DIAGNOSTIC RADIOLOGY RESIDENCY
ULTRASOUND CURRICULUM

From the curriculum developed by:
THE SOCIETY OF RADIOLOGISTS IN ULTRASOUND
Curriculum Committee
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This ultrasound curriculum is intended to serve as a guideline for diagnostic radiology residency training programs, utilizing the goals and objectives format required by the American Council of Graduate Medical Education (ACGME).

At the conclusion of each one-month rotation, the resident should be able to demonstrate competence in these six specific areas: medical knowledge, patient care, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice, as outlined below.

The resident should understand this material through a “hands-on” clinical experience, including ultrasound scanning, combined with formal didactic teaching such as conferences, and independent learning utilizing teaching files, textbooks, and on-line electronic web-based tools such as medical journal articles, etc.

There are two parts to the medical knowledge portion of the curriculum. The first, Section A, lists hands-on scanning objectives to be mastered by the end of each clinical rotation. The second, Section B, is a more comprehensive list of entities that the resident should understand by the end of each rotation. Each institution may have its own individual system for acquiring this knowledge base.

Core Curriculum

1. Vascular:
   --Lower extremity DVT.
   --Abdomen: venous thrombosis (hepatic and renal veins, inferior vena cava);
      portal hypertension; TIPS; renal stenosis.
   --Aortic diseases (aneurysm)
   --Carotid artery duplex evaluation (vascular surgery rotation)
   --Complications of percutaneous vascular interventions: pseudoaneurysm and AV fistula
   --Upper extremity DVT
   --vascular characterization of a mass

2. Biliary Tree and Gall Bladder
   --Normal anatomy
   --Biliary obstruction: benign and malignant causes
Congenital anomalies of the common bile duct—choledochal cysts
--Gallstones
--Inflammatory disease of the gall bladder—acute cholecystitis and complications
--Gall bladder carcinoma
--Cholecystoses

3. Liver and Spleen
--Normal anatomy
--Neoplastic disease—hepatoma, metastases, cysts.
--Infection—Abscess
--Cirrhosis and portal hypertension.
--Other parenchymal disease (steatosis)
--Trauma---biloma, hematoma

4. Pancreas
--Normal anatomy
--Inflammatory disease
   Complications of acute pancreatitis--pseudocyst
   Chronic pancreatitis
   Ductal calculi
--Neoplasms: adenocarcinoma, micro- and macro
   cystic adenomas, IPMN

5. Gastrointestinal
--Appendicitis
--Inflammatory bowel processes—colitis, Crohn’s Disease
--Bowel Obstruction
   Bowel related mass: neoplasm, phlegmon

6. Kidney
--Normal anatomy
--Congenital Anomalies: ectopia, horseshoe kidney, duplex collecting system, UPJ obstruction
--Infection: renal abscess and pyonephrosis
--Calculous disease
--Neoplasms: renal cell carcinoma, transitional cell carcinoma, angiomyolipoma, metastasis, cystic neoplasms.
--Cystic Diseases: cortical cysts, polycystic kidney disease, medullary cysts.
--Hydronephrosis

7. Retroperitoneum
--Anatomy: perirenal and pararenal spaces, pelvic extraperitoneal spaces.
--Adrenal neoplasms and other masses
--Lymphadenopathy
--Neoplasms
--Hematoma
--Abscess

8. Peritoneal cavity
--Anatomy
--Intraperitoneal collections: ascites and abscess
9. Gynecology
--Normal Anatomy
--Uterus
    Cyclic change in the endometrium
    Leiomyoma
    Leiomyosarcoma
    Adenomyosis
    Endometrial pathology: carcinoma, polyp, hyperplasia, changes related to tamoxifen
    Gestational trophoblastic disease
    Postpartum—retained products of conception
    Cervical carcinoma
    Intrauterine contraceptive device
--Adnexa
    Polycystic ovarian syndrome
    Ovarian cysts; follicular, corpus luteum, theca lutein
    Acute conditions
        Hemorrhagic cyst
        Ovarian torsion
        Ectopic pregnancy
    Neoplasms:
        Surface epithelial—cystadenoma/carcinoma
        Germ Cell—teratoma
        Metastatic
        (Sex cord/stromal)
    Pelvic inflammatory disease
        Hydro/pyo salpinx
        Tuboovarian abscess and complex
10. Thyroid/Head and Neck
--Normal Anatomy
--Nodules: patterns suggestive of benignity
--Neoplasms
--Nodular goiter and other conditions such as Thyroiditis
--Parathyroid mass: adenoma
--Submandibular and parotid gland masses
    Benign and malignant lymph nodes
11. Scrotum
--Normal Anatomy
--Neoplasms
    Seminoma and other germ cell tumors
    Metastatic
--Benign masses
Simple cysts
Epidermoid cysts
Epididymal cysts and sperm granuloma
--Infections
  Epididymitis/orchitis
  Testicular and scrotal abscess/pyocele
  Fournier’s gangrene
--Trauma
  Testicular hematoma/rupture
  Scrotal wall hematoma
  Hematocele
--Varicocele
--Torsion
--Hernia
--Extratesticular masses: spermatocele, adenomatoid tumor

