of the **Operators** proficiency. As equipment changes, upgrades done, additional training will become necessary to continue to this certification.

Currency: If an ‘**Operator**’ has not used the simulator in 9 months or greater, an operator will be required to come in and go through a demonstration of his/her proficiency.

Without exception, the Simulation Coordinator will be responsible for overseeing all training and assessment.

I Overview

A Training Overview:

This training is designed so that the participant can turn on, set up, operate, shut down, and trouble shoot minor basic problems as they arise. This level of training is not designed to program patients or scenarios. The **Operator** can open, operate, make parameter changes ‘on-the-go’ as needed for a given case, but should not save any patients, scenarios or changes made to either even if they are ‘repairs’.

What this training is not:

- Programming patients, scenarios, saving changes is a separate level of training. This includes ‘repair’ or modifications to existing programming.
- While some basic trouble shooting is covered, this does not imply technical servicing, or repair. That is also a separate level of training. As an ‘**Operator**’, one should not be unzipping, or ‘going inside the mannequin’—basic trouble shooting will not extend that far.
- It is possible to complete multiple certifications, however, one certification does not imply or confer successful completion of the other.

All persons trained at one certification are expected to know in general terms, what the other certifications entail. This helps one understand how and to what extent their own training extends (or does not extend).

B Overview of the HPS:

The Human Patient Simulator is a sophisticated piece of equipment that demands structured training in order to operate effectively and also to avoid damaging it. The Simulator is designed to mimic human form and physiology. The simulator's base form is that of a very healthy if not 'buff' 33 year old male. This base mannequin can be modified to change genders and a variety of patient types and ages.

1) Components: The 'Rack', HPS mannequin, computers, gases, Anesthesia machine (monitors, ventilator, ETCO2 analyzer).

- a) The Rack: This is the central hub of what makes the mannequin physically work. All components plug into the rack. The various pieces of instrumentation that control things like pulses, lungs, etc are housed here along with several circuit boards. The computer controls how these various components in the rack will work and interface with one another.
- b) The computer: The HPS works off a Mac desktop computer. The computer contains all of the software to run the HPS. It is here that various 'patients' and scenarios are created, stored and operated. It is this programming that controls the components in the rack.

In addition, to the desktop, the HPS can be run via a remote IBook laptop. Wirelessly operated, the laptop is slaved to the desktop and can only run the HPS when the desktop is on. The HPS patient programming is on both computers.

- c) The mannequin: The human form houses the components to physically move the lungs, provide pulses, etc. The mannequin provides output to a patient monitor as if so connected in an actual patient room. This includes taking in oxygen and giving off CO2. In addition, a multitude of procedures can be performed on the mannequin making it even more interactive.
- d) Gases: Four gases feed into the rack: Air, Oxygen, Nitrogen, and CO2. These gases are blended to represent normal respiration. Oxygen is consumed and CO2 is expired as in normal respiration.

In order to work properly, the rack requires 50 psi from each gas source which means when the overall pressure in the tank is less than 50 psi, the system will start to fail causing aberrant readings. The air is also used to drive the pneumatics such as lungs and pulses and requires frequent monitoring as it is used much more than the others. The **Operator** is expected to monitor gas levels and to change out tanks as needed. During training, the '**Operator**' will

be required to demonstrate he/she can locate, transport, and change out a tank.

- e) Anesthesiology Machine: Currently, the HPS is attached to a Datex-Ohmeda Aestiva/5 anesthesia machine. The current set up employs a sophisticated Phillips Intellivue MP70 monitor. This setup also includes a Datex-Ohmeda 7100 ventilator and an Agilent M1026A gas analyzer. In addition, there are two TEC7 anesthetic inhalation devices with 'Isoflurane' and 'Sevoflurane'.

The gas analyzer is to be left on at all times. An **Operator** must be able to turn on the monitor, and also to be able to also navigate through the various menus. Different patient types will require different monitor configurations and the **Operator** must be able to set the monitor up according to patient and typical hospital (or out of hospital) location.

2) HPS Features

In order to operate any equipment, it is essential to know just what that piece of equipment can do. It is therefore, essential that an **Operator** be familiar with all of the features and procedures of the HPS. Students using the HPS will not be familiar with these features and it is imperative that the **Operator** be able to tell them if something is or is not possible.

a) Airway:

- Esophageal intubation results in gastric distension and the absence of breath sounds, lung excursion, and carbon dioxide output.
- Right or left mainstem intubation results in: unilateral breath sounds and lung excursion.

b) Breathing

- Stan and Lil Joe physically consumes oxygen, and produces carbon dioxide
 - (also uptake or excretion of nitrous oxide, sevoflurane, isoflurane, enflurane, and halothane. We are currently not set up for this and as an operator you are not responsible for this. If this is added you will be required to have an inservice prior to using the HPS.)
 - Appropriate and dose dependent response to inhaled anesthetics
- Respiratory responses to sympathetic and parasympathic activities are modeled.
- "Stan" breathes with self regulated rate and tidal volume to maintain a target carbon dioxide partial pressure typically 40 mm Hg
- Pulse oximetry monitoring---responds in kind to nasal cannula, simple O2 mask, NRB mask and other adjuncts

- End tidal CO2 monitoring via capnography is possible.
- Airway resistance, lung compliance and chest wall compliance are modeled with independent control of the left and right lung. Changes in airway resistance in these areas show appropriate wave form on a capnograph.
- Three modes of ventilation, (spontaneous, assisted, and mechanical) can be superimposed on one another---for example 'fighting the ventilator
- Ventilator compatible---and capable of triggering a ventilator in SIMV and Assist modes, (ventilator weaning can be realistically rehearsed)
- Built in continuous monitoring for: tidal volume and ABG—ph, PO2, & PCO2 (PO2 & PCO2 are measured at venous, arterial and alveolar locations.)

c) Circulation

- Invasive hemodynamic monitoring with the following capability:
 - Mannequin has right internal jugular PA catheter that can be:
 - ✓ Advanced with appropriate waveforms
 - ✓ Wedged (by inflation)
 - ✓ Used for thermodilution cardiac output.
 - Arterial blood pressure
 - Left ventricular pressure
 - Central venous pressure
 - Right arterial pressure
 - Right ventricular pressure
 - Pulmonary artery pressure

d) Neuro:

- Eyes constrict and dilate to light and can be independently controlled.
- Blink rate can be controlled.
- In addition, left and right pupil size can be independently varied as needed.
- Eyes will close automatically when cerebral perfusion fails
- Right arm will accommodate a peripheral nerve stimulator. Appropriate thumb response to type of test and level of medication present.

e) Other Features

- Logs: the software supports event, physiological and drug logs allowing for review of all aspects both during and post training.
- Temperature: both body and blood temperature are monitored.
- Weight: Patient can be weight adjusted to represent different body masses.

