Syllabus for USCCM Level 1 Providers

I. Theory Syllabus for Basic Level 1 Providers

A. Ultrasound physics, technology, instrumentation: See recommended general competencies.

B. Ultrasound scanning procedures, administration: See recommended general competencies.

C. Ultrasound semiotics:
   1. Cross-sectional and ultrasonographic anatomy (patterns of normal morphology and function):
      a. THORACIC/CARDIAC: Heart, pericardial sac, diaphragm, pleura, and lungs.
      b. ABDOMINAL: Peritoneal spaces, abdominal aorta, inferior caval vein.
      c. VASCULAR: Abdominal aorta, caval vein, femoro-popliteal veins, cephalic and basilic veins.
      d. CRANIOCERVICAL: Optic nerve.
      e. MUSCULOSKELETAL: Long diaphysis, flat bones (sternum, ribs, clavicle, scapula, and skull).

   2. Pathology in relation to ultrasound (patterns and causes of abnormal morphology and function):
      a. THORACIC/CARDIAC: Pleural fluid, pneumothorax, congestive interstitialopathy/pulmonary edema/chronic obstructive pulmonary disease, pericardial fluid, basic cardiac abnormalities qualitative assessment (arrest, dysfunction, dilation, hypertrophy, tamponade, hypovolemia—see specific items in the practical syllabus).
      b. ABDOMINAL: Fluid collections.
      c. VASCULAR: Abdominal aortic aneurysm, “depleted” inferior vena cava, deep venous thrombosis (femoropopliteal tract, central veins).
      d. CRANIOCERVICAL: Optic nerve sheath dilation.
      e. MUSCULOSKELETAL: Long diaphysis and flat-bone fractures.

   3. Common artifacts related to module-specific applications.

D. Ultrasound incorporation into critical care management: Triage, diagnostic, monitoring, interventional, therapeutic relevance of point-of-care real-time ultrasound to indications, limitations, applications, imaging techniques and tests, referral criteria, decision-making and problem-solving algorithms of the following syndromes and procedures:

   1. Ultrasound-enhanced algorithms/protocols:

   2. Ultrasound-enhanced procedures: Endotracheal intubation, cricothyroidotomy, tracheostomy, needle aspiration/thoracostomy, pericardiocentesis, paracentesis, vascular access (central veins, femoral veins, peripheral arteries, intraosseous access), defibrillation, pacing, urinary catheterization, nasogastric tube insertion.

E. Ultrasound development planning at organizational and social level: Critical and transversal thinking, training, credentialing, accreditation, quality assurance, policy, medical/legal issues, ethics.

II. Practical Syllabus for Basic Level 1 Providers

A. Ultrasound physics, technology, instrumentation: Effectively manage system components and technology (see also general recommended contents).

B. Ultrasound scanning procedures, administration: Accurately perform the scanning procedures related to the module key applications, and appropriately manage images and documentation (see also general recommended contents).

C. Ultrasound semiotics: After obtaining optimal images in a correct orientation:

   1. Recognize normal morphologic and functional patterns of the targeted organs and systems.
   2. Recognize abnormal morphologic and functional patterns and causes of the targeted diseases and injuries (including pitfalls). Specific points that must be performed accurately for the following applications include:
      a. THORACIC/CARDIAC ASSESSMENT:
         i. Describe thoracic windows, create plans and procedures, and distinguish normal patterns for lungs, pleura, diaphragm, pleural space, heart.
         ii. Describe, identify, and assess pleural effusions (transudates vs. exudates, measurement and volume estimation).
         iii. Describe, identify, and assess pneumothorax (A lines, lung point, stratosphere sign, no B line, no lung-sliding/power-sliding sign, no seashore sign, localization, extension estimation, distinguish Z and E lines).
         iv. Describe, identify, and assess congestive interstitial disease/pulmonary edema (B lines; localization; density estimation; distinguish A, Z, and E lines; pulmonary edema vs. chronic obstructive pulmonary disease).
         v. Describe, identify, and assess pericardial effusions (measurement, localization, tamponade profile, pericardial fat vs. fluid).
         vi. Perform cardiac/hemodynamic qualitative assessment (abnormal movement, morphology, gross findings): asystolia confirmation, pulseless electrical activity (PEA) vs. pseudo-PEA, tamponade (right ventricular [RV] and/or atrial collapse, swinging heart), severe left ventricular (LV) systolic dysfunction, acute cor pulmonale (severe RV dilation, without hypertrophy, septal dyskinesia, and small LV), biventricular dysfunction, hypovolemic profile (small hyperkinetic LV, “kissing walls,” normal RV function), valvular gross anatomical lesions or intracardiac masses, inferior vena cava (heart preload): IVC size, respiratory variations, and collapsibility.
b. ABDOMINAL ASSESSMENT:
   i. Describe, identify, and assess abdominal and pelvic fluid collections (visualize hepatorenal, perihepatic, splenorenal, perisplenic, and Douglas spaces; differentiate subphrenic from pleural and pericardial fluid).

