



The SonoSim® Ultrasound Training Solution: Integrating Ultrasound Into Preclinical & Clinical UME Curricula

Introducing ultrasound in UME has been proven to improve anatomy knowledge, physiology understanding, and physical examination skills.^{1,2,3} Recognizing the benefits of early ultrasound education but seeing the gaps in implementation, the Society of Radiologists in Ultrasound and the Alliance of Medical School Educators in Radiology have collaborated to create a recommended “[National Ultrasound Curriculum for Medical Students](#).”⁴ The award-winning, patented SonoSim Ultrasound Training Solution matches these industry recommendations through an ecosystem of cloud-based courses, knowledge assessments, interactive SonoSimulator® scanning cases, performance tracking, and access to real-patient pathology.

National Ultrasound Curriculum for Medical Students – Preclinical Curriculum

Familiarity with the Basic Principles of the Physics of Ultrasound		
Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
Image acquisition	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Sound transmission and reflection, scatter	Basic Ultrasound Physics	<i>All SonoSim Cases</i>
Acoustic window	Imaging Artifacts	<i>All SonoSim Cases</i>
Image optimization	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Depth, focal zone, time-gain compensation, gain, field of view	Ultrasound System Operation	<i>All SonoSim Cases</i>
Posterior acoustic properties	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Posterior enhancement (increased sound transmission), sound attenuation, acoustical shadowing	Imaging Artifacts	<i>All SonoSim Cases</i>
Artifacts	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Near field, reverberation, edge refraction, mirror image	Imaging Artifacts	<i>All SonoSim Cases</i>
Terminology	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Echogenic, hyperechoic, hypoechoic, anechoic, isoechoic	Basic Ultrasound Physics	<i>All SonoSim Cases</i>
Characteristics of:	<i>Core Clinical & Advanced Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Simple & complex fluid	<i>GYN Normal Adnexa: Sonographic Anatomy, Sonographic Examination</i> <i>OB/GYN Core Clinical: Pathological Conditions</i>	<i>GYN Malignant Adnexal Conditions Cases</i> <i>GYN Nonmalignant Adnexal Conditions Cases</i> <i>GYN Normal Adnexa Cases</i>
Soft tissue/solid	<i>Introduction to MSK: Anatomy & Physiology</i> <i>Soft Tissue Core Clinical: Identification of Tissue Types</i>	<i>Introduction to MSK Cases</i> <i>Soft Tissue Core Clinical Cases</i>
Air/gas	<i>Fundamentals of Ultrasound: Basic Ultrasound Physics, Imaging Artifacts</i> <i>Intestinal/Biliary: Pathologic Gas</i>	<i>Intestinal/Biliary Cases</i> <i>Renal Cases</i>
Bone/calcium	<i>Fundamentals of Ultrasound: Basic Ultrasound Physics</i> <i>Introduction to MSK: Anatomy & Physiology</i> <i>Soft Tissue Core Clinical: Identification of Tissue Types</i>	<i>All MSK Cases</i> <i>Soft Tissue Core Clinical Cases</i>

<i>Imaging modes</i>	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
B-mode (gray scale)	Imaging Modes	All SonoSim Cases
Doppler (spectral, color, and power)	Imaging Modes	All Advanced GYN Cases All US-Guided Procedures Cases Aorta/IVC, Bladder, Lungs, and Renal Anatomy & Physiology Cases Aorta/IVC, DVT, & RUSH Core Clinical Cases FoCUS – Part I & II Cases SonoSim LiveScan® Critical Care & Genitourinary Cases
M-mode	Imaging Modes	FoCUS – Part I Cases Lungs Anatomy & Physiology Cases Second- & Third-Trimester Pregnancy – Part II Cases SonoSim LiveScan® Critical Care & Trauma Care Cases

Learning Objectives Not Covered: Analogy to SONAR

Knowledge of Instrumentation		
Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
<i>Basic probe and image orientation</i>	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Sagittal, transverse, coronal	Imaging Conventions	All SonoSim Cases
<i>Transducers</i>	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Frequencies, types (linear, curvilinear, sector, transvaginal), near field, far field	Transducer Basics	All SonoSim Cases
<i>Machine settings</i>	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Transducer frequency, focus, time-gain compensation	Ultrasound System Operation	--
Depth, gain	Ultrasound System Operation	All SonoSim Cases
<i>Control buttons</i>	<i>Advanced Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Freeze, save images, cine loop	--	All SonoSim Cases
Measure with calipers	First-Trimester Pregnancy: Pregnancy Dating Using Ultrasound FoCUS – Part I: Cardiac Output Measurements, Pulmonary Artery Pressure Measurements GYN Normal Adnexa: Sonographic Examination GYN Normal Uterus: Transvaginal Sonographic Technique Second- & Third-Trimester Pregnancy - Part I: Fetal Biometry & Pregnancy Dating	All SonoSim Cases