3) Procedures:

A large number of procedures may be performed on the simulator. The operator must be familiar with what is and is not available to the student. Also, several of these procedures require advanced preparation in order to work. For example urine out put requires priming with 'urine' (and to be flushed clean once done.)

a) Airway:

- Oral pharyngeal airway
- Nasal pharyngeal airway
- LMA
- Combitube
- Oral intubation*
- Nasal intubation*
- Use of lighted stylets
- Fiberoptic intubation*
- Retrograde intubation*
- Digital intubation*
- Needle cricothyrotomy---jet ventilation as well
- Surgical cricothyrotomy

b) Breathing

- Three modes of ventilation, (spontaneous, assisted, and mechanical) can be superimposed on one another---for example 'fighting the ventilator
- Needle thoracostomy
- Chest tube insertion

c) Circulation

- Actual non invasive blood pressure cuff readings---manual, or by monitor
- CPR
- IV insertion---simulator measures actual input and responds accordingly
- 5-lead EKG synchronized to pulse. (Many rhythms can be generated.)
- Electrical Therapy: traditional defibrillators, pacers can be applied and utilized
- Foley placement: Male or Female
- Pericardial fluid simulation and pericardiocentesis are possible
- Diagnostic peritoneal lavage

d) Neuro:

- Thumb twitch

4) Medications

- Medication administration: Appropriate and dose depended response to administered medications. [Actual intravenous administration of some 61+ commonly used medications is possible.] Among the supported. Medications mentioned are all drugs required for ACLS.

- Medications may be administered by the participant using the drug recognition module. The operator must be familiar with how this module works and be able to confirm it is primed and working prior to starting a simulation.

An **Operator** is required to be able to monitor and tell when a medication has or has not been appropriately read by the drug recognition module. He/she will need to inform the participants when the reported medication has not been read by the machine in the amount the participant desired to administer.

- Medications may also be given by the operator using the software to administer the medication in the amount, manner the participant requested.
- An **Operator** does not need to have memorized the entire medication formulary. However, he/she should be familiar with whether commonly or frequently given medications are available or not. He/she does need to be able to locate the medications within the software formulary quickly and to be able to administer medications in the dose and manner requested.
- List of medications:

Adenosine	Fentanyl	Phentolamine
Alfentanil	Flumazenil	Phenylephrine
Amiodarone	Glycopyrrolate	Procainamide
Atracurium	Isoproterenol	Propranolol
Atropine	Ketamine	Propofol
Bicarbonate	Labetalol	Quindine
Bretylium	Lidocaine	Remifentanil
Calcium	Lorazepam	Rocuronium
Cisatracurium	Methohexital	Succinylcholine
Curare	Metocurine	Sufentanil
Diazepam	Metoprolol	Thiopental
Digoxin	Meperidine	Vasopressin
Diltiazem	Midazolam	Vecuronium

Dobutamine	Mivacurium	Verapamil
Dopamine	Morphine	
Doxacurium	Naloxone	
Droperidol	Neostigmine	
Edrophonium	Nifedipine	
Ephedrine	Nitroglycerin	
Epinephrine	Nitroprusside	
Esmolol	Norepinephrine	
Etomidate	Pancuronium	

5) Adjustable Software Parameters

In order to operate the simulator, an **Operator** must be able to locate and use the various software parameters. It is these parameters that make the simulator mimic various disease states and injuries. Without a thorough working knowledge of these parameters, the HPS is just another static mannequin on a stretcher. **[Green denotes parameters that can be clinically assessed by the student.]**

a) Cardiovascular

1) Catheters:

Cardiac output measurement

Atrial: peripheral and left ventricle locations

Central Venous, (CVP): intrathoracic vein and extrathoracic vein locations

Pulmonary Artery: pulmonary artery, intrathoracic vein, right atrium, and right ventricle locations

2) External cardiac stimulation:

Defibrillation and cardioversion

Pacing: capture threshold, current, and rate

3) Heart:

Baroreceptor Gain, (cardiac) Factor

Cardiac rhythm override

Contractility factor:

Left ventricle

Right ventricle

Fixed Heart Rate

Heart Rate Factor

Heart sounds; (normal, S3, S4, S3 & S4, early systolic murmur, mid systolic murmur, late systolic murmur, pan systolic murmur, late diastolic murmur.)

Ischemic Index averaging

Ischemic Index sensitivity

Pericardial Fluid

Pericardiocentesis

Resistance Factor

Aortic Valve

Mitral Valve

Pulmonic Valve

Pulses

Chest compression Efficacy

4) Systemic

Baroreceptor gain, (overall) Factor

Baroreceptor gain, (peripheral) factor

Baroreceptor maximum pressure

Baroreceptor minimum pressure

Elastance: extrathoracic arteries

Intrathoracic arteries

Resistance Factor: Venous Return

Venous Capacity Factor

b) Respiratory

1) Airway

Airway occluder / resistance

Laryngospasm

Swollen tongue

Bronchial Occulsion

PEEP

2) Lung

Chest Wall compliance Factor

Functional Residual Capacity

Breath sounds; (Normal, rales, wheezes, muffled)

