CHEST

1. Scan 5 mm x 5 mm from apices of lungs through adrenal glands.
2. Use IV contrast unless otherwise indicated or unless it is for high–resolution CT which is without IV contrast.
3. Do the scan on inspiration breath hold.
4. Use smooth kernel at a mediastinum/soft tissue window.
5. Reconstruct coronal and sagittal images at 2 mm.
6. Send all images to PACS.

This scan is always with IV contrast unless the patient is contraindicated. So if the physician orders this to be either without contrast or without and with contrast and the patient has normal renal function without an allergy to contrast, then we need to investigate the reasons for the order and possibly call the physician to change the scan to be with IV contrast. If you are unable to contact the physician, then speak to the radiologist about changing the order.

HIGH RESOLUTION CHEST

1. Utilize bone algorithm.
2. Axial (sequential/step & shoot) 1.25 mm slice thickness x 10 mm interval through lungs only.
3. Scan supine and if the patient is able, prone. Scan only through the lung tissue from top to bottom.
4. Reconstruct each lung to a smaller field of view so that the lung fills the field, usually around 20-24 cm DFOV.
5. Use inspiration breath hold. This is usually 4 to 5 scans per breath hold.
6. Use sharp kernel at a bone algorithm and send in lung window.
7. Send all images to PACS.

ABDOMEN–KIDNEYS (DIAGNOSIS DEPENDENT)

Renal calculus:
1. Without IV or oral contrast.
2. Scan 3 mm x 3 mm helical images from the dome of liver through the ischial tuberosities (all).
3. If there is a kidney stone, please zoom the image and measure size and Hounsfield units of the stone on a bone window, save image and send to PACS.
4. Use a smooth kernel at an abdomen window.
5. Reconstruct coronal and sagittal images at 2 mm.
6. Send all images to PACS.
Hematuria
Renal mass (initial work-up or follow-up)
Adrenal mass work-up
Urography
1. Without and with IV contrast and delayed.
2. Oral contrast not necessary for hematuria but helpful if there is a history of cancer or adrenal masses.
3. Scan 3 mm x 3 mm helical images both pre and post-IV contrast and then at a five minute delay. On the pre-contrast scan, scan through the kidneys and adrenal glands. Post-contrast scan, scan from the dome of the liver through the ischial tuberosities. Delay scan through kidneys, ureters and bladder.
4. Use a smooth kernel at an abdomen window.
5. Reconstruct coronal and sagittal images at 2 mm and send both to PACS.
6. If ordered as a CT urogram, do all of the above but add a set of 10 mm thick coronal MIP images to the delayed series.
7. Follow up scans can be performed with one IV contrast series only. No pre-contrast scan is necessary but a delayed series might be. Check with radiologist.
8. Send all images to PACS.

Most, if not all of the urologists order their CT abdomen/pelvis examinations to be without and with IV contrast and without oral contrast. The radiologists will generally agree to not change the order even if the extra sets of scans are not truly necessary.

ABDOMEN/ABDOMEN-PELVIS (diagnosis dependent)

Oncology/cancer/metastasis (initial work-up or follow-up)
Diverticulitis
Colitis
Abdominal pain
Abscess
Fever of unknown origin
Sepsis
Liver or spleen enlargement
Abnormal liver enzymes
Cirrhosis
Pancreatitis
1. With IV and oral contrast unless contraindicated.
2. Scan 3 mm x 3 mm helical images from the dome of the liver through the ischial tuberosities.
4. Only do delayed imaging if abnormal findings indicate that it is needed.
5. Use a smooth kernel at an abdomen window.
6. Reconstruct coronal and sagittal images at 2 mm and send both to PACS.
7. Send all images to PACS.
Appendicitis
1. With IV contrast only (no PO contrast if in ER) unless it is contraindicated. If out-patient, PO if tolerated.
2. Do not use oral contrast unless the radiologist requests it.
3. Scan 3 mm x 3 mm helical images from the dome of the liver through bottom of the ischial tuberosities.
5. Use a smooth kernel at an abdomen window.
6. Reconstruct coronal and sagittal images at 2 mm.
7. Send all images to PACS.

Hemangioma/Indeterminate liver lesion
1. With IV contrast and oral contrast.
2. 3 mm x 3 mm helical images.
3. Noncontrast liver scan unless under 30 years of age.
4. Arterial phase-scan through liver only.
5. Portal venous phase through entire abdomen (or abdomen/pelvis if that is what is ordered).
6. Do one delayed set of images through liver only at a 5 to 10 minute delay.
7. Use a smooth kernel at an abdomen window.
8. Reconstruct coronal and sagittal images at 2 mm.
9. Send all images to PACS.