Describe Advantages of Ultrasound

Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
<i>General</i>	<i>Core Clinical, Advanced Clinical, & Procedures Courses</i>	<i>Relevant SonoSim Cases</i>
Real-time dynamic imaging, multiplanar imaging, portable, lack of ionizing radiation, lower cost, safe & noninvasive	<i>Various Core Clinical, Advanced Clinical, & Procedures Courses</i>	<i>All SonoSim Cases</i>

Learning Objectives Not Covered: Improved soft tissue resolution compared with noncontrast computed tomography (CT)

Describe Limitations of Ultrasound

Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
<i>General</i>	<i>Fundamentals of Ultrasound Course</i>	<i>Relevant SonoSim Cases</i>
Obese patients (attenuation, scatter, image degradation)	Basic Ultrasound Physics, Imaging Artifacts <i>Intestinal/Biliary: Introduction</i>	<i>SonoSim LiveScan® Late Stage Pregnancy Cases</i>
Impedance to transmission of sound waves: air (lung, bowel, gas), bone, metal	Basic Ultrasound Physics, Imaging Artifacts	<i>All MSK Cases Intestinal/Biliary & Renal Core Clinical Cases</i>
Smaller field of view	<i>All SonoSim Courses</i>	<i>All SonoSim Cases</i>
Operator dependence	Ultrasound System Operation	<i>All SonoSim Cases</i>

Learning Objectives Not Covered: Less interexamination reproducibility relative to CT

Correlate Patient Safety and Ultrasound

Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
<i>OB/GYN</i>	<i>GYN Normal Adnexa Course</i>	<i>Relevant SonoSim Cases</i>
No ionizing radiation, pelvic imaging in women of reproductive age	Introduction	<i>All SonoSim OB/GYN Core Clinical Cases</i>
<i>Pediatrics</i>	<i>Introduction to US-Guided Procedures</i>	<i>Relevant SonoSim Cases</i>
No ionizing radiation	Introduction	<i>All SonoSim Cases</i>
<i>General</i>	<i>Core Clinical & Procedures Courses</i>	<i>Relevant SonoSim Cases</i>
US and magnetic resonance imaging are methods to reduce ionizing radiation exposure	<i>Introduction to US-Guided Procedures: Introduction</i>	<i>All SonoSim Cases</i>
Heat deposition, cavitation: Doppler, gray-scale imaging	<i>Fundamentals of Ultrasound: Infection Control & Biosafety</i>	<i>All SonoSim Cases</i>
ALARA (as low as reasonably achievable) principle	<i>Fundamentals of Ultrasound: Infection Control & Biosafety</i>	<i>All SonoSim Cases</i>

