



The SonoSim Ultrasound Training Solution in Accordance with SCCM's Recommendations for Critical Care Ultrasound

In an effort to “provide guidance to both providers and hospitals in the process of credentialing in critical care ultrasound,” the Society of Critical Care Medicine (SCCM) published an official statement on appropriate knowledge- and skills-based training objectives, entitled “[Recommendations for Achieving and Maintaining Competence and Credentialing in Critical Care Ultrasound with Focused Cardiac Ultrasound and Advanced Critical Care Echocardiography](#).”¹ 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.

Critical Care Ultrasound: Knowledge-Based Objectives	
Recommended Critical Care Ultrasound Knowledge	SonoSim Courses & Lessons
General Ultrasound Knowledge	Fundamentals of Ultrasound Course
Physical principles of ultrasound image formation and pulse-wave, continuous, and color Doppler	Introduction, Basic Ultrasound Physics, Doppler Mode Imaging
Artifacts and pitfalls	Imaging Artifacts
Operation of ultrasound machines, including controls and transducers	Ultrasound System Operation, Transducer Basics
Equipment handling, infection control, and electrical safety	Infection Control & Biosafety
Ergonomics of ultrasound exam in intensive care unit environment	<i>Fundamentals: Imaging Conventions</i> <i>All Procedures Courses</i>
Indications, contraindications, limitations, and potential complications of critical care ultrasound and echocardiography	<i>Cardiology: Introduction</i> <i>RUSH: Introduction, The Pump - Global LV Function, Case Studies, The Tank - Intravascular Volume, The Pipes - AAA, The Pipes - DVT, Summary</i>
Normal sonographic anatomy of each relevant modality and organ system	<i>All SonoSim Anatomy & Physiology Courses</i>
Standard windows and views for each relevant modality	<i>All SonoSim Anatomy & Physiology Courses</i>
Cardiac Ultrasound Knowledge	Echocardiography Courses
Incorporation and integration of focused transthoracic with other modalities of hemodynamic monitoring	<i>FoCUS – Part I: Cardiac Output Measurements, Case Studies I, Pulmonary Artery Pressure Measurements, Case Studies II</i>
Normal and abnormal right and left ventricular size and systolic function	<i>Cardiology: Parasternal Long-Axis View, Parasternal Short-Axis View - Mid-Ventricle, Apical Four-Chamber View, Subcostal Four-Chamber View, Case Studies</i> <i>FoCUS – Part I: Imaging Windows, Case Studies I, Case Studies II</i> <i>FoCUS – Part II: Valvular Regurgitation, Mitral Regurgitation, Tricuspid Regurgitation</i> <i>Heart – Anatomy & Physiology: Anatomy, Sonographic Anatomy, Sonographic Technique</i> <i>RUSH: The Pump - Global LV Function</i>
Normal and abnormal cardiac atrial size	<i>Cardiology: Parasternal Long-Axis View, Parasternal Short-Axis View - Base, Apical Four-Chamber View, Subcostal Four-Chamber View, Case Studies</i> <i>FoCUS – Part I: Imaging Windows, Case Studies I, Case Studies II</i> <i>Heart – Anatomy & Physiology: Anatomy, Sonographic Anatomy, Sonographic Technique</i>