12. Obstetrics
First Trimester
--Diagnosis of intrauterine pregnancy and relationship to bHCG levels
--Basic anatomy and normal developmental features of embryo and early fetus
--Dating—CRL
--Complications
  Ectopic pregnancy
  Anembryonic pregnancy
  Subchorionic hematoma
  Intrauterine demise
--Anomalies identifiable in first trimester
Second and third trimester
--Basic evaluation
--Anatomy—Guidelines of AIUM, ACR, ACOG
  kidneys, stomach, urinary bladder, umbilical cord insertion, spine, cerebral
  ventricles and posterior fossa, 4-chambered heart
--Dating—BPD, FL, AC,
--Growth—EFW
--Placenta, location and morphology
--Amniotic Fluid
--Cervix—status, length, confirmation of IUG
--Diagnosis of chromosomal abnormalities
  Biochemical screening
  Genetic sonogram—markers of aneuploidy
--Fetal anomalies
  CNS
  Thorax/cardiac
  Genitourinary
  Gastrointestinal
  MSK
I. MEDICAL KNOWLEDGE

A. “HANDS-ON” SCANNING

By the end of each level of training, the resident should be able to scan most of the clinical scenarios listed below in each training category.

**Rotation 1**
Gallbladder (gallstones/acute cholecystitis)
Liver (masses)
Kidney (hydronephrosis, stones)
Transabdominal/transvaginal pelvis (mass/cyst/free fluid)
Abdominal aorta (aneurysm)
Pleural effusion and ascites
Pregnancy (normal early intrauterine pregnancy)
Thyroid nodules

**Rotation 2**
Pancreas (pancreatitis, mass)
Biliary (common bile duct, biliary ductal dilatation)
Abdominal mass/adenopathy
Kidney (mass/cyst)
Basic Doppler (portal vein, pseudoaneurysm, arteriovenous fistula)
Pregnancy (first trimester, failed pregnancy, ectopic pregnancy)
Adnexal mass (ovarian and non-ovarian)
Testis (pain and masses)
Basics obstetrics (basic fetal biometry, basic second/third trimester fetal anatomy, placental localization, amniotic fluid volume)
Neonatal brain

**Rotation 3**
Advanced obstetrics (comprehensive second/third trimester)
Pediatrics (abdomen, spine, hips)
Ultrasound-guided interventional procedures
Parathyroid
Advanced abdominal Doppler (visceral organs, organ transplants)

**Rotation 4**
Advanced obstetrics (comprehensive second/third trimester)
Pediatrics (abdomen, spine, hips)
Ultrasound-guided interventional procedures
Parathyroid
Carotid artery
Advanced abdominal Doppler (visceral organs, organ transplants)
Peripheral vessels (arterial bypass grafts, upper extremity veins)
Lower extremity (deep vein thrombosis)

B. COMPREHENSIVE KNOWLEDGE
**PHYSICS/INSTRUMENTATION**

The resident should understand the basic principles of physics that form the foundation of clinical ultrasound.

**Rotation 1**

Define ultrasound, including the relationship of sound waves used in imaging
- Straight narrow sound beams, simple reflection, constant sound speed
- Beam shape: linear, sector, curved array
- Probes: transabdominal, endocavitary
- Endocavitary imaging: transvaginal, transrectal, endoscopic, laparoscopic
- Display: Gray scale, M-mode, pulsed wave Doppler, color and power Doppler
- Image orientation: standard images in different planes
- Image optimization: power output, gain, time gain compensation
- Image recording options: electronic (digital), film, paper
- Acoustic properties of fluid, cyst, calcification, complex fluid and solid structures
- Tissue characteristics: acoustic shadowing and enhancement

**Focal zone**

**Rotation 2**

Transducer choice: curvilinear, linear, sector, vector
- Frequency, sound speed, wavelength, intensity, decibels, beam width, Fresnel zone, Fraunhoffer zone
- Interaction of sound waves with tissues: reflection, attenuation, scattering, refraction, absorption, acoustic impedance pulse-echo principles
- Generation/detection of ultrasound waves
- Doppler phenomenon, Doppler formula
- Beam formation/focusing
- Gray scale, M-mode, pulsed wave Doppler, color Doppler imaging, power Doppler imaging

**Rotation 3**

Beamwidth, sidelobe, slice thickness artifacts
- Multiple reflection artifacts - mirror image/reverberation
- Refractive artifacts
- Doppler artifacts - pulse wave, color imaging, including aliasing
- Gray scale versus Doppler (trade-off of penetration and resolution)
- 3-D volumetric imaging
- Thermal/non-thermal effects on tissue: biological health risks
- Image optimization
- Harmonic imaging
- Equipment quality assurance: phantoms, spatial/contrast resolution

**Rotation 4**

Beamwidth, sidelobe, slice thickness artifacts
- Multiple reflection artifacts - mirror image/reverberation
- Refractive artifacts
- Doppler artifacts - pulse wave, color imaging, including aliasing
- Gray scale versus Doppler (trade-off of penetration and resolution)
- 3-D volumetric imaging
- Thermal/non-thermal effects on tissue: biological health risks
- Image optimization
Harmonic imaging
Ultrasound contrast agents
Equipment quality assurance: phantoms, spatial/contrast resolution

