Goal: By the end of the curriculum, UNMC internal medicine residents will be able to acquire and interpret focused cardiac, lung, abdominal, soft tissue, and procedural ultrasound images and integrate this information into their patient management decisions.

US Physics & Machine Settings

- Describe the basics components of a transducer and their function.
- Describe how transducer frequency relates to axial resolution and penetration.
- Contrast the advantages/disadvantages of different transducers and how this impacts their clinical use.
- Describe how different machine settings effect image acquisition, including depth, gain, TGC, focus, and zoom.
- Describe basic imaging modes and their clinical application, including 2-D, M-mode, and color Doppler.
- Describe common artifacts encountered in ultrasound, including shadowing, enhancement, reverberation, comet tail, ring down, mirroring, and refraction artifacts.
- Distinguish artifacts from true anatomical structures in clinical practice.

Focused Cardiac US:

Rotational exposure: IM wards (VA and UNMC), CCM, cardiology

Image acquisition:

- Demonstrate correct probe selection, patient positioning, and machine settings when performing a FoCUS exam.
- Demonstrate acquisition of images in standard views:
  - Parasternal long-axis
  - Parasternal short axis (aortic, mitral, papillary, and apex)
  - Apical 4 chamber
  - Sub-costal 4 chamber
  - Sub-costal IVC
- Demonstrate image optimization in standard views, including correct orientation, gain, and depth.
- Demonstrate use of color Doppler to assess for valvular regurgitation

Image interpretation:

- Identify anatomic structures in standard views (above), including LA, LV, RA, RV, MV, AoV, TV, aortic outflow tract, and pericardium
- LV function: interpret myocardial thickening, endocardial excursion, and MV septal motion to semi-quantitatively assess LV function.
- LV size: Assess LV size qualitatively and quantitatively using simple measurements.
• LV wall thickness: Assess LV wall thickness qualitatively and quantitatively using simple measurements.
• RV: Qualitatively assess RV dilation (size and shape), wall thickness, and function.
• Assess interventricular septum to estimate RV pressure
• Measure IVC size and respiratory variation to estimate CVP
• Identify pericardial pathology, including effusion and tamponade physiology
• Differentiate pericardial and pleural effusions

<table>
<thead>
<tr>
<th>Core knowledge</th>
<th>Advanced knowledge</th>
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</thead>
<tbody>
<tr>
<td>Global LV function</td>
<td>LV size with measurements</td>
</tr>
<tr>
<td>Pericardial effusion</td>
<td>LV wall thickness with measurements</td>
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<tr>
<td>IVC assessment with 2-D</td>
<td>RV assessment (dilation, thickness, function)</td>
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<td></td>
<td>Assess intraventricular septum</td>
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<td>Tamponade physiology</td>
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<td></td>
<td>Gross Valve assessment, use of color doppler</td>
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<td>IVC assessment with M-mode</td>
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</tbody>
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Lung and Pleural US:
Rotational exposure: IM wards (VA and UNMC), CCM, pulmonology

Acquisition:
• Describe the relationship between lung ultrasonography and imaging artifacts.
• Demonstrate correct probe selection, patient positioning, and machine settings when performing a lung exam.
• Demonstrate acquisition of lung ultrasound images using the 3-point BLUE protocol exam, including the posterolateral alveolar/pleural syndrome (PLAPS) point.
• Demonstrate image optimization in standard views, including correct orientation (“bat sign”), gain, and depth.

Interpretation:
• Identify anatomic structures, including chest wall, pleural surfaces, lung tissue, diaphragm, and liver/spleen.
• Identify lung sliding using 2-D and M-mode
• Identify common patterns in lung ultrasound (A, B, and C-profiles)
• Identify pleural effusions and differentiate from intra-abdominal free fluid
• Identify patterns suggestive of pneumothorax, including lung point.
• Distinguish likely pathology using the BLUE protocol

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<thead>
<tr>
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<tbody>
<tr>
<td>A lines and B lines</td>
<td>Blue protocol (A,B, C profiles)</td>
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<tr>
<td>Pleural effusion</td>
<td>Pneumothorax- 2D and M-mode</td>
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<td>Pleural fluid dynamic changes and size</td>
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</tbody>
</table>
Abdominal Ultrasound:
Rotational exposure: ED (VA and UNMC), IM wards (VA and UNMC), CCM, Abdomen workshop

Acquisition:
- Demonstrate correct probe selection, patient positioning, and machine settings for performing an abdominal examination.
- Demonstrate acquisition of images in standard views:
  - Kidneys
  - Liver
  - Spleen
  - Gallbladder
  - Abdominal aorta
  - Bladder
  - Peritoneal Fluid
- Demonstrate image optimization in standard views, including correct orientation, gain, and depth.

Interpretation:
- Identify normal anatomic structures as listed above.
- Interpret kidney images to identify moderate-severe hydronephrosis
- Identify gallbladder stones.
- Screen for abdominal aorta abnormalities

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<thead>
<tr>
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<th>Advanced knowledge</th>
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<tbody>
<tr>
<td>Peritoneal fluid</td>
<td>Screen aorta for aortic aneurysm</td>
</tr>
<tr>
<td>Hydronephrosis</td>
<td>Identify cholelithiasis</td>
</tr>
<tr>
<td>Bladder size</td>
<td>Measurement of kidney size</td>
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<tr>
<td>Distinguish Aorta from IVC</td>
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DVT:
Rotational exposure: ED (VA and UNMC), IM wards, CCM

Acquisition & Interpretation:
- Demonstrate correct probe selection, patient positioning, and machine settings for performing DVT study.
- Perform a 2-point compression exam of femoral and popliteal veins
- Demonstrate image optimization in standard views, including correct orientation, gain, and depth.

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<thead>
<tr>
<th>Core knowledge</th>
<th>Advanced knowledge</th>
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</thead>
<tbody>
<tr>
<td>Identify femoral vein</td>
<td>Compression exam of femoral vein</td>
</tr>
<tr>
<td>Identify popliteal vein</td>
<td>Compression exam of popliteal vein</td>
</tr>
</tbody>
</table>
Skin and soft tissues:

Rotation: Rheumatology, Emergency medicine rotation

Acquisition:

- Demonstrate correct probe selection, patient positioning, and machine settings for performing a skin/soft tissue exam.

Interpretation:

- Identify normal anatomic structures of skin or soft tissues.
- Differentiate cellulitis, abscess, and masses of skin/soft tissues.

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<th>Core knowledge</th>
<th>Advanced knowledge</th>
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<tr>
<td>Recognize soft tissue abscess</td>
<td>Differentiate cellulitis, abscess, masses</td>
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Procedural:

The following ultrasound-guided procedures will be covered in the curriculum:

- Paracentesis
- Thoracentesis
- Lumbar puncture
- Central venous catheterization
- Knee arthrocentesis

See procedure-specific checklists for full objectives of each. General objectives are:

1. Describe indications, contraindications, and potential complications in performing each bedside procedure.
2. Demonstrate anatomy required to perform beside procedures using point-of-care ultrasound on live-models.
3. Perform all of the necessary elements of bedside procedures on simulation task trainers, including equipment set-up, ultrasound survey, sterile draping, and procedural steps.
4. Describe strategies to combat common barriers to performing bedside procedures.