Cardiac Ultrasound Knowledge (Cont.)	Echocardiography Courses (Cont.)
Ultrasound manifestations of pericardial effusion and signs of tamponade and limitation of ultrasound diagnosis of tamponade	<i>Cardiology</i> : Case Studies <i>RUSH</i> : The Pump - Global LV Function, Case Studies
Incorporation of cardiac ultrasound in Advanced Cardiac Life Support (ACLS) protocols	<i>Resuscitative TEE</i> : All Lessons
Vascular Ultrasound Knowledge	Vascular & Fluid Assessment Courses
Estimation of central venous pressure and limitation of ultrasound estimation	<i>Aorta/IVC – Core Clinical</i> : IVC Evaluation, IVC Case Studies <i>Cardiology</i> : IVC Evaluation & RAP <i>RUSH</i> : The Tank - Intravascular Volume
Ultrasound manifestations of septic shock and differentiation between severe hypovolemia and vasodilatory state	<i>RUSH</i> : Introduction, The Pump - Global LV Function, The Tank - Intravascular Volume, The Pipes - AAA
Ultrasound manifestation of severe hypovolemia and understanding of the limitation of assessment of “fluid status” with ultrasound	<i>Cardiology</i> : IVC Evaluation & RAP <i>RUSH</i> : The Tank - Intravascular Volume
Ultrasound manifestations of large deep venous thrombosis in femoral veins	<i>DVT – Lower Extremity</i> : All Lessons <i>RUSH</i> : The Pipes – DVT
Principles of needle/wire guidance with ultrasound for bedside procedures, including vascular access, thoracentesis, and paracentesis	<i>Introduction to US-Guided Procedures</i> : All Lessons <i>US-Guided Internal Jugular Vein Cannulation</i> : All Lessons <i>US-Guided Subclavian Vein Cannulation</i> : All Lessons <i>US-Guided Femoral Line Placement</i> : All Lessons <i>Peripheral Venous Access</i> : All Lessons <i>Thoracentesis</i> : All Lessons <i>Paracentesis</i> : All Lessons
Pulmonary Ultrasound Knowledge	Pulmonary Courses
Ultrasound manifestations of pneumothorax and understanding of the limitation in diagnosis of pneumothorax	<i>Pulmonary Core Clinical</i> : Pneumothorax Rule-Out, Pneumothorax Rule-In <i>Advanced Pediatric Lung Sonography</i> : Sonographic Anatomy, Case Studies
Ultrasound characterization of pleural effusion	<i>Pulmonary Core Clinical</i> : Pleural Effusion <i>Advanced Pediatric Lung Sonography</i> : Sonographic Anatomy, Case Studies

Recommended Critical Care Ultrasound Knowledge not covered: Data management, including image storage, integration with hospital image management systems, reporting, quality assurance process; Principles of needle/wire guidance with ultrasound for tube thoracostomy

Critical Care Ultrasound: Skills-Based Objectives

Recommended Critical Care Ultrasound Skills	SonoSimulator Cases to Scan
General Ultrasound Skills	SonoSim Cases
Ability to operate ultrasound machines and utilize their controls to optimize image quality	<i>All SonoSim Cases</i>
Ability to recognize common ultrasound artifacts (e.g. reverberation, side lobe, mirror image)	<i>All SonoSim Cases</i>
Ability to communicate ultrasound findings to other healthcare providers, the medical record, and patients	<i>All SonoSim Cases</i>
Ability to select an appropriate probe for a given ultrasound examination	<i>Knowledge Taught in All SonoSim Courses</i>
Recognize when referral to or consultation with other specialists is necessary	<i>All SonoSim Core Clinical & Advanced Clinical Cases</i>
Ability to recognize complications of various critical care ultrasound applications	<i>RUSH Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation & Critical Care Cases</i>
Cardiac Ultrasound Skills	Echocardiography Cases
Ability to insert transesophageal echocardiography probe in anesthetized, tracheally intubated patient	<i>Resuscitative TEE Cases</i>
Ability to incorporate ultrasound examinations in the bedside management of critically ill or injured patients during cardiopulmonary arrest or in shock	<i>eFAST Cases</i> <i>FAST Cases</i> <i>RUSH Cases</i> <i>LVAD Problem-Focused Echocardiography Cases</i> <i>Resuscitative TEE Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, Late Stage Pregnancy, & Trauma Care Cases</i>
Ability to perform basic transthoracic echocardiography and differentiate normal from markedly abnormal cardiac structures and function	<i>Cardiology Cases</i> <i>FoCUS – Part I & II Cases</i> <i>Heart – Anatomy & Physiology Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases</i>
Ability to recognize marked changes in global left systolic function	<i>Cardiology Cases</i> <i>FoCUS – Part I & II Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases</i>
Ability to recognize marked hypovolemia	<i>Aorta/IVC: Core Clinical Cases</i> <i>RUSH Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation & Critical Care Cases</i>
Ability to recognize gross valvular lesions and dysfunction	<i>Cardiology Cases</i> <i>FoCUS – Part I & II Cases</i>
Ability to detect significant pericardial effusions	<i>Cardiology Cases</i> <i>FoCUS – Part I Cases</i> <i>eFAST Cases</i> <i>RUSH Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, Early Stage Pregnancy, Late Stage Pregnancy, & Trauma Care Cases</i>