CLINICAL APPLICATIONS

GENERAL
The resident should understand the importance of clinical ultrasound protocols. Published protocols/standards from the American College of Radiology (ACR) or the American Institute of Ultrasound in Medicine (AIUM) with or without local modification are acceptable frames of reference. Residents should also be familiar with ACR appropriateness criteria as a guide for appropriate clinical use of ultrasound and other imaging modalities.
The resident should gain a general understanding of both the clinical uses and limitations of ultrasound as well as the appropriate integration of other complementary cross-sectional imaging studies, particularly CT and MRI.
The resident should understand the importance of documentation and reporting skills/requirements, including the electronic applications in their institution.
The resident should understand the importance of clinical quality assurance, including radiologic-pathologic correlation, as well as sonographer-physician discrepancies.

ABDOMINAL
Rotation 1
Liver: normal echotexture, size, and shape (including anatomic variants), diffuse disease, (fatty infiltration, acute and chronic hepatitis, cirrhosis, edema), focal masses, metastases, granuloma
Gallbladder: normal appearance, wall thickening, gallstones, including supine, decubitus and erect positions, sludge, acute cholecystitis (calculous/acalculous), sonographic Murphy’s sign, other etiologies of wall thickening, polyp
Bile ducts: normal intra- and extrahepatic bile duct diameters and dilatation
Pancreas: normal anatomy, pancreatic duct, mass
Spleen: normal echotexture, size and shape (including anatomic variants), focal masses (cystic versus solid), lymphoma, abscess, infarction, granuloma
Peritoneal cavity: ascites, fluid localization/quantification (free/loculated)
Pleural effusion

Rotation 2
Liver: hematoma, biloma, abscess
Post-liver transplantation collections: hematoma, biloma, abscess (see vascular section)
Gallbladder: hyperplastic cholecystoses, carcinoma
Bile ducts: bile duct stones, inflammatory disease, cholangitis, pneumobilia
Pancreas: neoplasm, cysts
Pancreatitis complications: abscess, pseudocyst and pseudoaneurysm, chronic pancreatitis
Peritoneal cavity: abscess, hemorrhage, omental mass, metastasis, carcinomatosis
Spleen: varices

Rotation 3
Liver: trauma
Bile ducts: neoplasm (cholangiocarcinoma)
Spleen: trauma
Chest: pericardial effusion, mass, atelectasis/pneumonia
Organ transplants: see vascular section
Gastrointestinal tract: normal gut ultrasound signature, acute appendicitis, diverticulitis, Crohn’s disease
Peritoneal cavity: free air
Abdominal wall hernia, inguinal hernia

**Rotation 4**
Liver: trauma
Bile ducts: neoplasm (cholangiocarcinoma)
Spleen: trauma
Chest: pericardial effusion, mass, atelectasis/pneumonia
Organ transplants: see vascular section
Gastrointestinal tract: normal gut ultrasound signature, acute appendicitis, diverticulitis, Crohn’s disease
Peritoneal cavity: free air
Abdominal wall hernia, inguinal hernia

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**KIDNEYS, URINARY BLADDER AND PROSTATE**

**Rotation 1**
Renal: Normal renal cortical echotexture, size and shape, glomerulointerstitial renal disease, simple renal cyst , renal stones, hydronephrosis, pyonephrosis
Ureters: hydroureter
Urinary bladder: calculi, wall thickening, ureteral jets, bladder volume, including post-void residual

**Rotation 2**
Abscess/pyelonephritis, perinephric fluid
Post-renal transplant collections: hematoma, urinoma, abscess, lymphocele (see vascular section)
Complex renal cyst, adult polycystic disease and acquired renal cystic disease, renal cell carcinoma, angiomyolipoma
Urinary bladder: mass, infection, hemorrhage, wall thickening, bladder outlet obstruction, diverticula, ureteroceles
Transabdominal prostate
Ureters: hydroureter

**Rotation 3**
Kidneys: xanthogranulomatous pyelonephritis, emphysematous pyelonephritis, congenital anomalies, pelvic kidney (see pediatrics section), medullary nephrocalcinosis
Adrenal glands: mass
Retroperitoneum: adenopathy, mass
Ureters: ureteral stone
Urinary bladder: ectopic ureteroceles
Renal artery stenosis, renal vein thrombosis (see vascular section section)
Transrectal prostate

**Rotation 4**
Kidneys: xanthogranulomatous pyelonephritis, emphysematous pyelonephritis, congenital anomalies, pelvic kidney, medullary sponge kidney, nephrocalcinosis
Adrenal glands: mass
Retroperitoneum: adenopathy, mass
Ureters: ureteral stone
Urinary bladder: ectopic ureterocele
Renal artery stenosis, renal vein thrombosis (see vascular section section)
Transrectal prostate with biopsy