Trauma-Chest/Abdomen/Pelvis
1. With IV contrast unless it is contraindicated.
2. 3 mm x 3 mm axial plane helical scan from above the apices of the lungs through bottom of the ischial tuberosities. (start above C-7 in case you need to reconstruction the T-spine)
4. Do 5 minute delayed images through the bladder if there is fluid in pelvis.
5. Use a smooth kernel at an abdomen window.
6. Reconstruct coronal and sagittal images at 2 mm.
7. Be sure to study split the chest from the abdomen/pelvis.
8. Separate coronal and sagittal reconstructions between the two examinations.
9. Send axial, coronal and sagittal images of each examination to PACS.
10. If you need to reconstruct the thoracic and/or lumbar spines out of the chest/abdomen/pelvis, you may have to first reconstruct them and send them to PACS, then move the appropriate images to the appropriate charge within PACS or you can be sure to include the reconstruction orders when you work list all the examinations that you are scanning together and then just assign each spine reconstruction to the correct Meditech order (study split).
Pelvis – routine
1. Scan 3 mm x 3 mm from top of iliac crest through ischial tuberosities.
2. Use 100 cc Omnipaque 240.
3. Scan through entire pelvis with venous bolus, usually around 80 to 90 second delay.
4. Use a smooth kernel at an abdomen window.
5. Reconstruct coronal and sagittal images at 2 mm.
6. Only do delayed images through the bladder if any abnormality is seen or if there has been trauma.
7. Send all images to PACS.

Pelvis/hips for fracture
1. Scan 3 mm x 3 mm from top of iliac crest through bony pelvis. If including a hip, scan down past lesser trochanters (or through prosthesis).
2. Use a sharp kernel at a bone window.
3. Reconstruct 2 mm coronal and sagittal images of the entire pelvis or coronal images of the pelvis and coronal and sagittal images of the hip on the affected side.
4. Send all images to PACS.

Extremities
1. Almost always non-contrast. Contrast is only used if it is indicated by the radiologist.
2. Try to locate any previous associated examinations for the radiologist for comparison (i.e. plain films, bone scan, MRI, etc.)
3. Scan 3 mm x 3 mm axial plane helical scan axial images (or thinner for smaller anatomy, i.e. hands, wrists, feet and ankles).
4. Use a sharp kernel at a bone window.
5. Reconstruct 2 mm coronal and sagittal images of the affected side.
6. Send all images to PACS.

CT ANGIOGRAPHY

Pulmonary arteries
1. Scan from bottom of the heart up through the lung apices.
2. Use 75 cc Omnipaque 350 at 4 cc/sec.
3. Utilize bolus tracking or use a timing bolus. Place ROI marker in the pulmonary artery away from the subclavian vein.
4. If any abnormal pathology is seen during the scan, be sure to scan all the way through it. Dissections and aneurysms often extend past the diaphragm and are found incidentally when this examination is ordered.
5. If the scan shows poor enhancement of the pulmonary arteries and the patient has a normal creatinine, then please repeat the scan, maybe try to verify that the IV flows freely.
6. Use a smooth kernel at an angio/mediastinum window.
7. Reconstruct 2 mm coronal and sagittal images and 10 mm MIP coronal images.
8. Send all images to PACS.
Carotid arteries and/or cerebral (Circle of Willis) arteries
1. Use 75 cc Omnipaque 350 at a rate of 4 cc/sec.
2. Utilize bolus tracking or timing bolus. Place ROI marker at the aortic arch.
3. Scan from a little below the level of the aortic arch up through Circle of Willis for a carotid/vertebral artery study.
4. Scan from base of skull up through upper brain for Circle of Willis study.
5. Scan 1.25 mm x 1.25 mm axial images.
6. Use a smooth kernel at an angio/mediastinum window.
7. Reconstruct sagittal and coronal MIP images.
8. Reconstruct a set of thin overlapping axial images to send to TeraRecon Aquarius Intuition for post-processing. Reformat appropriate MIP images and 3D-volume rendering.
9. Send all images on the scanner to PACS except the set of thin axials.
10. Send TeraRecon images to PACS except the set of thin axials.

Thoracic aorta
1. Scan 1.25 mm x 1.25 mm axial images from lung apices through renal arteries.
2. Use 75-125 cc Omnipaque 350 at a rate of 4 cc/sec.
3. Utilize care bolus at the level of the aortic arch.
4. Reconstruct sagittal and coronal images.
5. Reconstruct a set of thin overlapping images to send to TeraRecon Aquarius Intuition for post-processing. Reformat appropriate MIP images and 3D-volume rendering.
6. Send all but the set of thin axials to PACS.

Abdominal aorta
1. Use 125 cc Omnipaque 350 at a rate of 4 cc/sec.
2. Scan 1.25 mm x 1.25 mm axial images from diaphragm through level of femoral artery bifurcations. (This is usually just below the level of the lesser trochanters of the femurs.)
3. Utilize care bolus at the level of the diaphragm.
4. Reconstruct sagittal and coronal images.
5. Reconstruct a set of thin overlapping images to send to TeraRecon Aquarius Intuition for post-processing. Reformat appropriate MIP images and 3D-volume rendering.
6. Send all but the set of thin axials to PACS.