Chest Wall Capacity

Chest Wall Compliance

Distended Chest Wall Compliance Factor

Fixed Alveolar Enflurane

Fixed Alveolar Halothane

Fixed Alveolar Isoflurane

Fixed Alveolar Sevo Flurance

Fraction of inspired Oxygen Override

Intrapleural Volume: left and right

Lung Compliance Factor: Left and right

Ph shift

Venous Carbon Dioxide Shift

Chest tube air leak
Chest Tube flow rate
Needle decompression

- 3) Respiratory Control
 - Carbon Dioxide Production Factor
 - Carbon Dioxide Setpoint
 - Fixed neuromuscular blockade.
 - I to E ratio**
 - Oxygen Consumption
 - PetCO₂ – PaCO₂ Factor
 - Respiratory Gain Factor
 - Respiratory Quotient
 - Respiratory Rate** Factor
 - Respiratory Rate Override
 - Shunt Fraction
 - Tidal Volume** Factor
 - Tidal Volume Override
 - Volume/Rate** Control Factor

c) Other Patient Conditions:

- 1) **Assessment**
 - Bowel sounds:** (All four quadrants, Normal, Absent, Hyperactive, Hypoactive.)
 - Eye blink control** (Closed, Right or left only blink.)
 - Eye blink speed** (Normal, Slow, Fast)
 - Pupil diameter** (2 mm to blown)
 - Fixed neuromuscular blockade** (No respiration, Normal pulses present.)
- 2) Other parameters
 - Intracranial pressure
 - Patient weight
 - Arterial Temperature**
 - Body Temperature**
- 3) Fluids
 - Blood loss
 - Fluid loss—plasma
 - Fluid infusion**
 - Colloids
 - Crystalloids
 - Packed RBC
 - Whole Blood
 - Urine output**

II Operating the HPS

A Power On & Off Procedures:

1) Power On:

1) Turn the 'Rack' on first.

This is a black toggle switch on the bottom left. Push the top in to "On".

2) Turn the computers on.

Desk top Mac This is a round silver push button located to the bottom left. It is above the USB ports and headset jack. It looks pretty innocuous and more like a symbol than a button.

Mac Laptop is located on the second shelf of the beige rolling cart. Power button is a push button located above the keyboard and to the right.

3) Open the **HPS Program**

Click on "HPS User". You will then have to enter the case sensitive password:

4) Start up the programmed patients from the Default setting of "**Standard Man**"

There are two 'Meti Men' on the tool bar the bottom of the screen. Click on the one at on the right. This will open the "Patients@localhost" screen. Click "Open". Patients are listed alphabetically. Scroll down and click on "Standard Man"

5) **Connect** to the Rack

You are running in 'virtual mode' at this point, meaning 'Stan' has not come alive. To make the manikin breathe, etc. you will need to connect the manikin to the rack.

Before you connect, you need to turn on the gases. You must turn on all four gases; oxygen, nitrogen, CO2, and air. Use the main knob on top of each tank and turn counterclockwise several turns until the gages are pressurized. All four should show and output to the Rack of 50 psi or the system will not operate correctly.

Note the amount of gas in each tank with careful attention to air (and oxygen). The system uses air to drive the manikin, if

you have less than several hundred pounds of air you have a good chance of not getting through you first scenario. In short the manikin uses a lot of air. He also consumes oxygen, but not to the extent of air. If you have any N2 or CO2 you probably can run for hours.

The system should be left ready to go. Meaning if you use it, you are expected to leave it ready for the next person and change empty or near empty tanks out before you leave. They are located in the storage closet---room '1047'. This is locked and you will need to get the keys out of the top draw of the fiberoptic cart.

Once the gases are on and the amount checked you are ready to connect. To do this you must click on "**Connections**" to the top right of the 'patient screen'. A side tab will open to the right. At the top of the blank field you need to see: '**HPS 394**'. This may not appear initially as the computer and rack are 'talking' to each other. It should come up in a few seconds. Only after you see HPS 394 can you proceed. Click on **HPS394** then 'Connect' at the bottom of the tab.

After clicking 'Connect', you should hear the rack cycle. Stan's eyes will open briefly and he will take a breath. The system will then do an internal calibration check before starting to function. Post calibration check, Stan's eyes will stay open and he will start to breathe and function.

You should QC Stan before any exercise, meaning, is his chest rising normally, pulses present, eyes open, etc. Any problems need to be reported in writing to the Simulation Coordinator.

Congratulations, you have made it and ready to go. Close "Standard Man" and open desired patient.

2) Shut Down Procedure

(Basically the reverse of Power up---gases last)

1) Close the **patient**

First click 'Disconnect' located on the top left of the patient screen. Then click 'Stop'. You will see a command asking you if you want to save----click 'Don't Save'.

2) Quit **HPS**

Click on "**HPS**" on the topmost toolbar. Click 'Quit HPS' at the bottom of the screen that comes up.

3) Shut Down the **computer**

Click the 'Apple symbol' on the topmost toolbar. Click on "Shut Down" from the screen that pops up. The computer will shut down. As this is a Mac, you will not have to wait long for the computer to shut down---nice!

4) Turn off the **Rack**

Push the toggle switch down to 'off'.

5) Turn off and vent **tanks** **Do Not Leave tanks on---** **they will leak down**

First, note the pressure in each tank. Close the main valve on the top of the tank by turning clockwise until tight.

Open the small valve on the "Y" of each regulator by turning counter clockwise. When the pressure has come to zero and there is no more gas venting, close the small valve.

Change out any tanks that are empty or near empty.

Check the pressure in any 'new' tanks, then close and vent these as well.

You are done---close doors, thank you.

3) Comparison of On and Off procedure

Power up Procedure

- 1) Turn the 'Rack' on first.
- 2) Turn the **Desk top Mac** on.
- 3) Open the **HPS Program**
- 4) Start up the programmed patients from the Default setting of "**Standard Man**"
- 5) **Connect** to the Rack

Shut Down Procedure

- 1) Close the **patient**
- 2) Quit **HPS**
- 3) Shut Down the **computer(s)**
- 4) Turn off the **Rack**
- 5) Turn off and vent **tanks**

B Set Up and Operation for selected features

1) Defibrillation and Pacing

a) General

Defibrillation and pacing are important and relevant skills to learn and it is encouraged. Frankly, the students enjoy being able to do this.

