The SonoSim Ultrasound Training Solution in Accordance with the National Ultrasound Curriculum for Medical Students

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

Imaging modes	Fundamentals of Ultrasound Course	Relevant SonoSim Cases
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**
Basic probe and image orientation	*Fundamentals of Ultrasound Course*	*Relevant SonoSim Cases*
Sagittal, transverse, coronal	Imaging Conventions	*All SonoSim Cases*
Transducers	*Fundamentals of Ultrasound Course*	*Relevant SonoSim Cases*
Frequencies, types (linear, curvilinear, sector, transvaginal), near field, far field	Transducer Basics	*All SonoSim Cases*
Machine settings	*Fundamentals of Ultrasound Course*	*Relevant SonoSim Cases*
Transducer frequency, focus, time-gain compensation	Ultrasound System Operation	--
Depth, gain	Ultrasound System Operation	*All SonoSim Cases*
Control buttons	*Advanced Clinical Courses*	*Relevant SonoSim Cases*
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
General	*Core Clinical, Advanced Clinical, & Procedures Courses*	*Relevant SonoSim Cases*
Real-time dynamic imaging, multiplanar imaging, portable, lack of ionizing radiation, lower cost, safe & noninvasive	*Various Core Clinical, Advanced Clinical, & Procedures Courses*	*All SonoSim Cases*

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

Learning Objectives Not Covered: Less interexamination reproducibility relative to CT

Correlate Patient Safety and Ultrasound

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

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

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* *Advanced Neonatal & Infant Neurosonography Cases* *SonoSim LiveScan® Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, Genitourinary, Hepatobiliary, & Neonatal & Infant Neurosonography Cases*
Clinically suspected fluid accumulations	*Core Clinical & Procedures Courses*	*Relevant SonoSim Cases*
Ascites	*eFAST:* Case Studies *Intestinal/Biliary:* Gallbladder Evaluation *Paracentesis Course*	*Bladder, eFAST, & Intestinal/Biliary Core Clinical Cases* *Paracentesis Cases* *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*	*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	*Renal:* Obstructive Uropathy, Case Studies	*Intestinal/Biliary & Renal Core Clinical Cases* *SonoSim LiveScan® Hepatobiliary & Genitourinary Cases*
Screening (and following) abdominal aortic aneurysms	*Aorta/IVC:* Aortic Case Studies	*Aorta/IVC & RUSH Core Clinical Cases* *SonoSim LiveScan® Cardiac Resuscitation & Critical Care*

Gynecology	Core Clinical & Advanced Clinical Courses	Relevant SonoSim Cases
Pelvic mass	*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	*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*
Pelvic pain	*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	*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*
Abnormal vaginal bleeding	*GYN Abnormal Uterus - Part II:* All Lessons	*GYN Abnormal Uterus – Part I & II Cases* *GYN Normal Adnexa & GYN Normal Uterus Cases* *GYN Nonmalignant Adnexal Conditions Cases* *OB/GYN Core Clinical Cases*
Obstetrics	Core Clinical & Advanced Clinical Courses	Relevant SonoSim Cases
Abnormal bleeding	*GYN Abnormal Uterus - Part II:* Retained Products of Conception, Subinvolution of the Placental Site *OB/GYN:* Pathologic Conditions	*First-Trimester Pregnancy Cases* *SonoSim LiveScan® Early Stage Pregnancy & Late Stage Pregnancy Cases*
Dating	*First Trimester Pregnancy:* Pregnancy Dating Using Ultrasound *Second- & Third-Trimester Pregnancy - Part I:* Fetal Biometry & Pregnancy Dating	*First-Trimester Pregnancy Cases* *OB/GYN Core Clinical Cases* *Second- & Third-Trimester Pregnancy - Part I & II Cases*
Heartbeat	*First-Trimester Pregnancy:* General Considerations *OB/GYN:* Embryology *Second- & Third-Trimester Pregnancy - Part I:* Basic Fetal Anatomy	*First-Trimester Pregnancy Cases* *OB/GYN Core Clinical Cases* *Second- & Third-Trimester Pregnancy - Part I & II Cases*
Fetal anatomy	*Second- & Third-Trimester Pregnancy - Part I:* Basic Fetal Anatomy	*First-Trimester Pregnancy Cases* *OB/GYN Core Clinical Cases* *Second- & Third-Trimester Pregnancy - Part I & II Cases*
Decreased fetal activity	*Second- & Third-Trimester Pregnancy - Part II:* Biophysical Profile	--
Suspected ruptured membranes	*Second- & Third-Trimester Pregnancy - Part II:* Amniotic Fluid Assessment	--
Premature labor	*Second- & Third-Trimester Pregnancy - Part I:* Cervical Length	--
Pediatrics	Advanced Neonatal & Infant Neurosonography Course	Relevant SonoSim Cases
Suspected neonatal brain hemorrhage	All Lessons	*Advanced Neonatal & Infant Neurosonography Cases* *SonoSim LiveScan® Neonatal & Infant Neurosonography Cases*
Echocardiography	Core Clinical & Advanced Clinical Courses	Relevant SonoSim Cases
Pericardial effusion with or without tamponade	*Cardiology:* Case Studies *RUSH:* The Pump - Global LV Function, 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*