Cardiac Ultrasound Skills (Cont.)	Echocardiography Cases (Cont.)
Ability to identify signs of chronic cardiac disease	<i>Cardiology Cases</i> <i>FoCUS – Part I & II Cases</i> <i>Pulmonary Cases</i>
Ability to incorporate ultrasound in patient resuscitation during cardiopulmonary arrest without interfering with ACLS protocols or interrupting chest compressions	<i>Resuscitative TEE Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation & Late Stage Pregnancy Cases</i>
Pulmonary Ultrasound Skills	Pulmonary Cases
Ability to rule out pneumothorax in patients with normal chest walls	<i>eFAST Cases</i> <i>Pulmonary Cases</i> <i>RUSH Cases</i> <i>Advanced Pediatric Lung Sonography Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases</i>
Ability to assess pleural effusion: size, location, degree of loculation	<i>Cardiology Cases</i> <i>eFAST Cases</i> <i>FoCUS – Part I Cases</i> <i>Pulmonary Cases</i> <i>RUSH Cases</i> <i>Advanced Pediatric Lung Sonography Cases</i> <i>Pediatric Challenge Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation, Critical Care, & Trauma Care Cases</i>
Ability to assess alveolar/interstitial syndrome	<i>Pulmonary Cases</i> <i>RUSH Cases</i> <i>Advanced Pediatric Lung Sonography Cases</i> <i>Pediatric Challenge Cases</i> <i>SonoSim LiveScan® Cardiac Resuscitation & Critical Care Cases</i>
Vascular Ultrasound Skills	Vascular Cases
Ability to recognize large deep venous thrombosis in femoral veins	<i>DVT Cases</i> <i>RUSH Cases</i> <i>SonoSim LiveScan® Critical Care Cases</i>
Ability to guide bedside procedures with ultrasound (e.g., vascular access, thoracentesis, paracentesis, arthrocentesis)	<i>Introduction to US-Guided Procedures Cases</i> <i>US-Guided Internal Jugular Vein Cannulation Cases</i> <i>US-Guided Subclavian Vein Cannulation Cases</i> <i>US-Guided Femoral Line Placement Cases</i> <i>Peripheral Venous Access Cases</i> <i>Thoracentesis Cases</i> <i>Paracentesis Cases</i>