Learning Objectives Not Covered: Pediatrics: No sedation

Identify Classic Appearances of Normal Structures on Ultrasound

Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
Abdomen	Anatomy & Physiology Courses	Relevant SonoSim Cases
Liver	<i>Liver: All Lessons</i>	<i>Liver Cases</i>
Gallbladder	<i>Biliary Tree: All Lessons</i>	<i>Biliary Tree Cases</i>
Pancreas	<i>Pancreas: All Lessons</i>	<i>Pancreas Cases</i>
Spleen	<i>Spleen: All Lessons</i>	<i>Spleen Cases</i>
Kidneys	<i>Renal: All Lessons</i>	<i>Renal Cases</i>
Aorta & inferior vena cava	<i>Aorta/IVC: All Lessons</i>	<i>Aorta/IVC Cases</i>
Genitourinary	Anatomy & Physiology Courses	Relevant SonoSim Cases
Urinary bladder	<i>Bladder: All Lessons</i>	<i>Bladder Cases</i>
Uterus & ovaries	<i>Female Pelvis: All Lessons</i> <i>GYN Normal Uterus & GYN Normal Adnexa Advanced Clinical: All Lessons</i>	<i>Female Pelvis Cases</i> <i>GYN Normal Uterus & GYN Normal Adnexa Cases</i>
Prostate	<i>Prostate: All Lessons</i>	<i>Prostate Cases</i>
Obstetrical scans	Second- & Third-Trimester Pregnancy - Part I & II Courses	Relevant SonoSim Cases
Basic fetal anatomy (head, abdomen, heartbeat, limbs, umbilical cord, placenta, cervix)	<i>Second- & Third-Trimester Pregnancy – Part I: Basic Fetal Anatomy, Cervical Length</i> <i>Second- & Third-Trimester Pregnancy – Part II: Assessment of Extrafetal Anatomy, Placental Evaluation</i>	<i>Second- & Third-Trimester Pregnancy - Part I & II Cases</i> <i>SonoSim LiveScan® Early Stage & Late Stage Pregnancy</i>
Cardiac	Heart Anatomy & Physiology Course	Relevant SonoSim Cases
Subxiphoid view of heart for pericardial effusion	<i>All Lessons</i>	<i>Heart Anatomy & Physiology Course</i> <i>Cardiology Core Clinical Course</i>
Leg venous	Anatomy & Physiology and Core Clinical Courses	Relevant SonoSim Cases
Femoropopliteal venous system (with and without compression)	<i>DVT: Sonographic Anatomy, Sonographic Technique</i> <i>Leg-Venous: All Lessons</i>	<i>DVT Cases</i> <i>Leg-Venous Cases</i>
Neck	Anatomy & Physiology and Procedures Courses	Relevant SonoSim Cases
Internal jugular vein & carotid artery (relation to internal jugular vein, carotid bifurcation)	<i>Cerebrovascular: All Lessons</i> <i>US-Guided Internal Jugular Vein Cannulation: Sonographic Anatomy</i>	<i>Cerebrovascular Cases</i> <i>US-Guided Internal Jugular Vein Cannulation Cases</i>
Subclavian vein	<i>Cerebrovascular: All Lessons</i> <i>US-Guided Subclavian Vein Cannulation: Sonographic Anatomy</i>	<i>Cerebrovascular Cases</i> <i>US-Guided Subclavian Vein Cannulation Cases</i>
Thyroid	<i>Thyroid: All Lessons</i>	<i>Thyroid Cases</i>
Pulmonary	Lungs: Anatomy & Physiology Course	Relevant SonoSim Cases
Normal lung (pleural line, sliding lung sign) & diaphragm (hyperechogenicity and movement)	<i>All Lessons</i>	<i>Lungs Cases</i>
Musculoskeletal	All MSK Courses	Relevant SonoSim Cases
Tendon (principle of anisotropy), muscle, surface of bone, & joint fluid	<i>Introduction to MSK, Ankle, Elbow, Foot, Hand & Finger, Hip, Knee, Shoulder, & Wrist: All Lessons</i> <i>MSK Core Clinical: All Lessons</i>	<i>Introduction to MSK, Ankle, Elbow, Foot, Hand & Finger, Hip, Knee, Shoulder, & Wrist Anatomy & Physiology Cases</i> <i>MSK Core Clinical Cases</i>

National Ultrasound Curriculum for Medical Students – Clinical Curriculum

List Appropriate Indications for Common Ultrasound Examinations

Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
Characterization of masses	Core Clinical & Advanced Clinical Courses	Relevant SonoSim Cases
Cystic, solid, complex	Bladder, OB/GYN, & Renal Core Clinical: Case Studies/ Case Pathologies First-Trimester Pregnancy: Pathologic Conditions GYN Malignant Adnexal Conditions: Sonographic Characterization of Adnexal Masses, Borderline Tumors GYN Nonmalignant Adnexal Conditions: Ovarian Cysts GYN Normal Adnexa: Sonographic Anatomy	First-Trimester Pregnancy & All Advanced GYN Cases Bladder, DVT, Intestinal/Biliary, OB/GYN, Renal, RUSH, & Soft Tissue Core Clinical Cases SonoSim LiveScan® Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, Genitourinary, & Hepatobiliary Cases
Clinically suspected fluid accumulations	Core Clinical & Procedures Courses	Relevant SonoSim Cases
Ascites	eFAST: Case Studies Intestinal/Biliary: Gallbladder Evaluation Paracentesis Course [In Development]	Bladder, eFAST, & Intestinal/Biliary Core Clinical Cases Paracentesis Cases [In Development] SonoSim LiveScan® Genitourinary, Hepatobiliary, & Trauma Care Cases
Pleural effusion	eFAST: Case Studies Pulmonary: Pleural Effusion	Airway, Aorta/IVC, Cardiology, eFAST, Pulmonary, & RUSH Core Clinical Cases FoCUS – Part I Advanced Clinical Cases SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases
Pericardial effusion	Cardiology, eFAST, & RUSH Core Clinical: Case Studies Pericardiocentesis Course [In Development]	Airway, Cardiology, eFAST, & RUSH Core Clinical Cases FoCUS – Part I Advanced Clinical Cases SonoSim LiveScan® Cardiac Resuscitation, Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, & Trauma Care Cases
Abscess	Soft Tissue Core Clinical: Cellulitis and Abscess Imaging, Advanced Abscess Evaluation	Soft Tissue Core Clinical Cases
Hematoma	Musculoskeletal Core Clinical: Muscle Evaluation	Soft Tissue Core Clinical Cases
Abdomen	Core Clinical Courses	Relevant SonoSim Cases
Evaluation of right-upper-quadrant (RUQ) pain	Intestinal/Biliary: Gallbladder Evaluation, Common Bile Duct Evaluation Renal: Obstructive Uropathy, Case Studies	Intestinal/Biliary & Renal Core Clinical Cases SonoSim LiveScan® Hepatobiliary & Genitourinary Cases
Obstructive jaundice	Intestinal/Biliary: Gallbladder Evaluation, Common Bile Duct Evaluation	Intestinal/Biliary Cases
Clinically suspected appendicitis in children, young patients, or pregnant women	Intestinal/Biliary: Appendicitis	Intestinal/Biliary Cases
Suspected splenomegaly	eFAST: LUQ Views	eFAST, FAST, & RUSH Core Clinical Cases SonoSim LiveScan® Critical Care, Hepatobiliary, & Trauma Care
Hematuria	--	SonoSim LiveScan® Genitourinary Cases