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GYNECOLOGY

Rotation 1
Uterus: normal size, shape, position, echogenicity, fibroid identification
Endometrium: normal appearance during phases of menstrual cycle and thickness measurement (pre-menopausal, post-menopausal, effects of hormone replacement), intrauterine device, fluid
Ovary: normal size, shape, echogenicity, physiologic variation during phases of menstrual cycle (follicles, corpus luteum, hemorrhagic ovarian cyst)
Free pelvic fluid

Rotation 2
Uterus: congenital anomalies, endometrial polyp, endometrial hyperplasia, endometrial carcinoma, endometritis, pyometrium, fibroid localization (submucous, intramural, subserosal), adenomyosis
Ovarian cyst: hemorrhagic/ruptured cyst, endometrioma, polycystic ovarian disease, ovarian hyperstimulation syndrome
Ovarian neoplasm: cystic/solid adnexal masses, cystadenoma/carcinoma, dermoid, fibroma, germ cell tumor, Doppler evaluation
Ovarian torsion
Pelvic inflammatory disease, tubo-ovarian abscess
Cervix: mass, stenosis, endometrial obstruction
Fallopian tube: hydrosalpinx, pyosalpinx
Post-hysterectomy

Rotation 3
Uterus: congenital anomalies, endometrial polyp, endometrial hyperplasia, endometrial carcinoma, endometritis, pyometrium, fibroid localization (submucous, intramural, subserosal), adenomyosis
Ovarian cyst: hemorrhagic/ruptured cyst, endometrioma, polycystic ovarian disease, ovarian hyperstimulation syndrome
Ovarian neoplasm: cystic/solid adnexal masses, cystadenoma/carcinoma, dermoid, fibroma, germ cell tumor, Doppler evaluation
Peritoneal inclusion cyst
Ovarian neoplasm and cancer staging
Saline hysterosonography

Rotation 4
Uterus: congenital anomalies, endometrial polyp, endometrial hyperplasia, endometrial carcinoma, endometritis, pyometrium, fibroid localization (submucous, intramural, subserosal), adenomyosis
Ovarian cyst: hemorrhagic/ruptured cyst, endometrioma, polycystic ovarian disease, ovarian hyperstimulation syndrome
Ovarian neoplasm: cystic/solid adnexal masses, cystadenoma/carcinoma, dermoid, fibroma, germ cell tumor, Doppler evaluation
Peritoneal inclusion cyst
Ovarian neoplasm and cancer staging
Saline hysterosonography

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OBSTETRICS
**FIRST TRIMESTER**

**Rotation 1**
Normal findings: gestational sac appearance, size, gestational sac growth, yolk sac, embryo, cardiac activity including normal embryonic heart rate, amnion, chorion, normal early fetal anatomy/growth, crown-rump length measurement, correlation with BHCG levels and menstrual dates

**Rotation 2**
Multiple gestations (chorionicity and amnionicity), failed early pregnancy, spontaneous complete/incomplete abortion, ectopic pregnancy, blighted ovum, embryonic death, subchorionic hematoma, gestational trophoblastic disease, gross embryonic structural abnormalities, anencephaly

**Rotation 3**
Multiple gestations (chorionicity and amnionicity), failed early pregnancy, spontaneous complete/incomplete abortion, ectopic pregnancy, blighted ovum, embryonic death, subchorionic hematoma, gestational trophoblastic disease, gross and subtle embryonic structural abnormalities, anencephaly

Unusual ectopic pregnancy: interstitial, cervical, ovarian, scar, abdominal, rudimentary horn

Nuchal translucency

Chorionic villous sampling

**Rotation 4**
Multiple gestations (chorionicity and amnionicity), failed early pregnancy, spontaneous complete/incomplete abortion, ectopic pregnancy, blighted ovum, embryonic death, subchorionic hematoma, gestational trophoblastic disease, gross and subtle embryonic structural abnormalities, anencephaly

Unusual ectopic pregnancy: interstitial, cervical, ovarian, scar, abdominal, rudimentary horn

Nuchal translucency

Chorionic villous sampling

**SECOND AND THIRD TRIMESTER**

**Rotation 1**
Normal findings: normal fetal anatomy/situs/development, placenta, biometry, amniotic fluid volume, multiple gestations

Anencephaly

Oligohydramnios (spontaneous premature rupture of membranes, renal disease, fetal death, intrauterine growth retardation, infection)

Polyhydramnios, placenta previa

Cervical appearance and length

**Rotation 2**
Recognition of fetal abnormalities that require high risk obstetrics referral, including intrauterine growth retardation, hydrops, holoprosencephaly, hydrocephalus, neural tube defects, multicystic dysplastic kidney, hydronephrosis

Placental abruption, placental masses, two-vessel umbilical cord, cord masses, retained products of conception

