

January 28, 2021

## **UW CT Protocol Compliance with Joint Commission Diagnostic Imaging Requirements**

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**Attention:** Users of University of Wisconsin-Madison CT Protocols

This letter outlines how the University of Wisconsin-Madison CT protocols, delivered to you via GE Healthcare, are compliant with the “New Compliance Checklist for Diagnostic Imaging” published by The Joint Commission and effective July 20, 2016. The specific elements of performance fulfilled by using unaltered UW CT protocols are as follows:

**PC.01.03.01, A 25** The [critical access] hospital establishes or adopts diagnostic computed tomography (CT) imaging protocols based on current standards of practice, which address key criteria including clinical indication, contrast administration, age (to indicate whether the patient is pediatric or an adult), patient size and body habitus, and the expected radiation dose index range.

*UW CT Protocols are age and/or size-specific, and come with a design philosophy and indication instructions outlining how to select the most appropriate protocol. Every UW protocol has information specifying:*

- a. *Indication,*
- b. *Contrast Administration (i.e., we provide details on Oral and IV contrast in the form of volume, strength, flow rates, and timing of administration)*
- c. *Age (i.e., UW’s neuro head protocols are age-based as described in the manual and in our protocol naming structure)<sup>2</sup>*
- d. *Patient Size (i.e., UW protocols are size-based as described in the supplemental sizing information provided and in the protocol naming structure)*
- e. *Expected dose index range via the UW Dose Check manual which lists:*
  - i. *The Notification values (NV) for all UW CT Protocols*
  - ii. *The 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> percentile dose values for CTDIvol, SSDE, and DLP for all UW CT Protocols*

**PC.01.03.01 EP 26** Diagnostic computed tomography (CT) imaging protocols are reviewed and kept current with input from an interpreting radiologist, medical physicist, and lead imaging technologist to make certain that they adhere to current standards of practice and account for changes in CT imaging equipment. These reviews are conducted at time frames identified by the [critical access] hospital.

*The University of Wisconsin-Madison continually reviews our CT protocols. For your reference, the appendix of this letter contains each version’s itemized list of major UW CT protocol changes made to-date. You will also find these changes/ updates from the prior version in the front pages of your UW CT protocol manual.*

*We host at least bi-annual medical advisory board meetings for radiologists, CT technologists, and CT physicists. Details on these activities can be found on our website:*

*<https://www.radiology.wisc.edu/uw-ge-ct-protocol-project/advisory-board/>.*

*Please refer Joint Commission auditors to this link to verify compliance.*

*By having your local team: (1) review our protocols, (2) review our protocol changes version to version located in the appendix of this letter, and (3) sign this letter you should fulfill this joint commission requirement*

**PC.01.02.15 EP 5** Radiation dose index is documented for on every CT exam. The dose index is exam specific, summarized by series or anatomic area and retrievable

*Our protocol documentation instructs the technologist to send the scanner generated Series 999 "Dose Report" to PACS. This allows the dose information to be retrievable in a digital format.*

Use of the University of Wisconsin-Madison CT protocols also facilitates your institution's fulfillment of the following elements of performance:

**EC.02.04.03 EP 15 & EC.02.04.01 EP 10** Equipment quality control and maintenance activities are done and QC logs are complete. Equipment quality control and maintenance activities are identified. Timeframes are established for how often they are to be done.

*We provide daily/weekly/monthly QA/QC instructions on our website. These are free on-line resources available at <https://uwgect.wiscweb.wisc.edu/resources/daily-weekly-monthly-scanner-qa-resources/>*

**PC.01.02.15, A12** For [critical access] hospitals that provide diagnostic computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), or nuclear medicine (NM) services: The [critical access] hospital considers the patient's age and recent imaging exams when deciding on the most appropriate type of imaging exam.