Flank pain	<i>Renal: Obstructive Uropathy, Case Studies</i>	<i>Intestinal/Biliary & Renal Core Clinical Cases SonoSim LiveScan® Hepatobiliary & Genitourinary Cases</i>
Screening (and following) abdominal aortic aneurysms	<i>Aorta/IVC: Aortic Case Studies</i>	<i>Aorta/IVC & RUSH Core Clinical Cases SonoSim LiveScan® Cardiac Resuscitation & Critical Care</i>
Gynecology	<i>Core Clinical & Advanced Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Pelvic mass	<i>GYN Abnormal Uterus - Part I: Leiomyoma GYN Malignant Adnexal Conditions: Sonographic Characterization of Adnexal Masses, Borderline Tumors GYN Nonmalignant Adnexal Conditions: Ovarian Cysts OB/GYN: Case Studies</i>	<i>First-Trimester Pregnancy Cases GYN Abnormal Uterus – Part II Cases GYN Nonmalignant & Malignant Adnexal Conditions Cases GYN Normal Uterus Cases OB/GYN Core Clinical Cases SonoSim LiveScan® Early Stage & Late Stage Pregnancy</i>
Pelvic pain	<i>GYN Abnormal Uterus - Part I: Localization of Intrauterine Devices, Adenomyosis, Leiomyoma GYN Abnormal Uterus - Part II: Evaluating the Endometrium, Endometrial Polyps & Submucosal Leiomyomas GYN Nonmalignant Adnexal Conditions: Ovarian Cysts</i>	<i>First-Trimester Pregnancy Cases GYN Abnormal Uterus – Part II Cases GYN Nonmalignant & Malignant Adnexal Conditions Cases OB/GYN Core Clinical Cases SonoSim LiveScan® Early Stage Pregnancy & Late Stage Pregnancy Cases</i>
Abnormal vaginal bleeding	<i>GYN Abnormal Uterus - Part II: All Lessons</i>	<i>GYN Abnormal Uterus – Part I & II Cases GYN Normal Adnexa & GYN Normal Uterus Cases GYN Nonmalignant Adnexal Conditions Cases OB/GYN Core Clinical Cases</i>
Obstetrics	<i>Core Clinical & Advanced Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Abnormal bleeding	<i>GYN Abnormal Uterus - Part II: Retained Products of Conception, Subinvolution of the Placental Site OB/GYN: Pathologic Conditions</i>	<i>First-Trimester Pregnancy Cases SonoSim LiveScan® Early Stage Pregnancy & Late Stage Pregnancy Cases</i>
Dating	<i>First Trimester Pregnancy: Pregnancy Dating Using Ultrasound Second- & Third-Trimester Pregnancy - Part I: Fetal Biometry & Pregnancy Dating</i>	<i>First-Trimester Pregnancy Cases OB/GYN Core Clinical Cases Second- & Third-Trimester Pregnancy - Part I & II Cases</i>
Heartbeat	<i>First-Trimester Pregnancy: General Considerations OB/GYN: Embryology Second- & Third-Trimester Pregnancy - Part I: Basic Fetal Anatomy</i>	<i>First-Trimester Pregnancy Cases OB/GYN Core Clinical Cases Second- & Third-Trimester Pregnancy - Part I & II Cases</i>
Fetal anatomy	<i>Second- & Third-Trimester Pregnancy - Part I: Basic Fetal Anatomy</i>	<i>First-Trimester Pregnancy Cases OB/GYN Core Clinical Cases Second- & Third-Trimester Pregnancy - Part I & II Cases</i>
Decreased fetal activity	<i>Second- & Third-Trimester Pregnancy - Part II: Biophysical Profile</i>	--
Suspected ruptured membranes	<i>Second- & Third-Trimester Pregnancy - Part II: Amniotic Fluid Assessment</i>	--
Premature labor	<i>Second- & Third-Trimester Pregnancy - Part I: Cervical Length</i>	--