**Rotation 3**
Recognition of fetal abnormalities that require high risk obstetrics referral, including
congenital anomalies/chromosomal abnormalities and syndromes such as Down’s syndrome and Turner’s syndrome, hydrops, congenital infections, chest masses, cardiac malformations and arrhythmias, diaphragmatic hernia, abdominal wall defects, abdominal masses, gastrointestinal tract obstruction/abnormalities, ascites, skeletal dysplasias, cleft lip/palate, complications of twin pregnancy, hydranencephaly
Borderline findings: nuchal thickening, choroid plexus cyst, echogenic cardiac focus, echogenic bowel, borderline hydrocephalus
Placental cord insertion site/vasa previa, velamentous cord insertion, cord prolapse, succenturate placenta, cervical incompetence
Umbilical cord Doppler, fetal cranial Doppler, biophysical profile
Guidance for amniocentesis
Placenta accreta, percreta, increta

**Rotation 4**
Recognition of fetal abnormalities that require high risk obstetrics referral, including congenital anomalies/chromosomal abnormalities and syndromes such as Down’s syndrome and Turner’s syndrome, hydrops, congenital infections, chest masses, cardiac malformations and arrhythmias, diaphragmatic hernia, abdominal wall defects, abdominal masses, gastrointestinal tract obstruction/abnormalities, ascites, skeletal dysplasias, cleft lip/palate, complications of twin pregnancy, hydranencephaly
Borderline findings: nuchal thickening, choroid plexus cyst, echogenic cardiac focus, echogenic bowel, borderline hydrocephalus
Placental cord insertion site/vasa previa, velamentous cord insertion, cord prolapse, succenturate placenta, cervical incompetence
Umbilical cord Doppler, fetal cranial Doppler, biophysical profile
Guidance for amniocentesis
Placenta accreta, percreta, increta

**THYROID/NECK**

**Rotation 1**
Normal thyroid echotexture, size and shape
Thyroid disease: diffuse and focal disease
Multinodular thyroid

**Rotation 2**
Thyroid nodule characterization: echotexture, calcifications including microcalcifications, margins, recommendations for fine needle aspiration biopsy
Hashimoto’s thyroiditis/Graves’ disease

**Rotation 3**
Parathyroid mass: adenoma
Congenital cysts: branchial cleft
Lymph nodes: benign and malignant characterization
Post-thyroidectomy recurrence
Submandibular and parotid glands: normal and abnormal
Fine needle aspiration

**Rotation 4**
Parathyroid mass: adenoma
Congenital cysts: branchial cleft
Lymph nodes: benign and malignant characterization
Post-thyroidectomy recurrence
Submandibular and parotid glands: normal and abnormal
Fine needle aspiration

VASCULAR/DOPPLER

Rotation 1
Abdominal aorta: normal appearance and measurement, aneurysm
Inferior vena cava: normal appearance, thrombosis
Hematoma
Iatrogenic pseudoaneurysm

Rotation 2
Peripheral vascular aneurysm, including iliac and popliteal arteries
Hepatic vasculature: pulsed Doppler and color Doppler imaging of the portal veins, splenic vein, hepatic arteries and hepatic veins, including normal direction of flow
Hemodynamics of cirrhosis, portal hypertension and varices, portal vein thrombosis
Upper extremity venous thrombosis: subclavian and internal jugular vein thrombosis, axillary and brachial vein thrombosis
Carotid artery: normal, atherosclerotic plaque, carotid artery stenosis and occlusion
Renal vein thrombosis
Iatrogenic arteriovenous fistula

Rotation 3
Renal transplant: arterial resistive index (rejection, acute tubular necrosis), transplant vein thrombosis, renal infarction, post-biopsy complications, renal arterial stenosis
Liver transplants, including hepatic artery stenosis or thrombosis (resistive index), portal vein thrombosis, post-biopsy complications, inferior vena cava stenosis
Pancreas transplant: arterial and venous anastomosis, patency and stenosis
TIPS evaluation and complications
Lower extremities: chronic venous insufficiency
Arterial bypass graft
Mesenteric ischemia
Renal artery stenosis

Rotation 4
Liver transplants, including hepatic artery stenosis or thrombosis (resistive index), portal vein thrombosis, post-biopsy complications, inferior vena cava stenosis
Pancreas transplant: arterial and venous anastomosis, patency and stenosis
TIPS evaluation and complications
Vascular Lab/IR:
Lower extremities: chronic venous insufficiency
Arterial bypass graft
Hemodialysis graft/fistula
Carotid artery: waveform analysis, stenosis, dissection, pseudoaneurysm, stent
Vertebral artery: subclavian steal syndrome
Mesenteric ischemia
Lower extremity deep vein thrombosis
Pre-graft vein mapping

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**SCROTUM**
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**Rotation 1**
- Testes: normal echotexture, shape and size
- Epididymes
- Testicular mass
- Hydrocele

**Rotation 2**
- Epididymitis, orchitis
- Testicular torsion
- Testicular mass characterization: microlithiasis, germ cell tumor, lymphoma, metastasis
- Cystic ectasia of rete testis
- Extratesticular masses/cysts, spermatocele, adenomatoid tumor, epidydimal head cyst
- Varicocele
- Trauma

**Rotation 3**
- Testicular mass characterization: microlithiasis, germ cell tumor, lymphoma, metastasis
- Cystic ectasia of rete testis
- Extratesticular masses/cysts, spermatocele, adenomatoid tumor, epidydimal head cyst
- Varicocele
- Hernia
- Non-descended testis
- Fournier’s gangrene trauma

