# Point of Care Ultrasound Program for Surgical Critical Care Fellows

## Surgical Critical Care Program Directors Society (SCCPDS)
## Ultrasound Task Force

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This document serves as a revision of the original Point of Care Ultrasound Education Curriculum for Surgical Critical Care fellows created by the SCCPDS Ultrasound Committee

**Original Ultrasound Committee Members:** (alphabetical order)
Dennis Ashley
Amy Christie
Jay Doucet
Alison Fecher
Paula Ferrada
Timothy Novosel

**Current Ultrasound Task Force Members:** (alphabetical order)
Tanya Anand
Rachel Appelbaum
Victor Aquino
Paula Ferrada
Uzer Khan
Samantha Lahey
Mayur Narayan
Chinelo Ogbudinkpa

## Background

The use of ultrasound (including general and cardiac) as an extension of the physical examination when treating the critically ill, was borne out of necessity; a need for informed decisions regarding real-time anatomic and physiologic information, especially when guiding therapy of a hypotensive patient. The route of education for ultrasound has been different for every specialty, each with barriers and opportunities for enhanced collaboration between disciplines.

There is ample evidence that both general and cardiac critical care ultrasound can be performed and interpreted accurately by intensive care physicians. Recently, guidelines for the appropriate use of bedside general and cardiac ultrasound for the evaluation of critically ill patients[27], as well as international consensus statements regarding the training standards for achieving competency in both general critical care ultrasound (GCCUS) and critical care echocardiography (CCE basic and CCE advanced) have been published.[25]

The following document is a suggestion for surgical critical care fellowship training programs to standardize training in this emerging bedside technique. These suggestions are for training in CCE, referring to high yield anatomic and physiologic information to guide clinical conduct on a critical care patient.

**The suggested curriculum consists of the following components:**

- At least one surgical critical care faculty member should be skilled in critical care ultrasound to coordinate fellow training in this modality.
- The faculty responsible for ultrasound training of fellows should complete a formal ultrasound course and demonstrate proficiency in the subject of ultrasound and in teaching.
- All training programs should have access to a dedicated ultrasound machine with high quality 2-D imaging and full Doppler capability on a 24-hour basis in the intensive care unit (ICU). The machine should have capabilities to save images to the medical record (both for billing and for viewing later for educational purposes)
- A course including didactics and hands-on skill stations for performing and interpreting bedside ultrasound.
- Maintenance of a fellow logbook documenting critical care ultrasound examinations.
- Twenty five examinations per organ system with proctoring.
- Supervision and proctoring entails monitoring the real-time image acquisition and interpretation of the test.
- It is desirable for educational programs to have a system for saving images and clips for quality improvement evaluation of both fellow interpretation and quality of image acquisition.
- The fellow should be capable of teaching basic ultrasound principles and techniques (introduction to the machine, eFAST, venous and arterial access, etc.) to residents and/or medical students.

**Course:**

- We suggest a course that divides critical care ultrasound into GCCUS and CCE-Basic with both didactic lectures and image-based training specific to the designated topic.

**GCCUS Course**

By the end of the course the trainee will be able to

- Identify relevant ultrasound knobology and probe. Be capable of appropriate selection of probes and settings for various sonographic techniques and examinations.

- Relate the physics behind sonography.

- Identify normal lung and pleura
- Identify hemothorax, pneumothorax, and lung consolidation
- Identify arteries and veins for vessel cannulation and recognition of deep vein thrombosis (DVT)
- Identify the components screened during the Extended Focused Assessment with Sonography for Trauma (E-FAST)
- Demonstrate adequate image acquisition for all general systems involved
- Demonstrate adequate skills for ultrasound-guided intravascular catheter insertion

**CCE-Basic Course**

By the end of the course the trainee will be able to

- Identify relevant ultrasound knobology and probe. Be capable of appropriate selection of probes and settings for various sonographic techniques and examinations.
- Relate the physics behind sonography.
- Identify normal cardiac anatomy, including each chamber, valves, papillary muscles, etc.
- Identify and acquire the following cardiac views: parasternal long axis view, parasternal short axis view, apical four chamber view, apical two chamber view, subxiphoid four chamber view, subxiphoid five-chamber view, and subxiphoid inferior vena cava (IVC) view
- Qualitative assessment of left ventricular (LV) size and LV systolic function
- Qualitative assessment of global right ventricular (RV) size and function
- Measurement of IVC size and respiratory variation (both in spontaneous breathing and on positive pressure ventilation)
- Measurement of cardiac output, calculation of cardiac index systemic vascular resistance
- Identify cardiac pathologies including, but not limited to, hypovolemic and cardiogenic shock, LV failure, RV failure, cardiac tamponade, pulmonary embolus, severe valvular regurgitation
- Recognize when a formal study by an echocardiographer may be indicated

For programs that are equipped **with transesophageal echocardiography (TEE) capability,** suggested objectives of a one-day course on Basic TEE are as follows:

- Review the clinical indications and scenarios in which placement of a TEE probe may be useful in the hemodynamic monitoring of a mechanically ventilated ICU patient
- Review safe insertion techniques for TEE probe placement in an intubated patient
- Identify three limited TEE views for the purpose of hemodynamic monitoring: superior vena cava (SVC) view, midesophageal four chamber view, and transgastric short axis view (papillary muscle level)
- Qualitative assessment of global LV and RV size and function, as well as identification of fluid responsiveness
- Be able to obtain quantitative measurements: SVC collapsibility index, LV and RV end-diastolic area (LVEDA and RVEDA), and calculate RVEDA/LVEDA ratio
- Identify cardiac pathologies including, but not limited to, hypovolemic and cardiogenic shock, LV failure (both global and heterogeneous), RV failure, cardiac tamponade, pulmonary embolus
- Recognize when a formal TEE study by an echocardiographer may be indicated

**In order to attest to the fellow's capacity to perform bedside critical care ultrasound upon graduation, the following requirements are suggested:**

For each area, we suggest obtaining **25 images reviewed by supervising attending (**25 for lung, 25 for heart, 25 for abdomen, 25 for vascular)

Limited Bedside Echocardiogram

- Clip of parasternal long axis view
- Clip of parasternal short axis view at level of mid-ventricle
- Clip of apical four chamber view
- Clip of apical two chamber view
- Clip of subxiphoid long axis view
- Clip of IVC during inspiration/sniff
- Still images containing relevant measurements taken during study
- Extended Focused Assessment with Sonography for Trauma
- Clip of bilateral sliding lungs
- Clip of hepatorenal interface showing the costophrenic angle and liver tip
- Clip of subxiphoid long axis view
- Clip of splenorenal interface showing subphrenic space and costophrenic angle
- Clip of pelvic rectovesical interface

Limited Bedside Venous Ultrasound

- Clip of compression of common femoral vein
- Clip of compression of superficial femoral vein
- Clip of compression of popliteal vein

Limited Bedside Thoracic Ultrasound

- Clip of bilateral sliding lungs
- Clip of bilateral upper and lower lung looking for B-lines (4 separate clips)
- Clip of bilateral costophrenic angles

Procedural Ultrasound

- Clip of needle in vein (peripheral or central) OR
- Clip of main portion of a bedside procedure being performed (thoracentesis, thoracostomy tube placement, etc.)

Limited Transesophageal Echocardiography (for programs with TEE capability)

- Clip of SVC view
- Clip of midesophageal four chamber view
- Clip of transgastric short axis view (papillary muscle level)

Particularly for bedside echocardiography, we suggest 3 levels of proficiency

**Level 1:**

- Perform the basic echocardiographic examinations safely and accurately, acquiring all standard views. The ideal windows are parasternal long axis (PLAX) view, parasternal short axis (PSAX) view, apical four chamber (A4CH) view, subxiphoid long axis (SLAX) view, and subxiphoid IVC (SIVC) view.
- Recognize and differentiate between normal and abnormal cardiac anatomy and physiology (presence of a pericardial effusion, global decrease of LV or RV function, severe hypovolemia )
- Recognize when a second opinion is indicated
- Describe the relationship between echocardiographic images and other diagnostic techniques
- 25 proctored transthoracic echocardiography (TTE) examinations

**Level 2 Suggestions:**

- Perform the echocardiographic examinations safely and accurately and acquire all standard views
- Recognize and correctly diagnose life-threatening conditions within the cardiovascular system (severe hypovolemia, cardiac failure, pulmonary emboli, cardiac tamponade, severe valvular regurgitation)
- Understand and perform M-mode and color flow Doppler
- 25 proctored TTE examinations, and additional 10 TTE proctored examinations with pathology, as well as demonstrating competency in performing M-mode and color Doppler, 50 TTE logged examinations, and one-day CCE course
- *For programs with TEE capability, 25 proctored TEE examinations, 10 of these proctored TEE examinations with pathology, a total of 50 TEE logged examinations

**Level 3 Suggestions: (Advanced Critical Care Echocardiography)**

- Perform accurately and safely all the TTE windows
- Understand and perform M-mode, color flow Doppler, tissue Doppler, can obtain LV stroke volume (LVSV) assessment using direct measurement of LV outflow tract area [LVOT(A)], and can obtain diastolic function measurements. Can assess RV size comparing RVEDA/LVEDA ratio, measure RV systolic pressure (RVSP) utilizing continuous wave Doppler, and evaluate for tricuspid annular plane systolic excursion (TAPSE)
- Assess regional wall motion abnormalities to evaluate for cardiac ischemia
- Must also obtain competence in basic TEE
- Teach echocardiography at all levels
- Be able to integrate scan results into medical decision-making of patient care
- Know and follow the evolution of echocardiography
- List of suggested number of examinations:
    - 25 proctored TTE examinations in normal
    - 25 proctored TTE examinations with pathology
    - 10 TTE examinations demonstrating proficiency in above measurements
    - 150 TTE total logged examinations
    - 50 proctored TEE examinations
    - 100 logged TEE examinations

**Suggested Articles**

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