Right-sided heart strain	*Cardiology:* Case Studies *RUSH:* Case Studies	*Cardiology Cases* *FoCUS - Part I Cases*
Valvular dysfunction	*FoCUS - Part II:* Valvular Regurgitation, Valvular Stenosis	*Cardiology Cases* *FoCUS - Part I Cases*
Cardiac/chamber enlargement	*FoCUS - Part II:* Valvular Regurgitation	*Cardiology Cases* *FoCUS - Part I Cases*
Calculate ejection fraction	*Cardiology:* Case Studies	*Cardiology Cases* *FoCUS - Part I Cases*
Extremities	*DVT: Core Clinical Course*	*Relevant SonoSim Cases*
Lower- or upper-extremity swelling or pain (suspected deep vein thrombosis)	All Lessons	*DVT & RUSH Core Clinical Cases*
Musculoskeletal	*Musculoskeletal: Core Clinical Course*	*Relevant SonoSim Cases*
Evaluation of musculoskeletal pain (muscle, tendon, or other superficial soft tissue origin), effusions, collections	Tendon Evaluation, Muscle Evaluation, Effusion Evaluation	*Musculoskeletal Core Clinical Cases*

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

Observe the Following Ultrasound Studies		
Learning Objectives	**SonoSim Courses & Lessons**	**SonoSimulator Scanning Cases**
Abdominal	*Anatomy & Physiology Courses*	*Relevant SonoSim Cases*
RUQ US (liver, gallbladder, bile ducts, right kidney, head of pancreas) & upper abdominal US (RUQ plus spleen, left kidney)	*Biliary Tree, Liver, Pancreas, Renal, and Spleen Anatomy & Physiology:* All Lessons *Intestinal/Biliary Core Clinical:* Gallbladder Evaluation, Common Bile Duct Evaluation *Renal Core Clinical:* All Lessons	*Biliary Tree, Liver, Pancreas, Renal, and Spleen Anatomy & Physiology Cases* *Intestinal//Biliary & Renal Core Clinical Cases*
Aorta, IVC	*Aorta/IVC Anatomy & Physiology and Core Clinical:* All Lessons	*Aorta/IVC Anatomy & Physiology and Core Clinical Cases*
Pelvic	*Anatomy & Physiology, Core Clinical, & Advanced Clinical Courses*	*Relevant SonoSim Cases*
Urinary bladder	*Bladder Anatomy & Physiology and Core Clinical:* All Lessons	*Bladder Anatomy & Physiology and Core Clinical Cases*
Uterus, ovaries, cul de sac (transabdominal & transvaginal)	*Female Pelvis Anatomy & Physiology:* All Lessons *All Advanced GYN Courses:* All Lessons *OB/GYN:* All Lessons	*Female Pelvis Anatomy & Physiology Cases* *All Advanced GYN Cases* *OB/GYN Core Clinical Cases*
Prostate	*Prostate Anatomy & Physiology:* All Lessons	*Prostate Anatomy & Physiology Cases*
Obstetric	*Advanced Clinical Courses*	*Relevant SonoSim Cases*
First-trimester US (gestational sac, yolk sac, embryo, M-mode heartbeat)	*First-Trimester Pregnancy:* All Lessons	*First-Trimester Pregnancy Cases* *OB/GYN Core Clinical Cases*
Second/third-trimester fetal US (fetal heartbeat, placenta, amniotic fluid, cervix)	*Second- & Third-Trimester Pregnancy - Part I & II:* All Lessons	*Second- & Third-Trimester Pregnancy - Part I & II Cases*
Breast	*Breast Anatomy & Physiology Course*	*Relevant SonoSim Cases*
Breast US	All Lessons	*Breast Anatomy & Physiology Cases*