Lower Extremity Run-off
1. Use 125-150 cc Omnipaque 350 at 4 cm/sec.
2. Position the patient with a rolled towel between their feet with their toes pointing up and taped together.
3. Scan 2.5 mm x 2.5 mm axial images from aortic bifurcation through toes. If the order is CTA abdominal aorta with bilateral lower extremity run-off, then start at the diaphragm. For a lower leg only, you may start your scan at the level of the aortic bifurcation.
4. Reconstruct sagittal and coronal images. Separate them out into abdomen/pelvis, upper legs and lower legs. (This is a total of six sets of reconstructions-sagittal and coronal of each area.)
5. Reconstruct a set of thin overlapping images to send to TeraRecon Aquarius Intuition for post-processing. Reformat appropriate MIP images and 3D-volume rendering.
6. Send all but the set of thin axials to PACS.

**Brain/stroke perfusion (GE Lightspeed 16 scanner)**
1. First perform a noncontrast examination to exclude a hemorrhagic stroke.
2. Position at level of the anterior communicating artery. This is right between the anterior horns of the lateral ventricles.
3. Inject 50 cc Omnipaque 350 at 4 cm/sec.
4. Scan in cine mode at one-second rotations for 50 seconds.
5. Scan 5 mm thickness at 4i.
6. Retro reconstruct into 10 mm thickness at 2i.
7. Send the reconstructed images to the workstation and follow perfusion protocol.
8. This can be performed on a single slice scanner. You just do 10 mm thickness at 1i during your cine scan.
9. Charge a CT wo/w contrast and CT reconstruction.

**BRAIN/HEAD**
1. Axial (sequential/step and shoot) or helical 5 mm x 5 mm for both pre and post contrast examinations. Axial if the patient is able to hold still and the gantry can angle enough to obtain a canthomeatal plane. If patient is unable to hold still, then scan helically. No gantry angle for a helical scan. Do a reconstructed set of axials at the canthomeatal plane. Reconstruct a thin set of axials (1.2 mm) at a bone window if the patient has been involved in any kind of trauma.
2. Scan inferior to superior. Remove hearing aids and any metal in the hair, earrings if they remain in the way after angling the gantry. Try to position the patient with their chin tucked down to avoid scanning through fillings in the teeth.
3. Send all recons to PACS.
4. CT examinations of the brain from the Emergency Department, in-patients or emergent added-on outpatients are generally performed without contrast. A radiologist will review the examination and contrast will be given if indicated.
5. Outpatient CT examinations may or may not be pre and post-contrast examinations depending on what is ordered. A generalized guideline follows but the examination may need to be tailored to the patient. Reformat appropriate MIP images and 3D-volume rendering.
6. Send all but the set of thin axials to PACS.

**Non-contrast diagnosis**

a. Trauma.

b. Initial CVA or intracranial hemorrhage. TPA follow up scan should be performed “next day”.

c. Acute onset of worst headache ever.
d. Follow up to CVA or headache (if a contrast examination has already been performed.)
e. Pediatric patients (unless contrast is indicated on the noncontrast images. Please consult with the radiologist regarding any questions regarding pediatric patients.)
f. Hydrocephalus (unless contrast is indicated on the noncontrast images.)
g. VP shunt status.
h. Seizures (unless contrast is indicated on the noncontrast images.)

**Pre and post-contrast diagnosis**

a. Possible metastasis (especially if the patient has a known history of cancer.)
b. Chronic headaches.
c. Initial follow up of a CVA if a noncontrast examination has recently been performed.
d. Fever of unknown origin, abscess, meningitis and encephalitis.
e. Vascular malformations/cerebral aneurysm (please consider ordering a CT angiogram of the brain.)

Many physicians order just a CT head with contrast. This order is usually changed to a without and with (without needing to call the physician) unless the patient has had a very recent (within 24 hours or less) noncontrast CT.

**SINUSES**

1. Scan the patient supine in an axial plane.
2. 3 mm x 3 mm axial images with no gantry angle.
3. Use a moderately sharp kernel and sinus window.
4. Reconstruct coronal and sagittal images at 2 mm.
5. Send all images to PACS.

**SINUSES – LIMITED SCREENING**

1. Scan either prone (only if they can extend their head back far enough to angle the gantry to achieve a coronal plane) or supine if they are unable to lay prone depending on the patient’s ability.
2. Do just a few (4-8) scans through the sinuses. This works out approximately to one 3 or 5 mm slice every 15-20 mm. Be sure there is at least one image through each set of sinuses.
3. Use a moderately sharp kernel and sinus window.
4. Only send the scanned plane to PACS.

**SINUSES – LANDMARK**

1. Scan supine 1 mm axial or helical slices through the sinuses. Be sure the FOV is large enough to include the facial region (nose, eyes and forehead). Do not use any positioning devices that might bend the ears or shift any skin. Do not use any gantry angle.
2. Use a moderately sharp kernel and sinus window.
3. Do coronal and sagittal reconstructions.
4. Send all images to PACS.
5. Surgery can access the axial images from PACS to load into the Brian Lab guidance system.
6. If any questions, see attached Brain Lab protocol.