Advanced Critical Care Echocardiography: Knowledge-Based Objectives

Recommended Advanced Critical Care Echocardiography Knowledge	SonoSim Courses & Lessons
Advanced Echocardiography Knowledge	Advanced Echocardiography Courses
All knowledge needed to perform critical care ultrasound	See "Recommended Critical Care Ultrasound Knowledge" on Page 1
Advanced knowledge of artifacts and pitfalls in interpretation	<i>Cardiology: Case Studies</i> <i>FoCUS – Part I: Imaging Windows, Doppler Ultrasound, Cardiac Output Measurements, Case Studies I, Case Studies II</i> <i>FoCUS – Part II: Echocardiographic Technique, Doppler Imaging, Valvular Regurgitation, Valvular Stenosis</i>
Knowledge of comprehensive transthoracic echocardiography views	<i>Cardiology: Parasternal Long-Axis View, Parasternal Short-Axis View - Mid-Ventricle, Parasternal Short-Axis View – Base, Apical Four-Chamber View, Subcostal Four-Chamber View, Case Studies</i> <i>FoCUS – Part I: Imaging Windows</i> <i>FoCUS – Part II: Echocardiographic Technique</i> <i>Heart – Anatomy & Physiology: Anatomy, Sonographic Anatomy, Sonographic Technique</i>
Detailed knowledge of qualitative and quantitative echocardiography	<i>Cardiology: IVC Evaluation & RAP, Case Studies</i> <i>FoCUS – Part I: Doppler Ultrasound, Cardiac Output Measurements, Case Studies I, Pulmonary Artery Pressure Measurements, Case Studies II</i> <i>FoCUS – Part II: Doppler Imaging, Valvular Regurgitation, Aortic Regurgitation, Mitral Regurgitation, Tricuspid Regurgitation, Pulmonic Regurgitation, Valvular Stenosis, Aortic Stenosis, Mitral Stenosis, Tricuspid Stenosis, Pulmonic Stenosis</i>
Detailed knowledge of heart-lung interactions in spontaneously breathing and mechanically ventilated patients	<i>FoCUS – Part I: Pulmonary Artery Pressure Measurements, Case Studies II</i>
Detailed knowledge of diseases of the heart relevant to care of critically ill or injured patients (e.g., dynamic left ventricular outflow tract obstruction, systolic anterior motion of the mitral valve, ischemic cardiomyopathy, mitral or aortic stenosis)	<i>Cardiology: Case Studies</i> <i>FoCUS – Part I: Cardiac Output Measurements, Case Studies I, Pulmonary Artery Pressure Measurements, Case Studies II</i> <i>FoCUS – Part II: Valvular Regurgitation, Aortic Regurgitation, Mitral Regurgitation, Tricuspid Regurgitation, Pulmonic Regurgitation, Valvular Stenosis, Aortic Stenosis, Mitral Stenosis, Tricuspid Stenosis, Pulmonic Stenosis</i>
Detailed knowledge of normal and abnormal left ventricular systolic function, including segmental wall motion abnormalities	<i>Cardiology: Case Studies</i> <i>FoCUS – Part I: Case Studies I, Case Studies II</i> <i>FoCUS – Part II: Echocardiographic Techniques</i> <i>FoCUS – Part III: Segmental Wall Motion Abnormalities [Coming Soon]</i> <i>Heart – Anatomy & Physiology: Anatomy, Heart Physiology</i>
Detailed knowledge of normal and abnormal left ventricular diastolic function	<i>FoCUS – Part III: Diastolic Dysfunction [Coming Soon]</i>

Advanced Echocardiography Knowledge (Cont.)	Advanced Echocardiography Courses (Cont.)
Detailed knowledge of normal and abnormal right ventricular function, including the appearance of acute and chronic pulmonary hypertension, right ventricular infarct, pulmonary heart failure, tricuspid annular plane systolic excursion	<i>FoCUS – Part I: Case Studies I, Pulmonary Artery Pressure Measurements, Case Studies II</i> <i>Heart – Anatomy & Physiology: Anatomy, Heart Physiology</i>
Detailed assessment of hemodynamic significance of valve dysfunction	<i>FoCUS – Part I: Cardiac Output Measurements, Pulmonary Artery Pressure Measurements</i> <i>FoCUS – Part II: Valvular Regurgitation, Aortic Regurgitation, Mitral Regurgitation, Tricuspid Regurgitation, Pulmonic Regurgitation, Valvular Stenosis, Aortic Stenosis, Mitral Stenosis, Tricuspid Stenosis, Pulmonic Stenosis</i>
Detailed knowledge of tamponade physiology, including flow variation in the right and left hearts, chamber collapse, inferior vena cava plethora	<i>Cardiology: Case Studies</i> <i>FoCUS – Part I: Case Studies I, Case Studies II</i>
In-depth knowledge of applications of critical care echocardiography in evaluating fluid responsiveness	<i>Cardiology: IVC Evaluation & RAP</i> <i>RUSH: The Tank - Intravascular Volume</i>
Knowledge of echocardiographic manifestations of intracardiac masses and thrombi	<i>FoCUS – Part III: Intracardiac Masses [Coming Soon]</i>