*UW CT Protocols are age and/or size-specific, and come with a design philosophy and indication instructions outlining how to select the most appropriate protocol.*

**PC.02.01.01, A6** The [critical access] hospital reviews and analyzes incidents where the radiation dose index (CTDIvol, DLP, or size-specific dose estimate [SSDE]) from diagnostic CT examinations exceeded expected dose index ranges identified in imaging protocols. These incidents are then compared to external benchmarks.

*UW publishes a Dose Check manual, which lists:*

- a. Patient dose benchmark data from exams using UW CT protocols in the form of 25<sup>th</sup>, 50<sup>th</sup>, and 75<sup>th</sup> percentile dose values for CTDIvol, SSDE, and DLP.*
- b. Dose data from the American College of Radiology Dose Index Registry.*
- c. A large multicenter study published in a peer-reviewed journal.*

*All three of these sources can serve as an external benchmark for your internal dose events. Download the UW Dose Check Manual on our website:*

*<https://www.radiology.wisc.edu/uw-ge-ct-protocol-project/resources/>*

Please print this letter and have each member of your TJC compliance team sign and date this document.

X

\_\_\_\_\_  
Physician/Radiologist

X

\_\_\_\_\_  
Physicist

X

\_\_\_\_\_  
Technologist

For additional information related to compliance, please visit us online or contact us directly. <https://www.radiology.wisc.edu/uw-ge-ct-protocol-project/publications-and-presentations/>

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We hereby certify that our Diagnostic Computed Tomography (CT) imaging protocols are annually reviewed and kept current with input from an interpreting radiologist, medical physicists, and lead imaging technologists to make certain that they adhere to current standards of practice and account for changes in CT imaging equipment. Our annual updates are located in the appendix of this document.

X  MD

Physician/Radiologist

X  Ph.D. DABR

Physicist

X 

Ph.D., DABR, FAAPM

Physicist

X  RT(R)(CT)

Technologist

X  RT(R)(CT)

Technologist

# Appendix A.

## Changes from Revision 1 to Revision 2

### New Protocols Added

The following protocols are new to the Revision 2 protocol release: Abd/Pelvis - Pre-IVC Filter Removal , Abd/Pelvis - Colonography , Abd-Pancreas - Neoplasm Screening , Body Pelvis , Chest - Low Dose Follow-up , Chest - Low Dose Screening , Chest - Dynamic 3D Airway , Retrospectively-Gated CTA Chest, Gated Chest and Non-Gated Abd/Pelvis CTA, Prospectively-Gated Coronary CTA, Retrospectively-Gated Coronary CTA, TAVI CTA, Upper Extremity CTA, Post-Endostent Non-Con Volume Change (Abd/Pelvis only), Femoral Anteversion, Stealth - Stereotactic Head (Whole Brain Treatment Planning), Temporal Bone (with Contrast Only or with & without Contrast), Vascular Imaging: CT Venography , Pediatric Neck - Routine, and Chest Pectus.

### Global Changes Made to the UW Protocols

Through further study of the mA ranges resulting from actual scans of different size patients, we found that the rotation times for some patient sizes and some protocols could be reduced to produce less motion blur and artifact and faster exam times, and thus improve image quality. This was accompanied by an appropriate adjustment of the mA values. Slight changes in Noise Index and mA values occurred due to improved calculation and rounding methods. These changes will not affect image quality or dose in any significant way.

### DoseCheck Feature Now Pre-Programmed

The UW protocols now include DoseCheck notification values for each series. These values are set on a size and indication basis. In other words, you will see higher notification values for large adults than for small adults, and larger notification values for exams needing high image quality vs. a low dose exam. We publish a separate manual covering our use of DoseCheck, which can be found here <https://www.radiology.wisc.edu/protocols/CT/resources.php>

### Abdominal Protocols

The small, medium, and large adult protocols for Trauma - Chest and the chest portion of the Trauma - Chest/Abd/Pelvis were changed to 100, 120 and 140 kV respectively to provide better imaging of the different body sizes. Previously, 120 kV had been used for all sizes. For all trauma imaging, the noise index has been lowered slightly for the small and large adult protocols to provide better imaging of the spine.