**FACIAL BONES**

1. Scan supine 3 mm x 3 mm from just below the mandible to just above the frontal sinuses (or through petrous ridges) in an axial plane with no gantry angle.
2. For bony trauma, do without IV contrast. Use a sharp kernel and a bone window.
3. For abscess, cellulitis or infection, do the scan with IV contrast (50 ml hand inject). Use a medium kernel and a mediastinum/soft tissue window.
4. Reconstruct coronal and sagittal images at 2 mm.
5. Send all images to PACS.

**ORBITS**

1. Scan 3 mm x 3 mm from below the orbits to just above the frontal sinuses in an axial plane with no gantry angle.
2. For bony trauma do without IV contrast and use a sharp kernel at a bone window.
3. For abscess, cellulitis or infection, do the scan with IV contrast (50 ml hand inject). Use a medium kernel and a mediastinum/soft tissue window.
4. Reconstruct coronal and sagittal images at 2 mm.
5. Send all images to PACS.

**TEMPORAL BONES/IACs/MASTOIDS**

1. Scan helical 1 mm x 1 mm in the axial planes with no gantry angle. Scan inferior to superior.
2. Include entire temporal bone including mastoids.
3. Use a very sharp kernel and an IAC window (W4000/L1100).
4. Reconstruct (do not zoom or magnify) each side in axial, coronal and sagittal planes at 1 mm x 1 mm and at a 10 cm DFOV. Be sure to label the side (R/L) correctly.
5. If the diagnosis is for an acoustic neuroma and we are doing the CT because an MRI is contraindicated, then follow above protocol but use IV contrast (pre and post 50 cc hand injection) at a medium kernel and a mediastinal/soft tissue window.
6. Send the axial, coronal and sagittal plane of each side to PACS.

**CERVICAL SPINE**

1. Scan 3 mm x 3 mm in an axial plane with no gantry angle.
2. Scan top to bottom from just above the skull base through T-2. If you have difficulty with the time length of the scan, try scanning caudocranially (bottom to top). This might help on a patient with broad shoulders.
3. Use 13-15 cm DFOV.
4. Instruct patient not to swallow during examination.
5. Use a medium sharp kernel at a bone window. Reconstruct in soft tissue algorithm and send to PACS.
6. Reconstruct coronal and sagittal images at 2 mm.
7. Perform an additional set of reconstructed axial images if the native scan is off-plane due to patient positioning.
8. Send all images to PACS.

THORACIC SPINE

1. Scan 5 mm x 5 mm in an axial plane with no gantry angle.
2. Scan mid C-7 through mid L-1.
3. If possible, mark area of back pain with a BB marker.
4. Use 15-25 cm DFOV.
5. Use a medium sharp kernel at a bone window, reconstruct in soft tissue algorithm also and send to PACS.
6. Reconstruct coronal and sagittal images at 2 mm.
7. Sometimes a curved coronal is necessary in the case of severe kyphosis.
8. Send all images to PACS.

LUMBAR SPINE

1. Scan 5 mm x 5 mm in an axial plane with no gantry angle.
2. Scan mid T-12 through mid sacrum.
3. Use 15-25 cm DFOV.
4. Use a medium sharp kernel at a bone window and reconstruct in soft tissue algorithm. Send to PACS.
5. Reconstruct coronal and sagittal images at 2 mm.
6. Send all images to PACS.

NECK SOFT TISSUES

1. Scan 5 mm x 5 mm from just above orbits through the sternal notch or top of the aortic arch (be sure to extend scan through the thyroid if it is enlarged.)
2. Mark any areas of interest (such as palpable lumps or masses) with a BB marker.
3. Instruct patient not to swallow during examination.
4. Use IV contrast unless contraindicated.
5. Use smooth kernel at a mediastinal W/L.
6. Reconstruct coronal and sagittal images at 2 mm.
7. Send all images to PACS.

This scan is always with IV contrast unless the patient is contraindicated. So if the physician orders this to be either without contrast or both without and with and the patient has normal renal function without an allergy to contrast, then we need to investigate the reasons for the order and possibly call the physician to change the scan to be with IV contrast. If you are unable to contact the physician, then speak to the radiologist about changing the order.
CTA CARDIAC:

Patient prep:

1. No solid food for 4 hours prior to examination. Patient may drink clear liquids for hydration.
2. No nicotine or caffeine for 12 hours prior to examination.
3. No stimulants (i.e. Viagra or Cialis) 24 hours prior to examination.
4. Obtain resting heart rate. Please understand that this scan is affected by heart rate, both rate and rhythm. If the patient’s resting heart rate is greater than 70 or irregular, does the ordering physician want to medicate with beta blocks prior to examination?
5. Please understand that larger body habitus may have an affect on image quality.