Recommended Advanced Critical Care Echocardiography Knowledge not covered: Detailed knowledge of pericardial constriction & restrictive cardiomyopathy; Detailed knowledge of right ventricular fractional areachange; Detailed knowledge of commonly encountered complications of acute coronary syndrome; Knowledge of anatomy, physiology, and implications of intracardiac and intrapulmonary shunts; Detailed knowledge of other diagnostic modalities relevant in hemodynamic management of critically ill or injured patients

Advanced Critical Care Echocardiography: Skills-Based Objectives

Recommended Advanced Critical Care Echocardiography Skills	SonoSimulator Cases to Scan
Advanced Echocardiography Skills	Advanced Echocardiography Cases
All the skills needed in basic critical care ultrasound	See "Recommended Critical Care Ultrasound Skills" on Page 3
Ability to perform comprehensive transthoracic echocardiography exam	Cardiology Cases FoCUS – Part I & II Cases Heart – Anatomy & Physiology Cases SonoSim LiveScan® Cardiac Resuscitation Cases
Ability to quantify flows and pressures across various cardiac chambers	FoCUS – Part I & II Cases
Ability to acquire comprehensive hemodynamic data	Cardiology Cases FoCUS – Part I & II Cases Heart – Anatomy & Physiology Cases SonoSim LiveScan® Cardiac Resuscitation Cases
Ability to quantify systolic and diastolic left ventricular function	FoCUS – Part I & II Cases
Ability to quantify right ventricular systolic function	FoCUS – Part I & II Cases
Ability to recognize subtle left ventricular wall motion abnormalities	Cardiology Cases FoCUS – Part I & II Cases
Ability to quantify normal and abnormal native and prosthetic valvular function	Cardiology Cases FoCUS – Part I & II Cases
Ability to evaluate hemodynamic consequences of pericardial effusion and tamponade	Cardiology Cases eFAST Cases FoCUS – Part I Cases RUSH Cases SonoSim LiveScan® Cardiac Resuscitation, Critical Care Cases, & Trauma Care Cases
Ability to assess fluid responsiveness in spontaneously breathing and mechanically ventilated patients using validated echocardiographic dynamic indices of preload	Cardiology Cases* FoCUS – Part I Cases* RUSH Cases* SonoSim LiveScan® Cardiac Resuscitation* & Critical Care Cases*
Ability to assess for intracardiac masses and thrombi	Cardiology Cases FoCUS – Part II Cases
Ability to recognize limitations and inaccuracies of the chosen modality and identify additional diagnostic modalities necessary for the management of a critically ill patient, and recognize situations when referral to specialist is required	All SonoSim Cardiac Cases

*Right atrial pressure estimation from respirophasic variation covered

Recommended Advanced Critical Care Echocardiography Skills not covered: Ability to perform comprehensive transesophageal echocardiography exam; Ability to assess for the presence of intracardiac and intrapulmonary shunts

¹Pustavoitau A, Blaivas M, Brown SM, et al; Ultrasound Certification Task Force on behalf of the Society of Critical Care Medicine. Official statement of the Society of Critical Care Medicine: recommendations for achieving and maintaining competence and credentialing in critical care ultrasound with focused cardiac ultrasound and advanced critical care echocardiography. Crit Care Med. 2014;42:1021–1324, e319–e390. Available from: <http://journals.lww.com/ccmjournal/Documents/Critical%20Care%20Ultrasound.pdf>.