<i>Echocardiography</i>	<i>Core Clinical & Advanced Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Pericardial effusion with or without tamponade	<i>Cardiology: Case Studies</i> <i>RUSH: The Pump - Global LV Function, Case Studies</i>	<i>Cardiology, eFAST, & RUSH Core Clinical Cases</i> <i>FoCUS – Part I Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, & Trauma Care Cases</i>
Right-sided heart strain	<i>Cardiology: Case Studies</i> <i>RUSH: Case Studies</i>	<i>Cardiology Cases</i> <i>FoCUS - Part I Cases</i>
Valvular dysfunction	<i>FoCUS - Part II: Valvular Regurgitation, Valvular Stenosis</i>	<i>Cardiology Cases</i> <i>FoCUS - Part I Cases</i>
Cardiac/chamber enlargement	<i>FoCUS - Part II: Valvular Regurgitation</i>	<i>Cardiology Cases</i> <i>FoCUS - Part I Cases</i>
Calculate ejection fraction	<i>Cardiology: Case Studies</i>	<i>Cardiology Cases</i> <i>FoCUS - Part I Cases</i>
<i>Extremities</i>	<i>DVT: Core Clinical Course</i>	<i>Relevant SonoSim Cases</i>
Lower- or upper-extremity swelling or pain (suspected deep vein thrombosis)	All Lessons	<i>DVT & RUSH Core Clinical Cases</i>
<i>Musculoskeletal</i>	<i>Musculoskeletal: Core Clinical Course</i>	<i>Relevant SonoSim Cases</i>
Evaluation of musculoskeletal pain (muscle, tendon, or other superficial soft tissue origin), effusions, collections	Tendon Evaluation, Muscle Evaluation, Effusion Evaluation	<i>Musculoskeletal Core Clinical Cases</i>

Learning Objectives Not Covered: Renal failure; Evaluation of palpable neck/thyroid mass; Evaluation of scrotal pain, mass; Pediatrics: recurrent urinary tract infections, suspected neonatal brain hemorrhage, abdominal or pelvic mass, abnormal neonatal hip examination, tethered cord

Observe the Following Ultrasound Studies		
Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
<i>Abdominal</i>	<i>Anatomy & Physiology Courses</i>	<i>Relevant SonoSim Cases</i>
RUQ US (liver, gallbladder, bile ducts, right kidney, head of pancreas) & upper abdominal US (RUQ plus spleen, left kidney)	<i>Biliary Tree, Liver, Pancreas, Renal, and Spleen Anatomy & Physiology: All Lessons</i> <i>Intestinal/Biliary Core Clinical: Gallbladder Evaluation, Common Bile Duct Evaluation</i> <i>Renal Core Clinical: All Lessons</i>	<i>Biliary Tree, Liver, Pancreas, Renal, and Spleen Anatomy & Physiology Cases</i> <i>Intestinal//Biliary & Renal Core Clinical Cases</i>
Aorta, IVC	<i>Aorta/IVC Anatomy & Physiology and Core Clinical: All Lessons</i>	<i>Aorta/IVC Anatomy & Physiology and Core Clinical Cases</i>
<i>Pelvic</i>	<i>Anatomy & Physiology, Core Clinical, & Advanced Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Urinary bladder	<i>Bladder Anatomy & Physiology and Core Clinical: All Lessons</i>	<i>Bladder Anatomy & Physiology and Core Clinical Cases</i>
Uterus, ovaries, cul de sac (transabdominal & transvaginal)	<i>Female Pelvis Anatomy & Physiology: All Lessons</i> <i>All Advanced GYN Courses: All Lessons</i> <i>OB/GYN: All Lessons</i>	<i>Female Pelvis Anatomy & Physiology Cases</i> <i>All Advanced GYN Cases</i> <i>OB/GYN Core Clinical Cases</i>
Prostate	<i>Prostate Anatomy & Physiology: All Lessons</i>	<i>Prostate Anatomy & Physiology Cases</i>