- The **Operator** is solely responsible during electrical therapy for insuring proper pad placement---after all they are students and learning. This usually means stopping the scenario and inspecting the pads.
- When placing the pads, each pad should only touch their respective brass plate and nothing else. Otherwise this may arc and fry the system. Shorting out the mannequin will result in forfeit of Operator privilege.
- It is imperative to understand that the defibrillation and pacing are two different systems altogether in the HPS. [A 'real patient' has a single system so in this regard the HPS moves away from real life.]

The capacitors that absorb the energy are quite different. The pacing capacitor can only absorb a small amount of current—in milliamps just as a real pacer would deliver. It can not absorb the much larger current that is delivered through defibrillation which is measured in amps as opposed to milliamps. This **1000 fold difference** will fry the pacing capacitor. Thus each system has its own plates to put the pads on.

b) Defibrillation and Synchronized Cardioversion

- Defibrillation and Cardioversion can **only** be done using the right upper chest to left axillary pad placement. (Anterior-lateral placement)
- **DO NOT ATTEMPT FRONT TO BACK PAD PLACEMENT FOR DEFIBRILLATION and CARDIOVERSION.**----The brass screw-ins (for the brass plates) in these locations are only for pacing and are connected to the much lower voltage capacitor.
- The HPS is designed to be shocked by a monophasic defibrillator. This means that if you are using the software to automatically advance the scenario after a defibrillation or cardioversion, the programming will work as intended.

A biphasic defibrillator will test the resistance through the pads by sending current through the system just prior to shocking. If the HPS is in 'automatic advance' mode, this test current is enough to trip the software and advance the scenario prior to the defibrillation being delivered. When using a biphasic defibrillator you must take the automatic advance off and advance the scenario 'manually' using the appropriate software tab.

- The mannequin should not be shocked more than three times in succession as this will over heat the capacitor. The capacitor will dissipate the absorbed energy and the mannequin can be shocked again, however, do not exceed more than two shocks per minute.

c) Pacing:

- Similarly, **pacing can only be done using the front to back pad placement.** The brass plates for this therapy are not left in place. This prevents inadvertent frying of the pacing capacitor by incorrect pad placement during defibrillation.* If pacing is required the brass plates must be unscrewed from the defibrillation position and moved to the pacing positions. [Defibrillation is the more frequent therapy given so the mannequin is left set up for this therapy.]
- Thus the **Operator** needs to look ahead at the scenario and move the brass plates in advance for pacing and then immediately return them to the defibrillation (baseline) position when the scenario is over.
- Failure to return the brass plates to the defibrillation position will result in suspension of **Operator** privilege. If the pacing capacitor is fried as a result, the **Operator** will forfeit his/her privileges. If left in place and a subsequent **Operator** fails to notice and fries the pacing capacitor both **Operators** will forfeit their privileges.

- The mannequin does come with two sets of brass plates, which means pacing and defibrillation can be done in the same scenario without having to move the plates. It does mean that the pads would still have to be moved. Based on this and past experience it is better (and less confusing) to only have one set of studs on the mannequin at a time.
- Currently, no one is running a scenario that has both pacing and defibrillation in the same scenario. If someone has a case they desire to have both pacing and defibrillation in the same case, this needs to be cleared with the Simulation Coordination prior to running the case. Running such a case without approval will forfeit **Operator** privilege.

*[When doing defibrillation, there is a several fold increase in difficulty of placing the pads on the mannequin and avoiding contact with the pacing studs in place. This means this should not be routine practice.

2) Drug Recognition Module:

This is a module the students like, but sometimes have trouble operating. Most of the time there is something incorrect in how the medication was delivered versus a problem with the HPS. This is also the one area of the HPS that has more problems than others lending itself to being suspected as the problem.

a) Components:

- Medication Syringes: There are 61 medications that can be delivered. Each medication has a label with a bar code that can be put on the appropriate size syringe. Nearly all of these go on a ten ml syringe. The label also has the name of the medication and the concentration.

These syringes can be filled and refilled using, (and only using) distilled water. This helps to keep or at least slow the growth of mildew, etc in the tubing and collection system.

Note: most of these concentrations are standard concentrations that you would normally expect to find. However, not all of them are standard concentrations---a learning opportunity to stress the importance of always reading the label before administering a medication.

- Bar code scanner: This is a simple scanner you find on every cash register. The scanner will flash when reading the bar code on the medication syringe. This code tells the computer the drug and the concentration of the drug.
- Volume Syringes: Fluid administered from the medication syringe moves the barrel of one of two 50 ml glass syringes on the back of the rack. The change in direction represents a given volume.

Knowing the concentration and the volume the computer calculates the amount of medication given. The computer then adjusts the patient's vital signs in accordance with the amount of drug, how the drug should work and in the time the drug required for the medication to work.

- Three way stopcock: Two of the three positions are taken up by the fluid in from the IV bag and fluid out to the rack. The remaining position is open and where the medication syringes will screw on to be read by the bar code scanner. This open position is labeled '2'. The lever on top of the stopcock opens and closes the three positions to fluid flow. This lever should be left at the '1' position.
- To administer a medication: first fill a medication syringe with distilled water. Screw the syringe onto the stopcock and see if the scanner is flashing—thus reading the bar code. Note the bar code must be facing the scanner. Turn the lever from the '1' position to the '2' position. Administer the appropriate volume of fluid for the amount of medication desired. Move the lever back to the '1' position. Note: if the lever is not turned back to the '1' position, the computer will not know when you have finished and will not calculate a final volume/amount of medication. Without the calculated amount of medication, the computer will not adjust the vital signs.
- IV fluid bag and Collection Bag: These are used to keep the Drug Recognition system primed with fluid. Without a proper prime, the 50 ml glass syringe will not move respective to the volume given through the medication syringe. This means the amount of medication 'seen' by the computer will not be the same as administered. [Almost always less.]

The IV bag needs to have enough (distilled water) volume to last the case. The IV tubing going to the stopcock must be full and free of air.

The tubing leading from the stopcock and going inside the mannequin must also be full and free of air. This tubing runs to the rack via the umbilical from the mannequin. The tubing leading up to the glass syringes must be full and free of air.