### Chest Protocols

For small adult protocols, the kV was changed from 120 to 100 to improve image quality, and the Noise Index and mA were adjusted appropriately for this kV change. Also the soft tissue recon type was changed from Detail to Standard to improve image noise. The thick slice recon for all chest protocols was removed. The WW and WL for the soft tissue recons was changed to standard values that are being applied to most scans for all protocols: 140 kV - 350/40, 120 kV - 400/50, and 100 kV - 460/60. For the Chest - CTA for PE protocol the kV was changed from 140, 120, and 120 to 120, 100, and 100 for large, medium, and small adult patients to enhance the iodine contrast.

### CV Protocols

Protocols for small adult patients were added to these protocols with the kV lowered by 20 kV from that used in medium adult patients, when allowed by the system power limits. For the Upper and Lower Extremity CTA protocols, the slice thickness was changed from 2.5 mm to 1.25 mm, and the Noise Index was decreased to account for the slice thickness change. In the Lower Extremity CTA protocol, the dose in the legs was increased by a factor of 1.5 to improve image quality, and the kV was increased by 20 kV to allow better penetration and image quality above the legs.

### Neuro Protocols

In the Temporal Bone protocols, the Noise Index decreased in order to increase the dose by a factor of 2, which is needed for better visualization of fine structures. For the Adult Neck protocol, separate small, medium, and large adult protocols were created to replace the single adult protocol to accommodate the variation of sizes involved in scanning through the shoulders. For the Pediatric Neck, we increased the number of size gradations from 2 to 5 to better accommodate the variation in sizes. In addition the Noise Index was reduced for all sizes to improve image quality above the shoulders. Separate small, medium, and large adult protocols were created for the Cervical Spine to replace the single adult protocol. This was done to accommodate the variation of sizes involved in scanning through the shoulders.

## **Pediatric Protocols**

Some of the protocols which used a pitch of 0.531 for the three smallest pediatric sizes were changed to a pitch of 1.375 to reduce scan time and motion blur and artifact. This was done without affecting the image noise or patient dose by adjusting the mA ranges and rotation times.

## **MSK Protocols**

To make it more obvious what MSK extremity protocol should be selected for long bone imaging, we have included the name/s of the long bone/s below each joint in our MSK extremity protocol titles.



# Appendix B.

## Changes from Revision 2 to Revision 3

As part of our ongoing UW Madison CT protocol optimization, we have made the following changes between the Revision 2 and Revision 3 release. All of these changes have been internally reviewed and validated by our team of Radiologists, Physicists, and CT Technologists, thereby fulfilling The Joint Commission mandate on protocol review. Detailed documentation of our compliance with The Joint Commission Standards regarding the performance element for CT protocol review is posted on our website (<https://www.radiology.wisc.edu/protocols/CT/resources.php>).

### New Protocols Added

The following protocols are new to the Revision 3 protocol release: Neck (Parathyroid Adenoma) Adult; High Image Quality Cancer Follow-Up Abd/Pelvis; Urothelial tumor follow-up; Soft Tissue Extremity with IV Contrast; Chest Wall/Clavicle/AC Joint/SC Joint/Sternum/Ribs; Peds Chest Dynamic 3D Airway; Prospectively-Gated Left Atrial Appendage.

### Global Changes Made to the UW Protocols

We turned on auto voice when using smart prep. Upon interacting with users of our protocols, we realized most users expected this feature to be turned on by default.

Window width and window level have been standardized across all protocols. There is now a systematic approach to setting window width and window level, which is included in the Protocols Manual.

Scout start and end locations have been standardized for all protocols and are documented in a new section of the Protocols Manual. This includes a standardization of landmarks ex: om, sn, xy, ic. The anatomical landmarks on all non-scout series/groups have been standardized as well.

Tables for reformats have been created in all sections; previous versions lacked reformat tables for some protocols.