Obstetric	Advanced Clinical Courses	Relevant SonoSim Cases
First-trimester US (gestational sac, yolk sac, embryo, M-mode heartbeat)	<i>First-Trimester Pregnancy</i> : All Lessons	<i>First-Trimester Pregnancy Cases</i> <i>OB/GYN Core Clinical Cases</i>
Second/third-trimester fetal US (fetal heartbeat, placenta, amniotic fluid, cervix)	<i>Second- & Third-Trimester Pregnancy - Part I & II</i> : All Lessons	<i>Second- & Third-Trimester Pregnancy - Part I & II Cases</i>
Breast	Breast Anatomy & Physiology Course	Relevant SonoSim Cases
Breast US	All Lessons	<i>Breast Anatomy & Physiology Cases</i>
Thyroid	Thyroid Anatomy & Physiology Course	Relevant SonoSim Cases
Thyroid US	All Lessons	<i>Thyroid Anatomy & Physiology Cases</i>
Vascular	Anatomy & Physiology, Core Clinical, & Procedures Courses	Relevant SonoSim Cases
Upper- or lower-extremity deep vein thrombosis study	<i>DVT</i> : All Lessons	<i>DVT Cases</i> <i>RUSH Cases</i>
Internal jugular vein and subclavian vein (versus companion arteries)	<i>Cerebrovascular Anatomy & Physiology</i> : All Lessons <i>US-Guided Internal Jugular Vein Cannulation</i> : All Lessons <i>US-Guided Subclavian Vein Cannulation</i> : All Lessons	<i>Cerebrovascular Anatomy & Physiology</i> <i>US-Guided Internal Jugular Vein Cannulation Cases</i> <i>US-Guided Subclavian Vein Cannulation Cases</i>
Carotid US (if possible)	<i>Cerebrovascular Anatomy & Physiology</i> : All Lessons	<i>Cerebrovascular Anatomy & Physiology</i> <i>US-Guided Internal Jugular Vein Cannulation Cases</i>
Cardiac	Anatomy & Physiology and Core Clinical Courses	Relevant SonoSim Cases
Echocardiogram (basic views)	<i>Heart Anatomy & Physiology</i> : All Lessons <i>Cardiology Core Clinical</i> : All Lessons	<i>Heart Anatomy & Physiology Cases</i> <i>Cardiology Core Clinical Cases</i>
Biopsy guidance/fluid aspiration or drainage	Core Clinical Courses	Relevant SonoSim Cases
Fluid aspiration/drainage	<i>Bladder Core Clinical</i> : Ultrasound-Guided Suprapubic Catheterization <i>Soft Tissue Core Clinical</i> : Advanced Abscess Evaluation, Peritonsillar Abscess	--

Learning Objectives Not Covered: Neonatal brain US (if possible)

Recognize or at Least See Classic Examples of Common Pathological Conditions on Ultrasound

Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
<i>Cyst versus complex cyst versus solid mass</i>	<i>Core Clinical & Advanced Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Cyst vs. complex cyst vs. solid mass	<i>Bladder, OB/GYN, & Renal Core Clinical</i> : Case Studies/ Case Pathologies <i>First-Trimester Pregnancy</i> : Pathologic Conditions <i>GYN Malignant Adnexal Conditions</i> : Sonographic Characterization of Adnexal Masses, Borderline Tumors <i>GYN Nonmalignant Adnexal Conditions</i> : Ovarian Cysts	<i>Bladder, Cardiology, DVT, Intestinal/Biliary, OB/GYN, Renal, RUSH, & Soft Tissue Core Clinical Cases</i> <i>First-Trimester Pregnancy & All Advanced GYN Cases</i> <i>SonoSim LiveScan® Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, Genitourinary, & Hepatobiliary Cases</i>
<i>Fluid accumulations</i>	<i>Core Clinical Courses</i>	<i>Relevant SonoSim Cases</i>
Pleural	<i>eFAST</i> : Case Studies <i>Pulmonary</i> : Pleural Effusion	<i>Airway, Aorta/IVC, Cardiology, eFAST, Pulmonary, & RUSH Core Clinical Cases</i> <i>FoCUS – Part I Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases</i>