**Rotation 4**
- Testicular mass characterization: microlithiasis, germ cell tumor, lymphoma, metastasis
- Cystic ectasia of rete testis
- Extratesticular masses/cysts, spermatocele, adenomatoid tumor, epidydimal head cyst
- Varicocele
- Fournier’s gangrene trauma

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**PEDIATRICS**
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**Rotation 1**
- Normal abdominal anatomy
- Normal renal anatomy
- Normal brain anatomy
- Normal neck anatomy

**Rotation 2**
- Brain: intracranial hemorrhage and complications, including periventricular leukomalacia and hydrocephalus, shunt evaluation
- Kidneys: hydronephrosis, stones, hydroureters, anomalies of position and fusion, renal scarring, masses, cystic disease
Adrenal hemorrhage, masses (neuroblastoma)  
Liver: cirrhosis, choledochal cysts, liver masses, hepatitis/biliary atresia  
Gallbladder: gallstones, biliary stones, hydrops  
Pancreatitis  
Normal hip  
Intussusception  
Acute appendicitis  
Acute pancreatitis  
Hypertrophic pyloric stenosis  
Scrotal: torsion, epididymitis, orchitis, masses, undescended testis, mass , trauma  
Ovarian torsion  
**Rotation 3**  
Organ transplant  
Polysplenia, asplenia  
Kidneys: hydronephrosis, stones, hydroureters, anomalies of position and fusion, renal scarring, masses, cystic disease  
Adrenal hemorrhage, masses (neuroblastoma)  
Liver: cirrhosis, choledochal cysts, liver masses, hepatitis/biliary atresia  
Hip dislocation  
Congenital brain malformations, agenesis of corpus callosum, vein of Galen aneurysm, Dandy Walker Malformation, aqueductal stenosis  
Neonatal spine: tethered cord, intraspinal mass  
Liver Doppler  
Imperforate hymen, uterine anomalies  
**Rotation 4**  
Organ transplant  
Polysplenia, asplenia  
Hip dislocation  
Congenital brain malformations, agenesis of corpus callosum, vein of Galen aneurysm, Dandy Walker Malformation, aqueductal stenosis  
Neonatal spine: tethered cord, intraspinal mass  
Liver Doppler  
Imperforate hymen, uterine anomalies

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**MUSCULOSKELETAL**

**Rotation 1**  
Mass  
Hematoma  
Baker’s cyst, including rupture  
Cellulitis  
Abscess  
**Rotation 2**  
Normal tendon appearance  
Foreign body  
Soft tissue gas
Joint fluid
Muscle tear
**Rotation 3**
Tendon tear, inflammation
Rotator cuff tear
**Rotation 4**
Tendon tear, inflammation
Rotator cuff tear
Foreign bodies

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**BREAST**

Rotation 1
Sonomammographic anatomy
Cystic versus solid mass
Mastitis/abscess

Rotation 2
Characterization of cysts
Lymph node characterization: axillary, supraclavicular, intramammary

**Rotation 3 (There are three rotations in Mammography, including Breast US)**
Characterization of solid masses: benign versus malignant
Architectural distortion
Intraductal masses/abnormalities
Galactocele
Screening
Multifocal malignancy
Elastography

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**INTERVENTIONAL**

Rotation 1
Informed consent
Sterile technique
Localization of fluid for paracentesis or thoracentesis to be performed by another service
Ultrasound-guided paracentesis

Rotation 2
Pre-procedural evaluation: coagulation laboratory studies, anticoagulation medication
Stratification of risk for percutaneous procedures
Techniques for ultrasound-guided invasive procedures: understanding important landmarks and pitfalls of percutaneous procedures, including recognition of critical structures to be avoided
Biopsy of soft tissue masses
Random core liver biopsy
Aspiration of fluid collections, cysts and catheter placement for abscess and fluid drainage (pleural, peritoneal and other spaces)
Ultrasound-guided thoracentesis
Post-procedural evaluation: radiographic studies, patient monitoring, management of complications

Rotation 3
Aspiration of fluid collections, cysts and catheter placement for abscess and fluid drainage (pleural, peritoneal and other spaces)
Ultrasound-guided thoracentesis
Post-procedural evaluation: radiographic studies, patient monitoring, management of complications
Fine needle biopsy versus core biopsy in specific application, such as focal liver mass, renal mass, thyroid/parathyroid mass, retroperitoneal lymphadenopathy

Rotation 4
Aspiration of fluid collections, cysts and catheter placement for abscess and fluid drainage (pleural, peritoneal and other spaces)
Ultrasound-guided thoracentesis
Post-procedural evaluation: radiographic studies, patient monitoring, management of complications
Fine needle biopsy versus core biopsy in specific application, such as focal liver mass, renal mass, thyroid/parathyroid mass, retroperitoneal lymphadenopathy
Pseduoaneurysm management: contraindications and technique of non-surgical treatment with ultrasound-guided compression repair versus thrombin injection
Intraoperative ultrasound guidance

Assessment
ACR In-Service exam
ABR Exam
Faculty Evaluations
360 degree evaluations
Learning Portfolio
Pre-call skills list (Rotation 1)
Pre-call exam (Rotation 1)

II. PATIENT CARE
Rotation 1
Gather essential and accurate clinical and radiologic information about patients relevant to the interpretation of the ultrasound examination
Communicate effectively and demonstrate caring, respectful behavior when interacting with patients and their families, answering their questions and helping them to understand the ultrasound procedure as well as its clinical significance
Use information technology to support patient care decisions
Become familiar with common indications for ultrasound exams as well as limitation and capabilities of the modality for specific indications.

