UNM EDRU RUSH exam key points:

General points:

1. 10 Windows following the *HI-MAP* algorithm
    a. Heart (3-4); PLAX, PSAX, AP4C (+subcostal)
    b. IVC (1): subcostal
    c. Morrison's & abdominal (3); Morison's, spleno-renal, pelvic
    d. Aorta (1); sweep eval of prox, mid & distal aorta
    e. Pulmonary (2); Rt & Lt anterior mid clavicular views
        i. May use phased array probe for this as well
    f. Use cardiac pre-sets for "HI" and change to Abd preset for "MAP"

Heart:

1. General: A basic evaluation of the heart is aided significantly when evaluating in concert with ECG. Correlation with ECG facilitates measurements (ie, SV, CO) and diagnosis of pathologies (tamponade, PEA). It's good to get in the habit of connecting the ultrasound ECG leads (3 leads) prior to scanning. It is attached to our Sonosites and takes about 10 seconds to place on patient.
2. Technique:
    a. PLAX; probe roughly @ 2-4th IC space w/ probe marker to Rt shoulder. Adjust depth to see the entire heart, the DTA but not much more.
    b. Rotate probe 45-90 degrees to Lt shoulder for PSAX but not essential for 2 minute RUSH, esp if PLAX & AP4C answers main questions
    c. AP4C: may optimize image by placing patient in LLD position, 5th IC space just below nipple, probe marker to floor, probe angled toward base of heart
    d. If these windows are poor, may use sub-costal window for a 4-chamber view; sub-xyphoid, slightly right of midline with marker to patient's left
    e. If difficulty obtaining a particular view, move on to another view.

3. <u>Questions to answer through these views</u>
    a. Pericardial effusion, yes or no
        i. Pleural vs. pericardial; relationship to DTA on PLAX
        ii. Distinguish from anterior fat pad
    b. Associated tamponade:
        i. RV diastolic collapse using M-mode in PLAX through open MV, or review a clip using ECG leads to identify end diastole q wave
        ii. RA systolic collapse in AP4C
        iii. Dilated, non-collapsible IVC (supportive)

iv. BONUS; respirophasic mitral inflow velocity > 25 cm/s, using PWD at MV leaflets in AP4C

c. LV function:
   i. hyperdynamic (> 65%), normal (> 55%), moderately reduced (30%-50%), severely reduced (<30%), myocardium should thicken by ~ 30%
   ii. eye ball estimate is sufficient; once you've calibrated your eyes to enough exams & subjective measures (below)
   iii. May use 1 or 2 dimensional measurements to assist
   1. EPSS (end point septal separation). M-mode through MV leaflets on PLAX. Normal < 0.7 cm, severely reduced > 1.0 cm (confounders; severe AR, severe MS, dilated mitral annulus from CM)
   2. FS (fractional shortening) using M-Mode in PLAX or PSAX trans-papillary; EDD-ESD/ EDD. Normal > 27%
   3. BONUS; FAC (fractional area of change); EDA-ESA/EDA, normal > 50%

d. Rt heart dilatation & function
   i. Normal RV .6:1 of LV. If 0.7-1 it is moderately dilated, RV> LV (ratio >1) severe dilation.
   ii. Evaluate for septal flattening (D- sign) in PSAX
   iii. BONUS; RV free wall measured in PLAX should be ≤ 0.5 cm, otherwise hypertrophied from some chronic process
   iv. BONUS; RV function; TAPSE > 1.6 cm
   v. BONUS: Mconnel's sign: RV hypokinesis with preserved motion of the RV apex (may indicate PE or Rt AMI)

IVC:

1. General:
Controversial efficacy due to confounders when patient is spontaneously breathing, but perhaps useful as additional data point. More reliable in intubated & sedated patient on PPV mode.

2. Technique:
   a. subxyphoid position, identifying RA-IVC junction, measure IVC diameter.
   b. may obtain longitudinal view with probe aimed Rt of midline
   b. M-mode through IVC just inferior to hepatic vein. Have patient sniff to generate negative intrathoracic pressure. Measure % collapse.