The rack will switch glass syringes when the first one is full. While the second syringe is being filled the rack will dump the fluid from the first syringe into an IV collection bag. The tubing to the collection bag does not require to be primed.

The collection bag will need to be emptied. If you are having increased resistance when administering medications, make sure the stop cock to the collection bag is open. If at first, you are able to give medications and then the resistance starts to build up and you find you need a great deal of pressure to administer the medication, you should suspect that the stopcock to the collection bag is closed.

3) BP Cuff:

This simulator is equipped with a BP cuff that is currently set up to function off the automatic cuff from the monitor.

Our set up does not utilize a pressure gauge for auscultating BP manually.

However, it is possible to still palpate a systolic number by watching the count down on the monitor. You can also auscultate a systolic, however, you do not get a diastolic number as the pulse is easily heard all the way down.

Set up involves testing the cuff prior to beginning the training exercise. The manual cuff should correlate with the arterial line as you would normally expect a manual cuff to correlate with an invasive line.

4) Central Lines:

- This is one of the better features of the simulator as it very nicely demonstrates how all of the parameters are interlinked through the software.
- Start up involves opening Standard Man as the initial patient and calibration point for the simulator.
- Once up and functioning, you should zero the invasive lines. We are currently using: arterial, central venous pressure (CVP), and pulmonary artery pressure (PAP).
- These all can be zeroed together by pressing “Zero All” on the Phillips Intellivue MP70 monitor.
- Before pressing the ‘Zero All’ feature on the monitor, you must open, (as you would any invasive line), to room atmosphere as the zero point. To do this select the “**Cardiovascular**” tab. This opens a submenu and defaults to “**Cathereters**” which is where you need to be. Select each of these lines in turn and select ‘**Atmosphere**’ to open them.
- Press the “Zero All” soft key on the monitor and wait. Once the zeroing is complete, close them by returning each catheter to their respective locations: Arterial line to “**Peripheral**”, CVP to ‘**Intrathoracic**’ and PAP to “**Pulmonary Artery**”.
- The numbers you see should match the numbers on the HUD. If the numbers are off more than a few points, then the monitor and simulator may need to be calibrated to one another. The system does require calibrating occasionally. Past experience shows this takes a minimum of an hour to calibrate and often closer to two hours. If you are about to start or in the middle of a training experience, more than likely this is not going to happen before you need it. If you have a really important training experience that you will be dependent on this feature, it is a word to the wise to come and check the read out well in advance.

- Because of the time requirement, the Simulation Coordinator monitors the system and does this calibration. The calibration software is on the **'Administrator'** side of the HPS software, thus not readily accessible. Please inform the Simulation Coordinator, of any calibration needs.

5) The Microphone---'The Voice of Stan''

- This is one of the more interactive features is not one of the most fun things. It helps the simulator come alive as the students must interact and answer questions, address concerns of the patient. Not to use this is to leave a lot out.
- Set up is easy and quick. Once the simulator is up and running, turn the microphone on. The switch is on the top of the Nady UB-16 transmitter. The on light will come on briefly and then go out if the battery has sufficient charge. If not, then the light stays on and you need to replace the two AA batteries. At this point, simply speak into the microphone and listen for the transmission to come from Stan. The speaker is located on the left side at the top of the neck.

6) Chest Compressions:

Invasive catheters will reflect waveforms that are amplitude dependent based on the effectiveness of chest compressions. The more effective the compressions the greater the amplitude on the waveforms and the higher the resultant numbers. The concentration of exhaled CO₂ is proportional to chest compression effectiveness and automatically increases when resuscitation is successful.

There is no real set up required for this. The invasive lines should all be zeroed when the simulator is turned on. These numbers seen should closely match the respective numbers seen on the Heads UP Display, (HUD). The gas analyzer must also be on.

7) Needle Decompression:

This is software driven and requires little set up.

- Go to the **"Condition"** Tab and select **"Trauma"** then select **"Needle Decompression"**.
- Select **"Enable"** By selecting **'Enable'** the system will direct air pressure to the internal reservoir inside the mannequin.
- The system is now primed and ready for needle decompression. When a needle is inserted into the permanent decompression site this will depress a valve and air will escape. You should hear a hissing sound. If not the valve is not appropriately pressed.
- Decompression requires a 14 gauge needle that is 3 to 6 cm long.

Set Up:

If you expect to utilize this feature, you should test this prior to running a simulation.

8) Thumb Twitch:

The right arm, (also the 'IV arm') accommodates a Peripheral Nerve Simulator. The simulator will detect the stimulus pattern, emitted by the PNS, (single twitch, train-of-four, and tetanus). The simulator will generate the appropriate thumb twitch in response to pattern and type and level still present of the paralytic administered.

Set up involves testing before beginning the training exercise. Occasionally the 9 volt batter in the PNS will need to be changed.

9) GU System

- a) Urine output: Both the adult and peds mannequin will put out urine. The system will have to be primed first in order to do this.
- The system is primed with distilled water.
 - The system is not left primed and will thus require priming each time.
 - Note: if food coloring is used to 'dye ' the distilled water, this must be flushed out once done as the coloring will crystallize onto things and clog the system up.
 - The first thing you will need to do is to move the mannequin as close to the wall as possible. You will need to do this in order to have enough umbilical reach so you can move the rack out to get behind it where all of the connections are.
 - Priming the system requires that the orange 'GI' tubing going to the mannequin be connected to the peristaltic pump on the back of the rack. To do this first make sure the rubber peristaltic tubing has been properly set on the pump. The tubing is left in place, however, you should check placement before starting.
 - Flip the attachment lever down and lift the hood casing up.
 - Place the peristaltic tubing over the wheel mechanism and close the hood. [Note the end of the tubing with the connection for the orange tubing must be on the left side of the pump.]
 - Secure by placing the attachment lever to the up position.
 - Pull open the black clips on either side of the wheel mechanism and thread the tubing into place.
 - Attach the peristaltic tubing to the orange tubing going into the hydraulic umbilical going to the mannequin. [Note: the orange tubing if left connected together so you will have to disconnect the tubing from itself to be able to access the connection you will need.
 - Attach the other end of the peristaltic tubing to the IV urine supply bag. This bag can hang from one of the two hooks on the back of the rack.
 - Place a 14-16 foley in the mannequin.
 - You are now ready to prime the system. Go to the **"Fluid"** tab and open fluids. Go to the far right and select **"Urine Output"**. Use the

slide bar to select a high output to speed the priming. (Up to 999 mls/hr). Hit **'Set'**. Once you see 'urine' coming out the foley you are primed. Select '0' and set. You are now ready to go.