Rotation 2
Communicate effectively and demonstrate caring, respectful behavior when interacting with patients and their families, answering their questions and helping them to understand the ultrasound procedure as well as its clinical significance
Screen and supervise more complex ultrasound studies
Understand the importance of the physician/patient interaction during an ultrasound examination
Advise referring physicians (emergency staff) as to most appropriate diagnostic examinations.
Expedite more urgent cases referred on an emergency basis
Contact clinicians referring examinations to the ultrasound department if additional
information is needed.
Review prior radiologic studies and clinical information
Be responsive to individual patient needs.

Rotation 3
Communicate effectively and demonstrate caring, respectful behavior when interacting with patients and their families, answering their questions and helping them to understand the ultrasound procedure as well as its clinical significance
Screen and supervise, with increasing level of responsibility, most ultrasound studies
Prioritize exams based on urgency
 Expedite cases
Gather the pertinent information for interventional cases
Understand the bioeffects and safety issues in diagnostic ultrasound
Review prior radiologic studies and clinical information
Be responsive to individual patient needs.

Rotation 4
Communicate effectively and demonstrate caring, respectful behavior when interacting with patients and their families, answering their questions and helping them to understand the ultrasound procedure as well as its clinical significance
Screen ultrasound requests for appropriateness.
Interview patients for procedure as to allergies, medications, medical history
Review prior radiologic studies and clinical information
Be responsive to individual patient needs.

Assessment
Faculty evaluation
360 degree evaluation
ACR In-Service Exam
ABR Exam
Learning Portfolio

III. PRACTICE-BASED LEARNING AND IMPROVEMENTS

Rotation 1
Use information technology to manage information, to access on-line medical information, and for self learning
Concentrate on acquiring technical competence in sonography. Observe the ultrasound technologists and backscan. Accompany the attending radiologist when he/she is obtaining additional views.
List interesting cases on database

Rotation 2
Use information technology to manage information, to access on-line medical information, and for self learning
Demonstrate knowledge of principles of research methods, statistical methods, study design and their implementation
Demonstrate critical assessment of the scientific literature
 Demonstrate knowledge and application of the principles of evidence-based medicine in practice
List interesting cases on database
Follow up on interesting cases, including post-surgical and post-biopsy
Rotation 3
Use information technology to manage information, to access on-line medical information, and for self learning
Facilitate teaching of medical students, sonographers, other residents and other health care professionals
Participate in quality assurance programs for sonographers and physicians
Learn about equipment quality assurance programs
Apply basic knowledge of study design and statistical methods to the appraisal of clinical studies and other information on diagnostic and therapeutic effectiveness
List interesting cases on database
Follow up on interesting cases, including post-surgical and post-biopsy

Rotation 4
Use information technology to manage information, to access on-line medical information, and for self learning
Facilitate teaching of medical students, sonographers, other residents and other health care professionals
Participate in quality assurance programs for sonographers and physicians
Learn about equipment quality assurance programs
Apply basic knowledge of study design and statistical methods to the appraisal of clinical studies and other information on diagnostic and therapeutic effectiveness
List interesting cases on database
Follow up on interesting cases, including post-surgical and post-biopsy

Assessment
Faculty evaluation
ACR in service examination
ABR Exam
Medical Student evaluation
Learning Portfolio

IV. INTERPERSONAL AND COMMUNICATION SKILLS

Rotation 1
Dictate prompt, accurate and concise radiologic reports for basic ultrasound studies using available electronic software applications
Develop effective communication skills with patients, patients’ families, physicians and other members of the health care team
Promptly communicate urgent, critical or unexpected ultrasound findings to residents, referring physicians or clinicians and document the communication in the radiological report
Provide basic explanations of ultrasound examinations to patients.
Establish a working relationship with ultrasound technologists.

Rotation 2
Interact with residents and attending physicians in consultation when clinical-radiologic correlation is necessary
Dictate accurate and concise radiologic reports for more complex ultrasound studies with concise impression including diagnosis and/or differential diagnoses
Explain exams and, where appropriate, results to patients and families

**Rotation 3**
Dictate accurate and concise reports for the most complex ultrasound studies with concise impression including diagnosis and/or differential diagnoses as well as recommendations for further imaging and/or management, when appropriate
Consult effectively with senior residents and attending physician in most aspects of ultrasound
Explain the exams and results to patients and other learners

**Rotation 4**
Dictate accurate and concise reports for all, including the most complex ultrasound studies
Consult effectively with senior residents and attending physicians in most aspects of ultrasound
Explain the exams and results to medical students and other learners

**Assessment**
Faculty Evaluation
360 degree Evaluation
Medical Student Evaluation
ACR In-Service Exam
ABR Exam
Dictation Review

**V. PROFESSIONALISM**

**Rotation 1**
Demonstrate honor, integrity, respect and compassion to patients, other physicians and other health care professionals
Demonstrate positive work habits, including punctuality and professional appearance
Be discrete in discussing individual patient histories and findings.
Respect individual ethnic or religious preferences.