Protocol:

1. Scan noncontrast cardiac calcium scoring prior to CTA.
2. Technique kVp 120 and ref mAs 130.
3. Omnipaque 350 dose is based on patient weight. Flow rate will range from 5 to 6 cc/sec (also weight based), therefore must have 18G IV.
4. Smart Prep with ROI in the ascending aorta.
5. Scan superior to inferior from level of main pulmonary artery bifurcation through bottom of heart.
6. .75 mm x .7 mm with a 250 mm FOV.
7. Scan on inspiration.
8. Recon will include CTA 0-90% series, best diastolic series and full FOV series.
9. Send best diastolic series, full FOV series and cardiac scoring to PACS. Send CTA 0-90% series and cardiac scoring to TeraRecon.

CT CYSTOGRAM

This is most often ordered when looking for a leak in the bladder wall and is usually ordered by a urologist. It is charged as a CT abdomen/pelvis without IV contrast or a CT pelvis without IV contrast (whichever the physician orders.) Often it is ordered because the patient’s creatinine is too elevated to inject them intravenously.

IV contrast needs to be really dilute when putting it retrograde into the bladder so do not use Cystografin. Even though the CT scan is billed without IV contrast, you will still need to charge for the amount of contrast that you use.

The dilution is 25 ml of Omnipaque 240 to 500 ml saline. You can just draw some up in a syringe and inject into a 500 ml bag of saline.

There are a couple of ways to introduce this mixture retrograde into the bladder. The patient will need a Foley catheter. The ones that are used in this facility have a little Luer lock connection near to where the end of the Foley catheter and the tubing to the bag connect:
• You can use this Luer lock to hand inject one syringe (full) at a time. This is the best method if the urologist doesn’t want very much fluid in the patient’s bladder. They will be specific about this, if this is the case.
• You can connect IV tubing (like the kind used for VCUGs) to the saline bag and connect that to the patient’s side and then fill the bladder as full as the patient can tolerate.

1. Without IV or oral contrast.
2. Scan 3 mm x 3 mm axial images.
3. Scan from dome of liver through entire bony pelvis if abdomen/pelvis.
4. Scan from just above the iliac crests through entire bony pelvis if pelvis.
5. Use a smooth kernel at an abdomen W/L.
6. Reconstruct coronal and sagittal images at 2 mm.
7. Send all images to PACS.

CT LOW DOSE LUNG SCREENING

1. Scan from above the apices of the lungs through the lung bases.
2. No IV contrast is utilized.
3. This is a screening CT at a significantly reduced radiation dose, not a diagnostic CT scan.
4. Our facility uses the NCCN (National Comprehensive Cancer Network) screening guidelines. The NCCN guidelines can be found online.
5. The scan is performed with a 3 mm axial and a 1.5 mm axial reconstruction sets. Send this to PACS. Reconstruct a thin set and send these to TeraRecon for CAD utilization. Send all images and TeraRecon results to PACS.

PULMONARY EMBOLI CT STUDY WITH VENOUS LEG DELAYS

1. This is based on using 150 cc Visipaque 320 at 4 cc/sec injection.
2. There is a protocol in the scanner under chest.
3. The scout is long enough to include the pelvis so you can see where to start the lower scans.
4. Set up the PE chest part of the examination and then set up the pelvis and lower extremity. Make note of the table location at the ankle or feet.
5. For the lower venous system, start high enough to include the IVC bifurcation (usually a couple of inches above the iliac crest) and go low enough to get through the mid lower leg or ankle. Scan 10 mm thick x 10 mm interval. You don’t really need to scan any thinner.
6. The delay between the end of the PE chest study and the pelvis/legs is around 110 to 120 seconds. This is very much an approximation for now until we do a few to get a better feel for them.
7. If you do this study, add a CT angio lower extremity charge to the existing CT angio chest charge.
CT CARDIAC

The orders in Meditech are as follows and self explanatory:
CT Heart Cardiac Function
CT Heart Congenital Disease
CT Heart Coronary Arteries

These examinations will all be performed on the scanner at the main hospital. Please plan to schedule for a one hour time block. It is not necessary to block time for a radiologist. These are all performed with IV contrast so please screen according to department policy as with any other IV contrast examination. These will all follow the same patient prep.

PATIENT PREP:
1. No solid food for 4 hours prior to examination. Patient may drink clear liquids for hydration.
2. No nicotine or caffeine for 12 hours prior to examination.
3. No stimulants (i.e. Viagra or Cialis) 24 hours prior to examination.
4. Obtain resting heart rate. Please understand that this scan is affected by heart rate, both rate and rhythm. If the patient’s resting heart rate is greater than 70 or irregular, does the ordering physician want to medicate with beta blocks prior to examination?
5. Please understand that larger body habitus may have an affect on image quality.
WATER SOLUBLE CONTRAST OPTIONS

Breeza does not have contrast in it. It is like flavored water that is designed to mask the taste of Gastrografin. Please only use it if the patient is going to actually drink the contrast. If it is going to be put down an NG tube or Dobbhoff, then just mix the Gastrografin with water.

Option #1:
One bottle of Breeza to 15-20 ml Gastrografin. The bottles are underfilled for this purpose so just add it in and shake it up. It tastes fruity.