- When finished you must flush the system with a liter of clear distilled water to remove all of the food coloring or dye put into the 'urine'. Again, setting the urine output to a high rate will speed the process.
- Shut down is the reverse process.
 - Disconnect the orange tubing from the peristaltic tubing and place the orange tubing in a catch basin allowing gravity to drain the tubing from the mannequin. [Note, a foley must be in the mannequin in order for air to entrain and gravity to work.] You will also want to place a towel under the peristaltic pump to catch the fluid that drains from it and catch any other water that escapes.
 - Gently blow air through the orange tubing using a large syringe to remove the remaining fluid. (A cath tip syringe can be placed into the foley.)
 - The orange tubing can be left disconnected until next use to assist drying. A note needs to be placed on the door of the rack to alert the next Operator of this status. The orange tubing should be reconnected to itself when urine output is not being utilized.
 - Remove the foley.

10) IV Arm

While we do not generally use the IV arm, an Operator should know how to set it up. The arm will require priming with blood. First locate the gallon jug that the blood is in. This may be on the counter, but most likely is on the floor next to the HVAC in the server room.

- To prime the arm:
 - Fill an IV bag and connect the IV tubing to the IV tubing located in the neck region, (right side).
 - Connect a drain bag ,(second IV bag) to the IV drain.
 - Open the IV bag and prime---you will want some elevation as this is gravity fed.
 - When you see blood coming into the drain bag and are no longer seeing air bubbles, the arm is primed.
- When done you should flush the arm. This procedure is the same as the fill procedure, except replace the blood solution with clear distilled water. Flush until the fluid in the drain bag runs clear. This may take a liter or more.
- Vein and skin replacement: this is a technician level procedure, so as an **Operator** you are not responsible for this. You are responsible for reporting any leaks that will eventually occur even though the 'veins' are self healing.

11) Chest tube:

To use this feature requires priming the system. Note: this is not left set up primed.

○ To Prime:

- Fill an IV bag with simulated blood. Do not use the standard blood used elsewhere in this Simulation Lab and in the IV arm as this is too thick and will clog the system. Put up to 5 cc of red food coloring in an IV bag of distilled water.
- Connect this bag to the white "Trauma" hose at the back of the rack.
- Locate the special chest tube priming hose supplied with the mannequin. Lubricate with silicone and insert into the chest tube opening on the mannequin making sure to engage the valve at the base of the access site. This will open the valve and allow you to access the reservoir.
- Open the "**Condition**" tab. You have two choices in the submenu: 'Assessment' and 'Trauma'. ('Assessment' is the default setting and will show so you will have to click on the arrow to the right of '**Assessment**' to get to the '**Trauma**' menu. Select '**Chest Tube Enable**'. Once this tab is open select '**Prime**'.
- Check for leaks during the priming process.
- Once the chest tube is flowing, set the **Chest Tube Enable** parameter back to '**Disable**' (from 'Prime'.)
- Open the back of the rack and locate the 'Trauma flowmeter' in order to zero it. This is the black box on the back of the rack. Zero by pressing the black button on the bottom left hand corner as you are looking at it from the back of the rack. (There may be some fluctuation of the readings you see, for example 0.0 to 0.3 to 0.5 which is normal.) Once the meter reads zero you are ready to use the software to drive the process during your simulation.

○ Using the Software:

- Under the '**Condition---**'**Trauma**' Tab set '**Chest Tube Enable**' to "**Enable**"
- You will want to adjust the following to fit your specific scenario: '**Chest Tube Flow Rate**', and '**Chest Tube Air Leak**'.
- Under '**Respiratory---**'**Lung**' set "**Intrapleural Volume**" to the the desired amount for your scenario.

○ Clean up:

- This is pretty much going to be the reverse: .
- Disconnect 'blood' IV bag and replace the 'blood' IV bag with clear distilled water IV bag. Use a towel to catch any fluid that drips. Note: you will have to open the system by placing a chest tube into the mannequin.
- Open '**Condition---**'**Trauma**' tab
- Set to "**Prime**" and flush until clear. You will need a catch basin under the chest tube on the mannequin.
- Look for leaks, report any leaks to the Simulation Coordinator.

- Using a cath tipped syringe placed into the chest tube, blow out the remaining water from the system. You will have to first disconnect the IV flush from the white 'Trauma' tubing on the back of the rack and place the catch basin under the 'Trauma tubing'.

12) Pericardiocentesis:

- This starts with first priming the chest tube
 - Prime the pericardiocentesis site using the software. To do this select **'Conditon'** tab, next select **"Trauma"** sub menu, next select **"Pericardiocentesis Enable"**, and under this select **"Prime"**.
 - Once done, under the same **"Pericardiocentesis Enable"** tab, move from **"Prime"** to **"Enable"**.
 - Using a 20 ml syringe and a 16-18 gauge needle, (10-15 cm long) aspirate fluid until you get all of the air out of the system. [Needle should be inserted at the pericardiocentesis access port.]
 - The system is primed and ready to be used.
- Clean up:
 - Remove the chest skin and locate the pericardiocentesis mechanism.
 - Remove the red tape.
 - Replace the 'pericardial fluid' bag with clear distilled water.
 - Under the **"Pericardiocentesis Enable"** tab select **"Prime"** and flush the system.
 - Locate the **"Trauma Features Drainage Tube"** and attach it to the pericardiocentesis drain fitting inside the mannequin's belly.
 - Select **"Pericardiocentesis & Chest Tube/Disabled"** ---do not select **"Prime"**.
 - Using a syringe push air through the system until no water is observed exiting.
 - Reassemble the pericardiocentesis
 - Replace the chest skin per procedure.