Ascites	<i>eFAST: Case Studies</i> <i>Intestinal/Biliary: Gallbladder Evaluation</i> <i>Paracentesis [In Development]</i>	<i>Bladder, eFAST, & Intestinal/Biliary Core Clinical Cases</i> <i>Paracentesis Cases [In Development]</i> <i>SonoSim LiveScan® Genitourinary, Hepatobiliary, & Trauma Care Cases</i>
Hemoperitoneum	<i>eFAST: RUQ Views, LUQ Views, Pelvic Views, Case Studies</i> <i>FAST: RUQ Views, LUQ Views, Pelvic Views, Case Studies</i>	<i>eFAST & FAST Cases</i> <i>SonoSim LiveScan® Trauma Care Cases</i>
Hematoma	<i>Bladder: Case Pathologies</i> <i>Musculoskeletal: Muscle Evaluation</i> <i>Soft Tissue: Advanced Abscess Evaluation</i>	<i>Ocular Cases</i> <i>Soft Tissue Cases</i>
Abscess	<i>Soft Tissue: Cellulitis and Abscess Imaging, Advanced Abscess Evaluation</i>	<i>Soft Tissue Cases</i>
Abdomen	Core Clinical Courses	Relevant SonoSim Cases
Gallstones & acute cholecystitis	<i>Intestinal/Biliary: Gallbladder Evaluation</i>	<i>Intestinal/Biliary & RUSH Core Clinical Cases</i> <i>SonoSim LiveScan® Early Stage Pregnancy, Late Stage Pregnancy, & Hepatobiliary Cases</i>
Biliary obstruction	<i>Intestinal/Biliary: Gallbladder Evaluation, Common Bile Duct Evaluation</i>	<i>Intestinal/Biliary Cases</i>
Hydronephrosis	<i>Renal: Obstructive Uropathy, Case Studies</i>	<i>Renal Core Clinical Cases</i> <i>SonoSim LiveScan® Early Stage Pregnancy, Late Stage Pregnancy Cases, & Genitourinary Cases</i>
Abdominal aortic aneurysm	<i>Aorta/IVC: Aortic Case Studies</i>	<i>Aorta/IVC & RUSH Core Clinical Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation & Critical Care Cases</i>
Renal calculi	<i>Renal: Case Studies, Obstructive Uropathy</i>	<i>eFAST & Renal Core Clinical Cases</i> <i>SonoSim LiveScan® Early Stage Pregnancy, Genitourinary, & Trauma Care Cases</i>
Splenomegaly	--	<i>eFAST, FAST, & RUSH Cases</i> <i>SonoSim LiveScan® Critical Care, Hepatobiliary, & Trauma Care</i>
Urinary	Bladder Core Clinical Course	Relevant SonoSim Cases
Overdistended urinary bladder	Case Pathologies	<i>Bladder, Intestinal/Biliary, & RUSH Core Clinical Cases</i>
Foley catheter in urinary bladder	Foley Catheter Placement, Case Pathologies	<i>Bladder, eFAST, & RUSH Core Clinical Cases</i> <i>SonoSim LiveScan® Critical Care & Trauma Care</i>
Enlarged prostate	--	<i>Bladder Core Clinical Cases</i>
Gynecology	Core Clinical & Advanced Clinical Courses	Relevant SonoSim Cases
Uterine fibroid	<i>GYN Abnormal Uterus - Part I: Leiomyoma</i> <i>GYN Abnormal Uterus - Part II: Endometrial Polyps & Submucosal Leiomyomas</i>	<i>GYN Abnormal Uterus - Part I & II Cases</i> <i>GYN Nonmalignant & Malignant Adnexal Conditions Cases</i> <i>GYN Normal Adnexa Cases</i> <i>OB/GYN Core Clinical Cases</i> <i>SonoSim LiveScan® Early Stage Pregnancy</i>
Thickened endometrium	<i>GYN Normal Uterus: Female Pelvis Physiology, Transvaginal Sonographic Technique</i> <i>GYN Abnormal Uterus - Part II: Introduction, Retained Products of Conception, Endometrial Cancer & Endometrial Hyperplasia</i>	<i>First-Trimester Pregnancy Cases</i> <i>GYN Malignant Adnexal Conditions Cases</i> <i>GYN Normal Adnexa Cases</i> <i>OB/GYN Core Clinical Cases</i>

Hemorrhagic ovarian cyst	First-Trimester Pregnancy: Pathologic Conditions GYN Nonmalignant Adnexal Conditions: Ovarian Cysts GYN Normal Adnexa: Case Studies OB/GYN: Case Studies	GYN Nonmalignant & Malignant Adnexal Conditions Cases GYN Normal Uterus
Corpus luteum	First-Trimester Pregnancy: Pathologic Conditions GYN Normal Adnexa: Sonographic Anatomy OB/GYN: Case Studies	First-Trimester Pregnancy Cases GYN Abnormal Uterus - Part I Cases GYN Nonmalignant Adnexal Conditions Cases GYN Normal Adnexa & GYN Normal Uterus Cases
Ovarian cancer	GYN Malignant Adnexal Conditions: Evaluation of Adnexal Masses, Sonographic Characterization of Adnexal Masses, Borderline Tumors, Ovarian Cancer	GYN Malignant Adnexal Conditions Cases
Obstetrics	Core Clinical & Advanced Clinical Courses	Relevant SonoSim Cases
First-trimester pregnancy complications (subchorionic hemorrhage, embryonic demise)	First-Trimester Pregnancy: Detecting Pregnancy Failure, Pathologic Conditions	First-Trimester Pregnancy Cases
Ectopic pregnancy	First-Trimester Pregnancy: Pathologic Conditions OB/GYN: Pathologic Conditions	--
Placenta previa	Second- & Third-Trimester Pregnancy - Part II: Placental Evaluation	--
Incompetent cervix	Second- & Third-Trimester Pregnancy - Part I: Cervical Length	--
Polyhydramnios & oligohydramnios	Second- & Third-Trimester Pregnancy - Part II: Amniotic Fluid Assessment	--
Vascular	DVT Course	Relevant SonoSim Cases
Acute deep vein thrombosis in femoropopliteal system	All Lessons	DVT Cases
Thoracic conditions	Core Clinical Courses	Relevant SonoSim Cases
Large pericardial effusion (pericardial tamponade)	Cardiology: Case Studies Pericardiocentesis Course [In Development] RUSH: Case Studies	Cardiology, eFAST, & RUSH Core Clinical Cases FoCUS - Part I Cases SonoSim LiveScan® Cardiac Resuscitation, Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, & Trauma Care Cases
Pneumothorax	Pulmonary: Pneumothorax Rule-Out, Pneumothorax Rule-In	eFAST, Pulmonary, & RUSH Core Clinical Cases SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases
Pediatrics	Intestinal/Biliary Course	Relevant SonoSim Cases
Intussusception	Intussusception	--