4. Question to answer: Intravascular volume status; wet, dry or euvolemic?
   a. In spontaneous breathing patient, diameter & collapsibility may estimate CVP;
      i. <2.1 cm + > %50 collapse ~ CVP 0-5
      ii. <2.1 cm + < %50 collapse or > 2.1 + > 50% ~ CVP 5-10

iii. >2.1 cm + < %50 collapse ~ CVP 10-20

b. Intubated patient: respiratory dynamics reversed but IVC respiratory variation predictive of volume responsiveness.
    i. > 18% respiratory variation = fluid responsiveness
c. Repeat exam post fluid load to evaluate for change
d. BONUS: a 2-minute passive leg raise prior to re-measuring IVC may predict volume responsiveness prior to fluid load. Alternatively, one should repeat IVC exam post bolus.

Morison's/ FAST:

1. General: Sensitivity for free fluid in trauma patients between 73-88%. Specificity ~ 98%.

2. Technique:
    a. Morison's pouch best imaged @ 8-11th IC space in the mid axillary line. Identify the hepato-renal space. Trendelenburg positioning may increase sensitivity of this view. Probe marker to head, but may be rotated counterclockwise to axilla to eliminate rib shadows. Scan above the diaphragm to identify pleural fluid.
    b. Subcostal cardiac view obtained with probe in sub-xyphoid position, just right of midline using liver as an acoustic window. Probe Marker to the right. Flexing hips & knees help relax abdominal musculature & facilitate view.
    c. LUQ view also at the posterior axillary line (spleen is a posterior structure) in 8-11th IC space, aiming anteriorly. Identify the spleno-renal space. Scan above the diaphragm for pleural fluid.
    d. Pelvic view; probe placed just cephalad to pubic symphysis, scanning in transverse & longitudinal dimensions to evaluate retro-vesicular space.
3. Question to answer: Is there free intra-peritoneal fluid or a pericardial effusion? Are there pleural effusions/ hemothorax? Subcostal view may be used to answer any of the questions from the Heart scanning, or supplement the initial heart exam.
4. BONUS: Findings of pleural effusion other than seeing lung within the blackness above the diaphragm include…
    a. "Mirror image artifact" (appearance of liver parenchyma above the diaphragm, excludes significant effusion. Seeing the thoracic spine shadow above the diaphragm may indicate a pleural effusion.

Aorta:

1. General: If the aorta > 5 cm at any level, in the patient with undifferentiated shock, the diagnosis is AAA until excluded. The normal aorta is < 3.0 cm and tapers distally. Most AAAs are infra-renal, but we

scan from Celiac Axis (subxyphoid region) to the iliac bifurcation (umbilicus), also looking for dissection. Free fluid from AAA rupture is not typically seen as most rupture in the retro-peritoneum.

2. Technique:
    a. Probe indicator to patient's Rt. Identify proximal aorta in transverse section with CA. Slide distally ~ 1 cm to evaluate mid aorta and SMA. Slide down to identify distal aorta & iliac bifurcation.
    b. Identifying the spinal stripe/ vertebral body just posterior to the aorta is a helpful landmark
    c. Measure diameters of outer wall to outer wall, in the transverse plane, while perpendicular to the vessel.
    d. May need to exert mild pressure to push bowel out of the way
    e. Flexing hips & knees to relax abs and facilitate view
    f. Visualizing the aorta may require increasing image depth compared to other portions of the RUSH.
3. Question to answer:
    a. Is the proximal, mid or distal aorta ≥5.0 cm?
    b. Is there a flap and false lumen/ dissection?

Pneumothorax:

1. General: Signs of ptx include the absence of sliding between the lung & pleural interface, or absence of the seashore sign on M-mode. The bright pleural line is always deep to the rib shadow. Normally interposed pleura under the probe may also demonstrate "comet tail artifact" along with the sliding.

2. Technique: Can in the midclavicular line between the IC spaces moving inferiorly

3. Questions to answer:
    a. Is there a pneumothorax? b. Is there interstitial edema?

BONUS: Be aware of false positives. Absence of lung sliding may also be seen with ipsilateral bronchial obstruction, contralateral mainstem bronchus intubation, scarred & fixed pleura from pleurodesis, surgical scarring, or pneumonia with adhesions.

BONUS: you may identify a "Lung point", the point at which the visceral pleura attached to the chest wall. You will identify normal lung sliding in half the screen and fixed pleura adjacent to this.

BONUS: B-lines as a marker of interstitial fluid, appears as laser-like vertical lines extending from the pleural line for a depth of 18 cm (adjust your depth for this). As the severity of edema increases the lines go from thin to thicker lines that coalesce and become wedge shaped. You will not see A-lines which represent a normal artifact of well aerated lung.