

CAE Healthcare Human Patient Simulator (HPS)

The Human Patient Simulator, HPS, is a tethered simulator that is capable of patient assessment and treatment including mechanical ventilation and anesthesia. He has physiologic responses built into the software so it will give lifelike response to medications, fluid therapy and oxygen administration. For example, if a paralytic is administered and the patient not subsequently ventilated properly, vital signs will decompensate leading to the patient's death. This patient will also give physiologically appropriate responses to train of four testing.

Neurological Features	
Anatomy, Physiology and Clinical signs	Clinical Interventions, Patient Monitoring and Scenarios.
Eyes	Each eye has reactive pupils and functional eyelids that blink and close.
Convulsions	The mannequin simulates convulsions
Temperature	Body and blood temperature measured can be set using these parameters and can be displayed on the Patient Status Display.
Thumb Twitch/Train of Four	The right arm of the mannequin includes electrode attachments for a standard peripheral nerve stimulator (PNS).
Respiratory Features	
Anatomy, Physiology and Clinical signs	Clinical Interventions, Patient Monitoring and Scenarios.
Airway management and Ventilation	Alveolar and arterial gas concentrations appropriately reflect the efficacy of ventilation and oxygen administration.
Arterial Blood Gases	PaO ₂ , PaCO ₂ and pH are continuously calculated and displayed when selected for the Patient Status Display
Breakaway Teeth	Upper front teeth can be dislodged if laryngoscopy is performed incorrectly.
Bronchial Occlusion	Completely obstructs right and/or left mainstem bronchi, simulating a lower airway obstruction (e.g. mucus plug). This yields an inability to ventilate the
Chest Excursion	Synchronized with ventilation (spontaneous or mechanical). Excursion depth proportional to tidal volume.

Chest Tube Placement	Chest tubes can be inserted bilaterally into the mid-axillary line of the fifth intercostal space. Suction equipment can be applied to withdraw fluid from the simulated intrapleural space
Cricothyroid Membrane	Allows needle cricothyrotomy, transtracheal jet ventilation, retrograde wire techniques and cricothyrotomy.
Esophagus, Lower Esophageal Sphincter and Stomach	Esophageal intubation results in gastric distension and the absence of breath sounds, chest excursion and CO ₂ output.
Exhaled CO ₂	Measure the presence or absence of CO ₂ .
Laryngospasm	Closes vocal cords and prevents intubation and ventilation. When used with posterior pharynx swelling, creates a “can’t intubate, can’t ventilate” scenario.
Needle Decompression	Decompression of a pneumothorax can be performed bilaterally by inserting a needle at the midclavicular line of the second intercostal space.
Posterior Pharynx Swelling	Obstructs view of larynx to prevent intubation, but allows mask ventilation “can’t intubate, can’t ventilate” scenario.
Pulse Oximetry	Oxyhemoglobin saturation (SpO ₂) automatically correlates with the oxygen concentration in the lungs and the intrapulmonary shunt fraction.
Realistic Upper Airway (Oropharynx, Nasopharynx and Larynx)	Allows direct laryngoscopy, oral and nasal intubation and use of specialty airway devices. Senses if ET tube is correctly inserted.
Spontaneous, Self-Regulating Breathing	Normal tidal breathing and pathophysiological conditions such as atelectasis, pneumothorax, asthma and COPD.
Symmetric and Asymmetric Lung Ventilation	Tracheal & pathophysiologic conditions such as pneumothorax.

Tongue Swelling	Hinders but does not prevent intubation
Trachea & Left and Right Mainstem Bronchi	Tracheal intubation results in bilateral chest excursion and breath sounds. Endobronchial intubation results in unilateral chest excursion and breath sounds.
Venous Blood Gases	PvO ₂ and PvCO ₂ are continuously calculated and displayed when selected for the Patient Status Display.
Cardiovascular Features	
Anatomy, Physiology and Clinical signs	Clinical Interventions, Patient Monitoring and Scenarios.
3-Lead or 5-Lead ECG	ECG waveforms can be viewed on a standard monitor and/or on the Patient Status Display. Normal and abnormal cardiac rhythms are linked to patient physiology (e.g. blood pressure, cardiac output).
Baroreceptor Reflex	Cardiovascular system automatically compensates for changing hemodynamic conditions.
Cardiac Pacing	Transthoracic cardiac pacemaker can be used with iStan. Pacing results in appropriate physiological changes in blood pressure and cardiac output.
Cardiac Rhythms	The desired arrhythmia can be selected.
Chest Compression	Effective chest compression results in artificial circulation, cardiac output, central and peripheral blood pressures, palpable pulses, and CO ₂ return.
Circulation	Normal and abnormal circulation (e.g. hypovolemia, hypervolemia and right/left heart failure) can be adjusted.
Defibrillation	iStan supports operation with a variety of manual and automatic external defibrillators.
Invasive Hemodynamic Monitoring	Various hemodynamic physiological indicators are registered and can be monitored.
Manual Blood Pressure	Systemic blood pressure can be measured using the return-to-flow technique. Korotkoff sounds can also be auscultated.
Myocardial Ischemia	Myocardial oxygen supply and demand

	automatically influence the cardiac rhythm, yielding response to hypoxemia.
Palpable Pulses	Carotid, brachial, radial, femoral, popliteal, posterior tibial and dorsalis pedis pulses can be palpated bilaterally and are synchronous with the cardiac cycle. A pulse deficit automatically occurs if the systolic arterial blood pressure falls below specified thresholds:
Palpable Pulse Thresholds	Carotid: 60mmHg Femoral: 70mmHg Brachial: 80mmHg Popliteal: 80mmHg Posterior Tibial: 80mmHg Dorsalis Pedis: 80mmHg Radial: 90mmHg
Fluids	
Anatomy, Physiology and Clinical signs	Clinical Interventions, Patient Monitoring and Scenarios.
IV Access	The right arm of the simulator provides IV access locations at the brachial, cephalic, antecubital and basilic veins. IV Cannulations can receive a flash.
IV Medication Administration	Bolus injections are administered utilizing standard syringes while continuous IV infusions can be administered using infusion devices. Injections can be administered in IV arm or in two permanent access catheters located at the right jugular and left femoral veins.
IV/IO Fluid Administration	IV fluids can be administered in the IV arm or in the two permanent access catheters located at the right jugular and left femoral veins. Intraosseous (IO) sites are available at the sternum and bilaterally at the tibia.
Urinary Catheterization	The simulator allows for the insertion of urinary catheters and excretion of urine with flow rate that is controlled by the instructor.
Gastrointestinal features	
Anatomy, Physiology and Clinical signs	Clinical Interventions, Patient Monitoring and Scenarios.

Diagnostic Peritoneal Lavage	Diagnostic peritoneal lavage can be performed by inserting a needle into the peritoneum.
Sounds	
Bowel Sounds	The bowel sounds available are Normal, Hyperactive, Hypoactive and Absent.
Breath Sounds	Available breath sounds include Normal, Crackles, Wheezing and Diminished.
Heart Sounds	Available heart sounds include Normal, S3, S4, S3 & S4, Early Systolic Murmur, Mid Systolic Murmur, Late Systolic Murmur, Pan Systolic Murmur and Late Diastolic Murmur.