13) DPL:

It is unlikely that you will be required to set this up but is included in the off chance you might need to utilize it. If this is required, you need to review the set up with the Simulation Coordinator as more than likely neither of you are current on this set up. The reservoir will hold up to a liter of fluid.

- Prepare the fluid composition appropriate for the sort of tap per scenario using sterile, or distilled water.
- Roll the chest skin back to expose the abdominal area.
- Remove the red tape over the DPL slit.
- As this will place fluid, (a lot) inside the mannequin with all of its electronic equipment it is imperative that there are no leaks. First fill the reservoir with air and observe for leaks---reservoir is able to hold air pressure. To do this insert a needle and fill with air from a syringe. Once full, you may have to replace the red tape to effectively check air pressure.
- Once satisfied about leaks, fill with fluid observing for leaks as you go.
- Replace the red tape when full to insure a seal.

- You are now ready to go.

Clean up;

Using a syringe, remove the fluid taking precautions not to puncture the reservoir. This may be best done with suction tubing set and a suction unit.

C: Running a Patient and scenario:

After learning how to turn on the system and set up the various features you are now ready to run a patient simulation.

1) Opening a METI configured patient:

To do this click on **“Patient”** on the topmost tool bar followed by selecting **“Open”**. You may also click on **“Open”** on the **“Patient @ local host”** menu. Both pathways will take you to the Patient Menu. When first opening the software, this generally defaults to the METI preprogrammed patients menu*. At this point scroll down to find the patient you want and open it by highlighting it and clicking. For the purpose of illustration scroll down and open **“Truck Driver”**.

*[Note: If the METI preprogrammed patient menu is not the menu displayed, then you are most likely in the **“Shared”** patient menu. This is where all custom programmed patients have been saved. At the top of the menu you are in you will see “Shared”. To the right of this you will see the orange **METI man that has: “METI HPS Patients”** written with it. Click on this icon and the METI preprogrammed patients will open. Select the patient you desire.]

When any patient opens, you default to the **“Simulation”** tab. There are no adjustable parameters under this tab. What is displayed is a whole host of patient information that allows the instructor to frame the patient for the students.

Select “Connection” in the top right hand corner. A menu will open to the right. Once you see ‘HPS 394’ click on it to make the patient come ‘alive’.

To open a custom programmed patient you must go to the ‘Shared’ patient menu. Once there, scroll down and select the patient you want.

You are up and running and ready to begin the simulation.

There are six other tabs on the same line as “Simulation”: **“Scenario”**, **“Condition”**, **“Drug”**, **“Fluids”**, **“Cardiovascular”**, and **“Respiratory”**. These are pretty much self explanatory.

2) Opening a “Scenario” :

The “Scenario” tab is used to open and close any number of programmed scenarios. First click on “Scenario” tab to get out of the default “Simulation” tab. You will see a submenu open that will say “Player”. This is the mode you will want to use to run a scenario. [If you click the arrows to the right of “Player”, “Editor” will pop up. “Editor” is used to make changes to a scenario. Unless you

have programming privileges, you should not open “Editor”. Unauthorized editing will result in loss or simulator privileges.

Under the “Player” menu is another tab that says “Scenario” It is this tab from which all scenarios are opened and closed. Click on “Scenario” and then click on “Open” in the menu that pops up.

There are both METI created scenarios and custom made scenarios under this tab. Opening a either a METI scenario or a custom scenario is the same as opening a patient respectively.

The custom scenarios are under the “Shared” folder just at custom patients are under a separate “Shared” patient folder.

The METI scenarios are accessed by clicking on the METI Man just as you did to open the patient itself. The menu that appears, you have seven categories to choose from: ACLS 2006, ACLS, Anesthesia, Allied Health, Obstetrical, Pediatric, and Factory Test scenarios. Each of these heading has a number of scenarios that pertain to that heading.

It is not expected of an Operator to have memorized a list of all of the available scenarios. However, it is important for an Operator to know the general content of these submenus (and the custom “Shared” scenario folder) in order to be able to locate and open scenarios in a timely fashion for the instructor.

Select the appropriate category and scroll down to find the desired scenario and click “Open”. The Scenario will open in “Baseline”.

‘Baseline’ means the scenario is open and ready to advance, but no changes have actually been made yet to the patient**. This allows the Operator to open the scenario and be ready for the case. As an Operator, you can open multiple scenarios all at the same time and they will sit in baseline without making changes to the mannequin. This allows the Operator to open all of the scenarios he /she is going to use in a given case and be able to quickly open each one as needed---a nice feature.

**[Some authors have written scenarios that actually open and begin to run in baseline. It is therefore, important for the Operator to have looked over the day’s cases and scenarios prior to beginning. Fortunately, there are only a few of these. All of the METI scenarios open in baseline without affecting the mannequin.]

To get a scenario to advance from Baseline, click on “Next” in the bottom right hand corner of the scenario you are in. The scenario will advance to the first step and start to affect the patient per the specified changes programmed at that step.

Scenario programming is such that the flow is expected to go from step to step, (top to bottom.). Each step builds on and depends on the one in front of it.

Some scenarios will have transitions built in. When there is a time specified the scenario will advance on it's own after the specified time is reached.

At other times, the transition only occurs if the specified patient condition is reached or a treatment is performed. When the students are performing well this works as designed. However, when the correct thing is not done the scenario will stay at that step. As an Operator, you may have to advance the scenario and you will need to look for a queue from the instructor.

When the case is stalled or there are no transitions programmed into the scenario, the scenario can be advanced by using the **"Next"** button in the bottom right hand corner of the scenario page. By clicking on **"Next"**, the scenario will only go downward to the next step. The Operator will need to take queues from the Instructor as to when to advance the scenario.

When working with any instructor it is important to go over the scenario prior to starting the simulation, to make sure you both know and understand when and how the scenario should advance. Often, these changes are pretty obvious.

However, the scenario is written with a general notion that the student will do the correct thing. Since they are learning, at times they will not do the correct thing and in fact will do adverse if not bizarre things. It is therefore, a good idea to discuss with the instructor, possible alternate pathways that the scenario can go and when teaching points either have been reached or lost and it is time to advance or stop the scenario.