c. VASCULAR ASSESSMENT:
   i. Describe normal vascular patterns (differentiate between arteries and veins, no Doppler).
   ii. Describe, identify, and assess aneurysmatic abdominal aorta (normal vs. pathologic patterns, transversal and longitudinal scanning, measurements).
   iii. Describe, identify, and assess femoropopliteal DVT (normal vs. pathologic patterns, static and dynamic/compressive signs, no Doppler study ± right heart dilation/thromboembolism).
   iv. Describe, identify, and assess inferior cava vein (measurement, collapsibility with compression and inspiration, gross thrombosis).

d. CRANIOCERVICAL ASSESSMENT:
   i. Describe, identify, and assess optic nerve sheath dilation (bilateral measurement).

e. MUSCULOSKELETAL ASSESSMENT:
   i. Describe and identify long diaphysis and flat-bone cortical fracture (normal vs. pathologic patterns; limbs, sternum, ribs, clavicle, scapula, skull/face).

f. PROCEDURAL GUIDANCE: Describe and perform the following procedures, acquiring and incorporating appropriately pre-, intra-, and post-interventional sonographic image information:
   i. Endotracheal intubation: Confirmation of tube position/ventilation, transtracheal static and dynamic observation, transthoracic sliding-lung/seashore-sign detection.
   ii. Cricothyroidotomy and tracheostomy: Cervical and tracheal assessment, confirmation of tube positioning and ventilation (direct detection, bilateral sliding-lung/seashore signs).
   iii. Needle aspiration/thoracostomy and pleurocentesis: PNX/fluid detection and assessment, puncture-site selection, guidance, aspiration/drainage monitoring, assessment of complications, management of difficult cases (loculated or small effusions, ventilated patient).
   vii. Central venous access: Regional assessment, patent veins selection, guidance, confirmation of catheter positioning, assessment of complications (internal jugular, subclavian, including femoral).
   viii. Peripheral arterial access: Regional assessment, guidance, confirmation of catheter positioning, assessment of complications.
   ix. Intraosseous access: Confirmation of needle positioning (intraosseous Doppler flushing, optional).
   x. Defibrillation and pacing: Confirmation of cardiac mechanical activity (recovery or capture).
   xi. Urinary catheterization and nasogastric tube insertion: Confirmation of positioning.

D. Ultrasound incorporation into critical care management (see general recommended contents): Describe triage, diagnostics, monitoring, interventional use, therapeutic relevance of point-of-care real-time ultrasound to indications, limitations, applications, imaging techniques and tests, referral criteria, decision-making and problem-solving algorithms.

1. Ultrasound-enhanced protocols/algorithms: Incorporate basic Level 1 ultrasound information into the diagnostic work-up and the management of the following clinical scenarios: Cardiopulmonary resuscitation—airway-breathing-circulation-disabilities/deficits-exposure, shock, dyspnea, coma, focused assessment with sonography for/in trauma and extended uses (extended focused assessment with sonography for/in trauma, focused assessment with sonography for/in trauma including extremities and respiratory tract, focused assessment with sonography for/in trauma—airway-breathing-circulation).

2. Ultrasound-enhanced procedures: Endotracheal intubation, thoracostomy/needle aspiration, pericardiocentesis, pleurocentesis, paracentesis, vascular access, defibrillation, pacing, urinary catheterization, nasogastric tube insertion.

E. Ultrasound development planning at the organizational and social level: Describe and explain the relevance of the following subjects to the management of point-of-care ultrasound development (as highlighted in the literature), and the possible applications in your institution/service: Critical and transversal thinking, training, credentialing, accreditation, quality assurance, policy, medical/legal issues, ethics.