Thyroid	Thyroid Anatomy & Physiology Course	Relevant SonoSim Cases
Thyroid US	All Lessons	Thyroid Anatomy & Physiology Cases
Vascular	**Anatomy & Physiology, Core Clinical, & Procedures Courses**	**Relevant SonoSim Cases**
Upper- or lower-extremity deep vein thrombosis study	DVT: All Lessons	DVT Cases RUSH Cases
Internal jugular vein and subclavian vein (versus companion arteries)	Cerebrovascular Anatomy & Physiology: All Lessons US-Guided Internal Jugular Vein Cannulation: All Lessons US-Guided Subclavian Vein Cannulation: All Lessons	Cerebrovascular Anatomy & Physiology US-Guided Internal Jugular Vein Cannulation Cases US-Guided Subclavian Vein Cannulation Cases
Carotid US (if possible)	Cerebrovascular Anatomy & Physiology: All Lessons	Cerebrovascular Anatomy & Physiology US-Guided Internal Jugular Vein Cannulation Cases
Cardiac	**Anatomy & Physiology and Core Clinical Courses**	**Relevant SonoSim Cases**
Echocardiogram (basic views)	Heart Anatomy & Physiology: All Lessons Cardiology Core Clinical: All Lessons	Heart Anatomy & Physiology Cases Cardiology Core Clinical Cases
Pediatrics	**Advanced Neonatal & Infant Neurosonography Course**	**Relevant SonoSim Cases**
Neonatal brain US (if possible)	All Lessons	Advanced Neonatal & Infant Neurosonography Cases SonoSim LiveScan® Neonatal & Neurosonography Cases
Biopsy guidance/fluid aspiration or drainage	**Core Clinical & Procedures Courses**	**Relevant SonoSim Cases**
Fluid aspiration/drainage	Bladder Core Clinical: Ultrasound-Guided Suprapubic Catheterization Soft Tissue Core Clinical: Advanced Abscess Evaluation, Peritonsillar Abscess Glenohumoral Joint Injection & Aspiration: All Lessons Subacromial-Subdeltoid Bursa Injection & Aspiration: All Lessons	Glenohumoral Joint Injection & Aspiration Cases Subacromial-Subdeltoid Bursa Injection & Aspiration Cases

Recognize or at Least See Classic Examples of Common Pathological Conditions on Ultrasound		
Learning Objectives	**SonoSim Courses & Lessons**	**SonoSimulator Scanning Cases**
Cyst versus complex cyst versus solid mass	**Core Clinical & Advanced Clinical Courses**	**Relevant SonoSim Cases**
Cyst vs. complex cyst vs. solid mass	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, Cardiology, DVT, Intestinal/Biliary, OB/GYN, Renal, RUSH, & Soft Tissue Core Clinical Cases First-Trimester Pregnancy & All Advanced GYN Cases Advanced Neonatal & Infant Neurosonography Cases SonoSim LiveScan® Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, Genitourinary, Hepatobiliary, & Advanced Neonatal & Infant Neurosonography Cases
Fluid accumulations	**Core Clinical Courses**	**Relevant SonoSim Cases**
Pleural	eFAST: Case Studies Pulmonary: Pleural Effusion	Airway, Aorta/IVC, Cardiology, eFAST, Pulmonary, & RUSH Core Clinical Cases FoCUS – Part I Cases SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases
Ascites	eFAST: Case Studies Intestinal/Biliary: Gallbladder Evaluation Paracentesis	Bladder, eFAST, & Intestinal/Biliary Core Clinical Cases Paracentesis Cases SonoSim LiveScan® Genitourinary, Hepatobiliary, & Trauma Care Cases

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

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

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*	*Paracentesis Cases*
Thoracentesis	*Thoracentesis Course*	*Thoracentesis Cases*
Pericardiocentesis	*Pericardiocentesis Course*	*Pericardiocentesis Cases*
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	*Core Clinical & Procedures Courses*	*Relevant SonoSim Cases*
Aspirations	*Soft Tissue:* Advanced Abscess Evaluation *Glenohumoral Joint Injection & Aspiration:* All Lessons *Subacromial-Subdeltoid Bursa Injection & Aspiration:* All Lessons	*Glenohumoral Joint Injection & Aspiration Cases* *Subacromial-Subdeltoid Bursa Injection & Aspiration Cases*
Foreign body localization	Soft Tissue: 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

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