**Rotation 2**
Demonstrate a commitment to the ethical principles pertaining to confidentiality of patient information
Demonstrate responsiveness to the needs of patients that supercedes self-interest (altruism)
Demonstrate honor, integrity, respect and compassion to patients, other physicians and other health care professionals
Demonstrate positive work habits, including punctuality and professional appearance

**Rotation 3**
Demonstrate a commitment to the ethical principles pertaining to confidentiality of patient information
Demonstrate responsiveness to the needs of patients that supercedes self-interest (altruism)
Demonstrate honor, integrity, respect and compassion to patients, other physicians and other health care professionals
Demonstrate positive work habits, including punctuality and professional appearance
Demonstrate accountability to patients, society and the profession

**Rotation 4**
Demonstrate a commitment to the ethical principles pertaining to confidentiality of patient information
Demonstrate responsiveness to the needs of patients that supercedes self-interest (altruism)
Demonstrate honor, integrity, respect and compassion to patients, other physicians and other health care professionals
Demonstrate positive work habits, including punctuality and professional appearance
Demonstrate accountability to patients, society and the profession

Assessment
Faculty Evaluation
360 degree Evaluation
Medical Student Evaluation
ACR In-Service Exam
ABR Exam
Patient/Family Feedback, where appropriate

VI. SYSTEMS BASED PRACTICE
Residents must demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value.

Rotation 1
Start to understand how their professional practice affects other health care professionals, the health care organization, and the larger society, and how these elements affect their own practice
Assist referring clinicians in providing cost-effective health care
Begin to learn about practice cost-effective health care and resource allocation
Be prepared to
Begin to evaluate the request for imaging as regards cost, effectiveness, and appropriateness, and to facilitate performance of an alternative study if indicated.
Become familiar with the ACR Appropriateness Criteria

Rotation 2
Understand how their professional practice affects other health care professionals, the health care organization, and the larger society
Learn how these elements affect DHMC
Help referring clinicians provide cost-effective health care
practice cost-effective health care and resource allocation that does not compromise quality of care
Be prepared to evaluate the US request for cost, effectiveness, and appropriateness
Understand the ACR Appropriateness Criteria

Rotation 3
Understand how their professional practice affects other health care professionals, the health care organization, and the larger society
Know how these elements affect their own practice
Help referring clinicians provide cost-effective health care
Practice cost-effective health care and resource allocation that does not compromise quality of care
Evaluate the US request for cost and effectiveness, and appropriateness
Facilitate performance of an alternative study if indicated.
Understand the ACR Appropriateness Criteria

**Rotation 4**
Understand how their professional practice affects other health care professionals, the health care organization, and the larger society
Know how these elements affect their own practice
Help referring clinicians provide cost-effective health care
Practice cost-effective health care and resource allocation that does not compromise quality of care
Evaluate the US request for cost, effectiveness, and appropriateness
Facilitate performance of an alternative study if indicated.
Understand the ACR Appropriateness Criteria

**Assessment**
Faculty Evaluation
360 degree Evaluation
Medical Student Evaluation
ACR In-Service Exam
ABR Exam
Patient/Family Feedback, where appropriate

**SUGGESTED READING**
**Year I Rotations**
Requisites, Middleton, Kurtz, Hertzberg, 2nd ed.
Ch 1-9, 13-20
Diagnostic Ultrasound, 2nd ed. McGahan, Goldberg
Ch. 39

**Year II Rotation**
Requisites
Ch 6, 10, 12, 21-23
Diagnostic US
Ch 25, 27-28, 32, 38

**Year III Rotation**
Diagnostic U/S
Ch 1-2, 11,15,40, 43-51

**Year IV Rotation**
Diagnostic U/S
Ch 4,5,7,10,12,18.19

*Ultrasound Conferences*
1. RUQ - Liver, GB, Biliary Tree (RDH)
2. Retroperitoneum - pancreas, splean, aorta (RDH)
3. Kidneys (RDH)
4. GYN I - Uterus (RD)
5. GYN I - Uterus (RD)
6. GYN III - Infertility (MBP)
7. OB I - 1st Trimester (RDH)
8. OB II - Dating Growth (RDH)
9. OB III – Fetal CNS (RD)
10. OB IV - Fetal - Cardiac & Chest (RDH/JS)
11. OB V - Fetal GI (RD)
12. OB VII - Fetal MSK (EB)
13. OB VIII - Placenta, Cervix (RDH)
14. OB IX - Multiple Gestations (RD)
15. Scrotum (RDH)
16. U/S Doppler Principles (RD)
17. Pediatrics I (Sarge)
18. Pediatrics II (TV)
19. Vascular U/S (Visiting Prof)