Learning Objectives Not Covered: Acute deep vein thrombosis in internal jugular vein, Testicular mass, Hydrocele, Torsion, Epididymitis, Varicocele, Paralyzed hemidiaphragm, Pediatric hypertrophic pyloric stenosis, Pediatric intracranial hemorrhage

Describe Clinical Situations Where Ultrasound is Used to Guide Interventional Procedures

Learning Objectives	SonoSim Courses & Lessons	SonoSimulator Scanning Cases
Centesis procedures	Procedures Courses	Relevant SonoSim Cases
Paracentesis	Paracentesis Course [In Development]	Paracentesis Cases [In Development]
Thoracentesis	Thoracentesis Course [In Development]	Thoracentesis Cases [In Development]
Pericardiocentesis	Pericardiocentesis Course [In Development]	Pericardiocentesis Cases [In Development]
Vascular access	Procedures Courses	Relevant SonoSim Cases
Peripherally inserted central catheter line	Peripheral Venous Access: All Lessons	Peripheral Venous Access Cases
Venous access	All Procedures Courses: All Lessons	All Procedures Cases
Localization for aspiration and drainage	Core Clinical & Advanced Clinical Courses	Relevant SonoSim Cases
Abscess	Soft Tissue: Cellulitis and Abscess Imaging, Advanced Abscess Evaluation, Peritonsillar Abscess	Soft Tissue Core Clinical Cases
Hydronephrosis	Renal: Obstructive Uropathy, Case Studies	Renal Core Clinical Cases SonoSim LiveScan® Early Stage Pregnancy, Late Stage Pregnancy, & Genitourinary Cases
Cysts	Bladder, OB/GYN, & Renal Core Clinical: Case Studies/ Case Pathologies First-Trimester Pregnancy: Pathologic Conditions GYN Malignant Adnexal Conditions: Sonographic Characterization of Adnexal Masses, Borderline Tumors GYN Nonmalignant Adnexal Conditions: Ovarian Cysts	Bladder, DVT, Intestinal/Biliary, OB/GYN, Renal, RUSH, Soft Tissue Core Clinical Cases SonoSim LiveScan® Critical Care, Genitourinary, & Hepatobiliary
Procedures	Soft Tissue: Core Clinical Course	Relevant SonoSim Cases
Aspirations	Advanced Abscess Evaluation	--
Foreign body localization	Foreign Bodies, Foreign Body Removal Techniques	Ocular Cases
Fetal procedures	Second- & Third-Trimester Pregnancy – Part I Course	Relevant SonoSim Cases
Amniocentesis	Basic Fetal Anatomy	--
Sonohysterography	GYN Abnormal Uterus - Part II: Evaluating the Endometrium	Relevant SonoSim Cases

Learning Objectives Not Covered: Arterial access, Biopsies, Injections, Fetal therapeutic procedures

¹Brown B, Adhikari S, Marx J, et al. Introduction of ultrasound into gross anatomy curriculum: perceptions of medical students. *J Emerg Med.* 2012 Dec;43(6):1098-1102. Epub 2012 Mar 28.

²Bell FE, Wilson LB, Hoppmann RA. Using ultrasound to teach medical students cardiac physiology. *Adv Physiol Educ.* 2015 Dec;39(4):392-396.

³Hoppmann RA, Rao VV, Poston MB, et al. An integrated ultrasound curriculum (iUSC) for medical students: 4-year experience. *Crit Ultrasound J.* 2011 Apr;3(1):1-12. Epub 2011 Feb 1.

⁴Baltarowich OH, Di Salvo DN, Scoutt LM, et al. National ultrasound curriculum for medical students. *Ultrasound Q.* 2014 Mar;30(1):13-19.