III. Theory Syllabus for Advanced Level 1 Providers

A. Ultrasound physics, technology, instrumentation: Basic module contents review, focusing the choice of appropriate technology and equipment for different indications and scenarios.

B. Ultrasound scanning procedures, administration: Basic module contents review plus insights on all the applications targeted in the module.

C. Ultrasound semiotics:
   1. Cross-sectional and ultrasonic anatomy (patterns of normal morphology and function): Basic contents review plus:
      a. THORACIC: Basic semiquantitative/quantitative heart measures/parameters (see specific items in the practical syllabus); diaphragm (morphology, function).
**IV. Practical Syllabus for Advanced Level 1 Providers**

A. Ultrasound physics, technology, instrumentation: Properly and effectively manage system components and technology (see also general recommended content).

B. Ultrasound scanning procedures, administration: Accurately and quickly perform scanning procedures related to key applications, and manage images and documentation (see also general recommended content). Describe causes of suboptimal imaging in critical care (ventilation, PTX, surgical wounds, dressing, tapes and tubing, anasarca, and others).

C. Ultrasound semiotics: After obtaining optimal images the correct orientation should:
   1. Recognize normal morphologic and functional patterns of targeted organs and systems.
   2. Recognize abnormal morphologic and functional patterns and causes of targeted diseases and injuries (including pitfalls).

Students should be able to perform the following applications effectively and accurately:

- **THORACIC ASSESSMENT:**
  1. Describe and identify pulmonary consolidation and atelectasia (normal vs. abnormal, static vs. dynamic, air bronchograms, liquid bronchograms, lung pulse, abnormal lung vs. pleural diseases).
  2. Describe and identify pulmonary focal interstitialopathy (dense localized B lines, distinguish A, Z, and E lines).
  3. Describe and identify pulmonary contusions (normal vs. abnormal, distinguish different evolutive patterns).
  4. Perform semiquantitative/simple quantitative assessment of cardiac performance and filling state, partic-
ularly for: overall heart chambers abnormal dimensions (four chambers view apical/subcostal); left and right atrial diameters (LAd1, LAd2, RAd1, RAd2); RV mid-diameter at end diastole (parasternal long-axis view); LV end diastolic diameter; septal and posterior walls thickness (four chambers subcostal view); RV free-wall thickness; LV function, “visual” (four chambers view apical/subcostal; parasternal long or short axis; severe, mild to moderate, or normal hyperkinetic function) and measured (fractional shortening, parasternal long axis percentage variation of LV end diastolic to end systolic diameter); fractional area change (parasternal/subcostal short axis percentage variation of LV end diastolic to end systolic area); gross preload estimation of LV (“caricatural” hypovolemia, LV end diastolic to end systolic area) and of whole heart (inferior vena cava diameter and respiratory variations); RV function (four chambers apical/subcostal view, “visual” free-wall kinesis, RV to LV end diastolic areas ratio).

v. Describe and identify acute pulmonary embolism cardiac findings (acute cor pulmonale: RV dilation, increased RV/LV end diastolic area ratio, interventricular septal dyskinesia, no RV hypertrophy, McConnel sign, intracavitary visible thrombus), gross valvular dysfunction (gross morphologic findings such as ruptured papillary muscle and gross abnormal leaflets thickness/motion), suspected infective endocarditis (gross valvular vegetations).

vi. Perform “contrast-enhanced echocardiography” for suboptimal chamber imaging (optional competence).

vii. Describe and identify diaphragm rupture lesions (absence of B-mode and M-mode tracing movements, absence of normal profile, interfluid free edge, visceral herniation / hemothorax, rib fracture, other abdominal or thoracic).

ix. Describe, identify, and assess diaphragm paralysis, weakness, paradox motion (B-mode and M-mode assessment, measurement).

b. ABDOMINAL/UROGENITAL ASSESSMENT:

i. Describe and identify gross parenchymal lacerations and subcapsular hematomas (liver, spleen, kidneys, subcapsular vs. free fluid).

ii. Describe, identify, and assess gross parenchymal atrophy/enlargements (measurements of spleen, kidney, and renal cortex).

iii. Describe, identify, and assess perirenal hematomas (pericapsular vs. subcapsular vs. free fluid) and lateral retroperitoneal collections.

iv. Describe, identify, and assess pneumoperitoneum (air artifacts right anteriorly/anterolaterally, between abdominal wall and adjacent liver, distinguish from intramural/intraluminal gas, lung air, rib shadowing).