At times it is desirable to advance the scenario, by skipping a step(s). You can highlight the step you wish to advance to and click on **"Go To"** above the **"Next"** button. The scenario **will skip the steps** in between.

As an Operator, it is important for you to realize that when you skip a step(s) in the scenario, all of the changes that normally would have occurred in the skipped steps do not happen. [You must go through a step for the parameter changes in a given step to affect the programming.]

Unless there are only minor changes in the skipped steps, the patient that results from skipping steps is going to be different. Often very different and not usually where you want the 'patient' to be.

Skipping steps can have it's advantages. It can move the case faster. You can also sometimes use this to keep the patient from crashing as the last step often is designed return the patient to 'normal' or stable by undoing all or most of the of the changes. You have to look at the programming in order to know if this is advantageous to do in the case. Again, different authors have crafted their scenarios differently.

Instructors experienced with the simulator know and understand this.

Inexperienced instructors will have little to no appreciation for this.

It is possible to use the “Go to” button to also go back up to any step above in the scenario. Sometimes an instructor will request this as means of restarting the scenario so the students can have a second chance.

This is not recommended unless you are very familiar with the scenario----this means you have tried this out on the front end. It is important to understand that the patient is going back up to a step still has all of the changes made in the various steps along the way. This means the scenario is not going to flow as originally designed.

As a general, rule, going back up to a step in a scenario will cause the scenario to not work well at all, (and usually fail completely.) .

Occasionally, the changes that have been made are minor enough that you can go back to a step and the scenario will still function pretty well. You may also, be able to make changes on-the- fly quickly enough for the scenario to work. Again, you have to be familiar with the changes made to the patient and should try this before risking it in a simulation.

Therefore, when an Instructor wants to rerun a scenario this almost always means you have to close not only the scenario, but the patient as well and reboot them both. If you are not familiar with how to make changes on-the-fly and quickly, it really is your only recourse. It does take a minute or two, but is time well spent as you are most likely going to be unproductive doing differently thus wasting the time of multiple people. .

When you reach the end of a scenario, you can close that scenario by clicking on “Close” under the same menu you opened the scenario. The computer will ask you if you want to save changes---**do not save changes**. (The METI preprogrammed patients and scenarios are in a ‘read only’ mode and the programming will not allow you to save changes. This not true for the custom made patients and scenarios in the Shared folder. If you save them, you will be making changes to the patient and / or scenario. The case will not work properly the next time.

You can then begin any additional scenarios for that case.

It is important to understand that the patient often is not back to exactly where he started at the end of a scenario. This means a second scenario has to account for this when written. It also means that scenarios usually have to be run in a specific order or the simulation will not work.

Sometimes an instructor will want to skip a scenario and just use the second or third scenario for that case. Just as skipping a step during a scenario changes how the case will go, so does skipping a scenario affects how a case will unfold.

General rule of thumb, if a case is crafted to run scenarios in a certain order, it should be run in a certain order.

Sometimes, (when changes are minor, or the patient has been put back to 'baseline' as part of the programming) scenarios can be run out of sequence. It is also possible to make changes on-the-fly and get the case to work. This requires the ability to look at the changes made and to return the patient to 'normal/stable' in short order.

As a guide, look at the changes made by the programming. If there are a lot of changes or several large changes this is most likely not going to work. Even if there are only small changes, you should try this on the front end before putting it to the test during an actual simulation. Again, this comes back to Operator and Instructor communication.

3) Making Changes On-The-Fly:

The remaining tabs, (**Conditions, Drugs, Fluids, Cardiovascular, and Respiratory**) all deal with making changes to the mannequin. The author whom originally crafted the patient or scenarios used these tabs (in Editor mode) to write the case.

While a patient or scenario is running as the Operator in "Player" mode you can go into each tab and change any parameter under it. This will immediately change either the physiology or physical presentation of the 'patient-mannequin'. This allows the Operator to tweak and fine tune the case.

It is also an avenue to take the case in a whole new direction which can be advantageous at times.

The best way to understand what parameters can be changed, to what extent, how they affect the physiology, and how to do this is to simply run some patients and cases. The more an Operator has the chance to work with the simulator in this capacity, the more proficient he / she will become.

One point to note, under the **Cardiovascular** tab there are several sub menus one of which is **'Heart'**. Under the 'Heart' menu is a parameter called: **"Cardiac Rhythm Override"**. This can be utilized to keep a patient from crashing when the case is not going well. This will give the students time to recover and think and eventually 'save' the patient resulting in a more positive experience. Also, it means to give the Operator time to make all of the changes that may be required to keep or get the scenario back on track.

D Troubling Shooting:

The above guide has provided instruction on how to set up and run the simulator. In the process, insight has also been given to pitfalls that will arise and solutions. Experience shows this is where most issues have been.

Things can and do go wrong with the simulator. There are things that can be done to sort out where the issue resides: software and computer, mechanical functioning of the mannequin, instrumentation inside the rack, or Operator.

Operator: if you can and have done all of the above correctly, then you have almost completely eliminated Operator error which is nice to know. You still need to go over all that you have done to make sure you actually did it as you remember.

Computer and Software: Remember you are working with a computer. When not functioning correctly—reboot. It is the easiest and fastest thing to do and often works.

If the patient is not “alive” make sure you connected the mannequin to the rack and software. [Easy to forget when you have opened the file and are in a hurry.]

If ETCO₂ does not show up on the Anesthesia patient monitor—reboot, it is a computer also.

Rack :

Make sure the gases are on and that you have 50 PSI coming from each tank to the rack.

If you do not have enough CO₂ the paCO₂ level will never reach 40 and the mannequin will not breath as he is designed to respond to CO₂ level.

Mannequin:

Drug recognition module must be primed. Do not let the students drain the IV bag feeding the reader as you will lose your prime.

Most issues with drug administration are student in origin---they did not open or close the stopcock in the correct fashion.

The drug recognition module works sometime and not at others: If the students are administering drugs correctly, and the system is primed the problem is generally with the stopcock switch. Turn the reader over and make sure the flat metal tab is both breaking the circuit and also clearing the circuit completely. If not it will work intermittently. Defer to the Simulation Coordinator to readjust the switch.