Option #2:
Mix 20 ml Omnipaque 240 to 16-20 oz water. This is basically tasteless.

OR

Mix one bottle (30 ml) Gastrografin to 32 oz water. This will taste like Gastrografin which is somewhat bitter.

REMEMBER: A 30 ml bottle of Gastrografin is single use only. That means we cannot use on more than one patient, so toss what you don’t use.
RECTAL CONTRAST IN CT

Use an empty BE bag from the diagnostic department and fill with one of the following. Try to use warm (not hot) water to help alleviate cramping:

WATER SOLUBLE:

Gastrografin (Gastroview) dilution for CT scans: 30 ml
Gastrografin (Gastroview) to 32 oz clear liquid (water). Double if need be for volume.

BARIUM:

Readi-Cat: may dilute with warm water to be not more dilute than a 3 (barium) to 1 (water) ratio. Double if need be for volume.

Place the patient on the CT table on their left side, tip them and inflate the balloon on the tip just like for a BE. Tie a knot in the blue tube that we would normally use for putting in air. Leave the patient on their left side and begin slowly filling their colon. When they feel full, clamp the bag, roll them onto their back and then up onto their right side to let the contrast backfill. Slowly try to add more contrast and when the patient feels really full, clamp the bag, roll the patient onto their back and place the bag and tubing on the patient’s legs to that it cannot get caught up in the table motion. Proceed to scan a routine CT abdomen/pelvis. When finished, place the bag on the floor and open the clamp and let the patient expel as much contrast as possible back into the bag, just like a BE.

DO NOT THROW AWAY THE BALLOON TIP INSUFFLATOR!!

CT COLONOGRAPHY

IV contrast is used so the patient needs risk factors screened according to our policy. Thirty minute time slot is needed. Patient sedation is not utilized so there is no recovery time or alternate driver needed. Arrive 15 minutes early for registration. This patients who are paying for their own examinations because their insurance doesn’t cover will have to sign an ABN at the time of registration. The patient will need to pick up one bottle of Readi-Cat CT barium from the radiologist department and one 10 oz bottle of Magnesium Citrate solution along with 4 Bisacodyl (or Dulcolax) tablets from their pharmacy. No physician prescription is necessary for any of the above items.

Two days prior to examination, eat a low residue diet for all meals. (Guidelines next page.)

One day prior to examination, only clear liquids are allowed:

Clear liquids include: fruit juices without pulp, water, clear broth or bouillon, coffee or tea (without milk or creamer), Gatorade, carbonate or noncarbonated drinks, Kool-aid or other fruit flavored drinks, plain Jell-O (without toppings).

At noon, drink 225 ml (half bottle) of Readi-Cat (CT barium) along with clear liquid lunch. (Barium may be chilled.)
8 oz glass of water at 1:00 p.m. and then one 8 oz glass of water hourly until 9:00 p.m.

At 5:00 p.m., drink 225 ml (half bottle) of Readi-Cat (CT barium) along with clear liquid dinner.

At 5:30 p.m., drink 10 oz bottle of Magnesium Citrate solution (may be chilled).

At 7:30 p.m., take 4 Bisacodyl (or Dulcolax) tablets.

**LOW RESIDUE DIET**

**Grain Products:**
- Enriched refined white bread, buns, bagels, English muffins
- Plain cereals, e.g. Cheerios, Cornflakes, Cream of Wheat, Rice Krispies, Special K
- Arrowroot cookies, tea biscuits, soda crackers, plain melba toast
- White rice, refined pasta and noodles
- Avoid whole grains

**Fruits:**
- Fruit juices except prune juice
- Applesauce, apricots, banana (1/2), cantaloupe, canned fruit cocktail, grapes, honeydew melon, peaches, watermelon
- Avoid raw and dried fruits, raisins and **berries**

**Vegetables:**
- Vegetable juices
- Potatoes (no skin)
- Well-cooked and tender vegetables including alfalfa sprouts, beets, green/yellow beans, carrots, celery, cucumber, eggplant, lettuce, mushrooms, green/red peppers, squash, zucchini
- Avoid vegetables from the cruciferous family such as broccoli, cauliflower, brussel sprouts, cabbage, kale, Swiss chard, etc.

**Meat and Protein Choice:**
- Well-cooked, tender meat, fish and eggs.
- Avoid beans and lentils.

**Nuts and Seeds:**
- Avoid all nuts and seeds, as well as foods that may contain seeds (such as yogurt)

**Dairy:**
- As directed by your healthcare providers
PREPS

CT EXAMINATIONS WITH IV CONTRAST:
- Patient should be NPO for 4 hours with the exception of clear liquids and may take any necessary medications except Metformin.
- In the case that the CT examination is an emergency/urgent/same day add-on, NPO status will not prohibit the examination from being performed in a timely manner.