v. Describe, identify, and assess hydrops and cholecistitis (normal vs. abnormal, sonographic Murphy’s sign, distension and wall-thickening measurements, distinguish other edemigen causes—pericholecistic liquid/abscess, calculi/sludge, air artifacts).

vi. Describe, identify, and assess cholelithiasis (detection, measurements, distinguishing calculi from artifacts, sludge, polyps).

vii. Describe and identify “prandial” status (stomach observation).

viii. Describe and identify mechanical/paralytic ileus (normal vs. abnormal, air/fluid levels, abolished/diminished/augmented peristalsis, bowel loops dilatation, bowel wall and valvulae thickness, air-fluid levels, extra-luminal fluid presence and echogenicity, related symptoms).

ix. Describe, identify, and assess appendicitis (normal vs. abnormal, dilation, thickness, appendicolith, adjacent fluid or abscess).

x. Describe, identify, and assess hydronephrosis (detection, grading, and pelvic AP measurement) and gross urolithiasis (detection, measurement).

xi. Describe and identify significant bladder distension and causes (calculi, coagula, prostate hyperplasia detection, paralysis and intermittent catheterization).

xii. Describe and identify or rule out scrotal emergencies (testicular torsions, epididymitis, orchitis, testicular fracture, hernias, and hydroceles).

xiii. Describe, identify, and assess intrauterine pregnancy to exclude ectopic pregnancy in the first trimester (normal vs. abnormal, transabdominal vs. transvaginal proliferative and secretory endometrial stripe, intradecidual sign, double decidual sign, yolk sac, embryo, gestational age correlation with findings).

xiv. Describe, identify, and assess foetal heart beat, placenta praevia, placenta disruption in the third trimester.

c. VASCULAR ASSESSMENT:

i. Describe, identify, and assess femoropopliteal, iliac, axillary-subclavian veins for deep vein thrombosis (basic competences plus basic Doppler evaluation).

ii. Describe, identify, and assess aortic root dilation (transthoracic measurement) and abdominal aorta aneurysm complications (thrombosis, dissection, rupture, including basic Doppler evaluation).

d. CRANIOCERVICAL ASSESSMENT:

i. Describe, identify, and assess maxillary sinusitis (“sinusogram,” complete vs. incomplete).

ii. Describe and identify ocular trauma (retinal detachments, lens dislocations).
iii. Describe, identify, and assess pupils if visually inaccessible (through closed lids: size, symmetry, reactiveness measurements).*
iv. Describe, identify, and assess cerebral midline shift (B-mode, temporal window, shift measurement).*
v. Describe and identify cervical trauma (cervical spine line displacement).*
e. MUSCULOSKELETAL ASSESSMENT:
i. Describe and identify soft-tissue hematomas and abscess.
f. PROCEDURAL GUIDANCE: Describe and perform the following procedures, acquiring and incorporating appropriately pre-/intra-/postintervention sonographic-image information:
i. Nerve blockage: Identify paths of appropriate peripheral nerves (e.g., brachial plexus), regional assessment, guidance, assessment for complications.
iii. Foreign body removal: Detection and guidance.

D. Ultrasound incorporation into critical care management: Describe triage, diagnostic, monitoring, interventional, therapeutic relevance of point-of-care real-time ultrasound to indications, limitations, applications, imaging techniques and tests, referral criteria, decision making and problem solving algorithms. Incorporate, in an effective and timely manner, all Level 1 ultrasound information into the diagnostic work-up and the management of the following clinical scenarios:

   a. Focus on topics: Abdominal trauma, thoracic trauma, ocular trauma, hemodynamics, acute coronary syndrome/acute cardiac ischemia, cardiac failure, pulmonary embolism/deep vein thrombosis, cervical-cranial, soft tissues, obstetrics and gynecology, ventilated patient, pediatrics, geriatrics.
   b. Focus on settings: Intensive care unit, perioperative, prehospital emergency medical service/helicopter emergency medical service, disaster medicine, remote and austere medicine.

2. Ultrasound-enhanced procedures: Basic module contents review plus cricothyroidotomy, tracheostomy, vascular access (central veins, femoral veins, and peripheral arteries), intraosseous access, nerve blockage, foreign-body detection and removal, abscess and hematoma drainage.