CT ABDOMEN/PELVIS:
Knowing when to have patients drink PO contrast or not and when we inject them or not is often confusing. Mostly how we scan at SRHC is dependent upon the diagnosis. Not only do we scan with regard to diagnosis, we scan according to the protocol put forth by the radiologist for that particular diagnosis or disease process. Basically it is most important to the reading radiologist to know what the ordering physician is looking for. If they need to drink CT barium, then they need to do so. A couple of hours prior to the scan is the goal to shoot for, but not always achievable either due to the patient’s ability to drink it or the CT schedule. It can be put down an NG tube with a syringe. All we ask is that the patient try their best.

CT ANGIOGRAPHY:
All CT angiography examinations are done with IV contrast and without PO contrast **ALWAYS**. If the patient is contraindicated to IV contrast, then they will not be able to have this examination.

BIOPSIES:
These are usually done in CT or US depending on the area of abnormality as well as the radiologist performing the procedure. The patient needs to be off any anticoagulants for a minimum of 3 days prior to the biopsy. They need to have a PT with INR and a PTT drawn prior to the procedure. This is usually done the day before or the same day as the biopsy. It is important to have any imaging studies (not just reports) showing the abnormal areas that are to be biopsied so that the radiologist may plan the procedure.
Here's a general guideline for your perusal but always call if any questions. We'd rather you call than not:

**PO AND IV CONTRAST:**
- Abdomen/pelvic pain
- Oncology work up or follow up
- Metastasis/masses/tumors
- Abscess
- Hemangiomas/specific liver diagnoses
- Pancreatitis

**IV CONTRAST ONLY:**
- Appendicitis
- Hematuria work up (other than kidney stones)
- AAA (you should be ordering CT angio abdomen and angio pelvis)
- Pulmonary emboli (you should be ordering a CT angio chest)
- Thoracic aortic aneurysm (you should order at CT angio chest)
- Aortic dissection (you should order a CT angio chest and angio abdomen)
- Bowel perforation (sometimes we use a water soluble oral contrast)
- Retroperitoneal hematoma

**NO CONTRAST:**
- Renal calculi
- Patient’s renal function is compromised
- Severe allergy and unable to premedicate

**DIFFERENT ORAL CONTRAST AGENTS:**
- Barium. We use Readi-Cat. Usually one bottle 1 to 2 hours prior to CT abdomen/pelvis. If you use Readi-Cat for rectal contrast, dilute with a little bit of warm water.
- Gastrografin (water soluble). This needs to be mixed with some kind of clear liquid before use. Any kind of clear liquid can be used, i.e. Breeza, Gatorade, Kool-Aid, lemonade, juice, 7-Up. Use 15-30 ml Gastrografin to 450-550 ml (16 to 20 oz) of liquid. If the patient is actually drinking this, please use something other than water as it doesn’t taste that great. If it is being put down an NG tube or Dobbhoff, then just use water to dilute.
- Omnipaque. Mix with clear liquid, the same as with Gastrografin. Use 20 ml Omnipaque to 50 ml (16 oz) water. This is actually mostly tasteless.

**CT TABLE WEIGHT LIMIT:**
*450 POUNDS.* This needs to be accurate as putting a patient on the table that exceeds the weight limit for the equipment renders the service contract with the equipment vendor useless. This is totally a patient safety issue. (i.e., if it breaks, we’ve got a big problem)

In the case of CT scanning, be advised that even if the patient weighs less than the table limit, the table still might not work properly or they might just not fit into the gantry.
GENERAL INFORMATION:
1. If there are any questions, ask the radiologist (if they are available), refer to the protocol book or ask a CT tech.
2. Always check the creatinine level if over 65 years of age, if the patient is diabetic, has hypertension or has only one kidney, regardless of age.
3. Routine examinations use Omniraque 240. Standard injection rate is 2 cc/sec. CT angiography routinely uses Omniraque 350 at a rate of 4 cc/sec.
4. Cannot use PICC lines, mid lines or most central lines unless they have been manufactured to be compatible with pressure injectors. These are usually clearly marked for allowable flow rate on the hub or side clamp of the line. Follow manufacturer’s guidelines.
5. If using any kind of PICC or central line, scrub the hub according to the guidelines and check for blood return. Flush before and after with a full 10 ml saline. Central lines are key sites of infections which can lead to sepsis.
6. **Never use any central line that is specific for dialysis.**
7. Always use a 20G IV or larger for CTA at a rate of no less than 4 cc/sec for CT angiograms. This is optimal. May have to adjust according to patient.
8. Check PT, PTT, INR before interventional procedures and patients should be off any anticoagulants.

**Creatinine**

<table>
<thead>
<tr>
<th>Creatinine Level</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1.5</td>
<td>Normal contrast dose as long as the patient is not diabetic. If they are diabetic, ask the radiologist (or ordering physician if radiologist is unavailable) if they want to reduce the dose or not inject at all.</td>
</tr>
</tbody>
</table>
| 1.5 to 1.8       | Talk to radiologist or the ordering physician if radiologist is unavailable regarding the following choices:  
|                  | 1. Pre-treat with Mucomyst.  
|                  | 2. Decrease dose.  
|                  | 3. **If there is no radiologist or physician to consult with (i.e. after hours), then do not use contrast.**  |
| 1.8 and above    | No contrast. |
CONCERNING METFORMIN:
There are multiple medications containing Metformin beyond just Glucophage and Glucovance:
- Metformin
- Fortamet
- Fortamet ER
- Glucophage
- Glucophage XR
- Glumetza
- Riomet

Metformin combinations:
- Metaglip (glipizide/metformin)
- Glucovance (glyburide/metformin)
- Avandamet (metformin/Avandia)
- ACTO plus met (metformin/Actos)
- Janumet (metformin/Januvia)
- PrandiMet (metformin/Prandin)

They always seem to be changing names or adding drug combinations so don’t assume that these drugs listed as the only ones. If you have questions, you can call the pharmacy at SRHC at 452-6939. They can tell you for sure if a medication contains metformin.
MR PROTOCOLS

ROUTINE MR BRAIN

Sag T1 5/1.5
Ax T2 5/1.5
Cor T2 5/1.5
Ax FLAIR 4/1 or 5/1
Ax diffusion with ADC map 5/1
Ax T1 5/1.5
Ax T1 post 5/1.5
Cor T1 post 5/1.5
*If looking for demyelination (MS, tuberous sclerosis, etc), include Sag T1 post and Sag FLAIR.
*Shuffle scans and inject early if desired.
We usually don’t use the eADC map
If there is any history or concern for bleed, do axial gradient. STOP DOING PROTON DENSITY!

CERVICAL SPINE

Sag T2 3/.3
Sag T1 3/.3
Axial T1 C2-3 through C7-T1 and other affected areas 3.5/5
Axial FRFSE (driven equilibrium) T2, same locations as T1 3.5/.5
*Can do COSMIC or FIESTA for cord/CSF demyelination. (Don’t know what these are called on Siemens, used to be similar to Turbo Flash.)

THORACIC SPINE

Sag T2 3/.3
Sag T2 FAT SAT
Sag T1 3/.3
Axial T1/T2 4/1 only through abnormal areas. If no abnormalities noted, do not need to do.

LUMBAR SPINE

Sag T2 4/1
Sag T2 FAT SAT 4/1
Sag T1 4/1
Ax T1 4/1
Ax T2 4/1
If fat sat is non-uniform, use IR.
Axials to include at least L3-4 through L5-S1 sliced contiguously; include any other areas of abnormality noted proximal to L3-4.
SHOULDER

Cor T1 3/.3
Cor T2 FS 3/.3
Sag T2 FS 3/.3
Ax T1 or PD 3/.3
Ax T2 FS 3/.3

May add ABER position if doing arthrogram. All T1 is FAT SAT for arthrograms. Only need T2 cor FS if arthrogram. Dr. Johnson does a dual oblique (perpendicular to the RC insertion) obl/sagittal in addition.

KNEE

Cor T1 3/.3
Cor T2 FS 3/.3
Sag T1 3/.3
Sag PD 3/.3
Sag T2 FS 3/.3
Ax T2 FS 3/.3

ELBOW

Axial T1 2.5/.2
Axial T2 FS 2.5/.2
Sagittal T1 2.5/.2
Sagittal T2 FS 2.5/.2
Coronal T1 2.5/.2
Coronal T2 FS 2.5/.2

WRIST

Use same protocol as elbow, use 2 mm instead of 2.5 mm

ABDOMEN

Imaging of the abdomen can be performed many different ways. If imaging liver include a dynamic study with contrast to include arterial, portal venous, and equilibrium phases similar to 3 phase CT. If evaluating for hemangioma, do very long TE, T2 weighted imaging to evaluate intensity of lesion at varying TEs. Always performed In/Out of phase imaging in the abdomen. The most important plane is the axial plane for CT comparison.

PELVIS

Axial T1 5/1
Axial T2 FS 5/1
Coronal T1 5/1
Coronal T2 FS 5/1
Do sagittal T1/T2 FS if imaging female pelvis.

**HIPS**

Use pelvis protocol. Use 4/1 slice thickness. Do sagittal T1/T2 FS through affected hip if evaluating labral tear.

**LONG BONES**

As a general rule on all long bone studies, use T1 and T2 FS in at least the two planes that demonstrate the anatomy or pathology the best.

Axial imaging is necessary on all long bones. This can be difficult due to time constraints and slice available. The images do not need to cover the entire extremity being imaged. They do need to extend well above and below the abnormal area or region of interest. Additional planes should include entire extremity if FOV allows.

**FAT SAT IMAGING**

Off center imaging will often not lend itself well to FAT SAT FSE. STIR imaging may be substituted for FSE T2 weighted imaging when necessary.

Certain patients that are claustrophobic or uncooperative due to confusion, etc. will need to be subjected to limited MR studies. Try to get a minimal of Axial t2, FLAIR and a diffusion if imaging the brain. Pre and post FAT SAT imaging must be performed.