E. Ultrasound development planning at organizational and social level: Describe and explain the relevance of the following subjects to the management of point-of-care ultrasound development (see highlights in the literature), and the possible applications at local, national, and international level:

1. Organizational development plans: Continuing Medical Education, professional development, research projects, networking development (social, cultural, political, scientific, interhospital, national, international level).
2. Integrated competencies: Health policies, laws, ethics, management, administrative, economics, statistics, language, and informatics.
3. Soft skills: Planning, leadership, team-building, communication, problem-solving, transversal competence, and others.

Asterisk, application still under initial investigation.

V. Bibliography and Sources

A. GENERAL

1. Lichtenstein DA: General Ultrasound in the Critically Ill. Berlin, DE, Springer-Verlag, 2004

B. Basic Level 1 Module Bibliography


99. Blaivas M: Outcome in cardiac arrest patients found to have cardiac standstill on the bedside emergency department echocardiogram. Acad Emerg Med 2001; 8:616–621


Crit Care Med 2007 Vol. 35, No. 5 (Suppl.)

C. Advanced Level 1 Module Bibliography


Crit Care Med 2007 Vol. 35, No. 5 (Suppl.)
171. Vieillard-Baron A: Cyclic changes in arterial pulse during respiratory support revisited by Doppler echocardiography. AM J Respir Crit Care Med 2003; 168:1640–1646
Ultrasound Standard Competencies in Critical Care Medicine

1) Physics, technology and instrumentation (image generation)
   - Ultrasound physics.
   - System components, functions, control, hygiene/sterility, calibration, maintenance.
   - Ultrasound interaction with tissue (including biological effects).
   - Safety with regards to ultrasound and instrumentation (contrast agents if appropriate).
   - Image generation, display, processing, recording, storing and filing
   - Image formats (hard copies or electronic pictures; analog or digital videos).
   - Operator and patient-dependent technical variables.
   - Integration with point-of-care monitoring, medical information systems and other networks.

2) Ultrasound scanning procedures (image acquisition)
   - Point-of-care scanning approach to body systems, diseases and syndromes.
   - Patient information, preparation, positioning, respiratory maneuvers.
   - Provider positioning, key-board control, probe handling, image annotation, communication skills.
   - Views, planes, orientation, sequence and techniques in diagnostic or interventional applications.
   - Nurse/paramedic/technician support.
   - Acquisition/interpretation sequences; remote guidance and teleconsulting.
   - In-hospital and out-of-hospital setting-specific issues.

3) Ultrasound Semeiotics (image interpretation)
   - Cross-sectional anatomy, physiology and pathology (of the targeted body systems).
   - Sonographic structural and functional findings/patterns (of the targeted body systems).
   - Common artefacts, tips and pitfalls.

4) Ultrasound Administration (image administrative/medico-legal/ethical management)
   - Annotations and reporting (data, technique, limitations, descriptive and diagnostic interpretation).
   - Recording and archiving of images and other documentation.
   - Provider, instructor, center’s training requirements, CME/CPD, credentialing, accreditation, QA.
   - General vs specialist, radiologist vs non-radiologist, allied personnel roles and responsibilities.
   - Patient information and consent; therapeutic communication.

5) Clinical Decision Making (image incorporation into clinical thinking)
   - Triage, diagnosis, monitoring, therapeutic goals and technique of selected applications.
   - Limitations, relevance, inter-relationship with other imaging techniques and point-of-care tests.
   - Referral criteria to other operators or services or centers.
   - Situational and clinical indications for patient examinations.
   - Incorporation and impact of results in decision making and problem solving algorithms.
   - Longitudinal, system, organ-based vs transversal, disease, syndrome, problem-based approaches.
   - Critical, transversal and quick thinking development.
   - Intra-hospital pathways: emergency dept, perioperative areas, intensive/critical care units, imaging.
   - Extra-hospital pathways: EMS/HEMS, disasters/mass casualties, remote & austere settings, scarce-resource services.

6) Organizational and Social Thinking (quality assurance and development planning)
   - Training, credentialing, accreditation, quality assurance systems.
   - Continuing medical education and professional development.
   - Research projects developments.
   - Networking: social, cultural, political, scientific development at intra-/inter-departmental, inter-hospital, regional, national, international level.
   - Integrated competencies: health policies, laws, ethics, management, administrative, economics, statistics, language, informatics, etc.
   - Soft skills: planning, leadership, team-building, communication, problem solving, transversal competence and others.