The naming of all series descriptions has been standardized to soft tissue, thin soft tissue, bone, thin bone, axial soft tissue, etc.

To optimize image quality, all reformats have been changed to set intervals at one half of the reformatted slice thickness.

The Smart prep phase was mistakenly called a series; this is now corrected in the protocol documentation.

References made in the reformat instructions were changed from the recon number to the series description of the source reconstruction.

All oral contrast and IV instructions were updated to be uniform with respect to their units.

Creatinine Guidelines and Pediatric Contrast Guidelines were also added to the protocol resources section

# Abdominal Protocols

To assist CT technologists in choosing the correct size protocol (small/medium/large), all medium DFOV were changed from 36 to 40 cm. This means patients too big to be scanned as small or medium will reveal tissue extending outside of the “blue target region” on the scout images, prompting the technologist to select a larger-sized protocol.

The threshold for switching from small to medium was moved from a scout AP + Lateral measurement of 55 to 60cm to improve the image quality of patients on the smaller side of what could be considered a medium patient.

All large protocols with a 50 DFOV were changed from soft to a standard algorithm to increase the resolution and decrease the “blurry” appearance of the large protocol’s soft tissue reconstructions.

Realizing that some organizations may not have the P3T power injector option on their Bayer injector, a weight-based contrast chart was created for non-P3T sites. This is located in the Protocol Resources Section of the Protocols Manual.

To save patient dose during the smartprep phase, the monitoring delay was increased from 30 to 40 seconds since contrast usually never peaks before 40 seconds.

A dedicated “Oncology Cancer Follow-up” protocol was created to better visualize subtle lesions on cancer follow-up patients.

DMPR was added to the without series on the Adrenal Gland Adenoma protocol, and on all three phases of the liver donor work-up.

Realizing the text-based instructions provided in previous versions of the protocols were confusing for some, an easier to use formula and pictures were created to calculate the timing for the Liver - Triphasic and liver donor protocols.

The contrast amount was updated for Chest/Abd/Pel/Neck (100 cc contrast/50 cc chaser) and Chest/Neck (75 cc contrast /75 cc chaser).

The “exam split” feature is now utilized on the Chest/Abd/Pelvis protocols (both the with and without contrast), which allows multiple sections to read different body regions (i.e., the Chest section reads the chest portion of the exam and the Abdominal section reads the Abd/Pelvis portion of the exam). The DMPRs on the chest portion of the Chest/Abd/Pelvis protocol were also updated.

Trauma - Chest exams are now started at the bottom of the spleen to improve visualization of any arterial injuries in that organ.

The Trauma - Cystogram protocol, which was scanned at a trauma-level dose, was removed. This protocol was found to be unnecessary since no spine reconstructions were performed with that protocol. For trauma cases, the Cystogram (Non Trauma) protocol is now recommended, which includes a without contrast, a with contrast, and a delay phase. For trauma patients, the without phase is skipped.

In the Trauma - Chest/Abd/Pelvis protocol, recon #10 was changed to a thoracic/lumbar spine instead of the bony pelvis.

The Abd/Pelvis - Urography protocol has been changed to a 115 second delay. The scan and injection should be started at the same time and the delay is built in to the protocol. In this protocol, the need to do manual oblique sagittal reformats was removed, as well as the advice to have a radiologist check mid scan for any age; instead, all patients get the entire exam.

The Abd/Pelvis - R/O Hernia protocol has been removed from the scanner. Instead use the routine Abd/Pelvis protocol and follow the clinical instructions in this manual regarding the request to the patient to bear down (Valsalva maneuver).

The Pancreas protocols (pre-op and screening) were combined into a single protocol now called "Pancreas Cancer".

## **Chest Protocols**

DMPR coronal and sagittal reformats were added on the Chest protocols (including the Trauma - Chest from the Abdominal protocols).

The oblique sagittal MIP reformat (i.e., "the candy cane view") was removed in the Trauma - Chest.

The large patient contrast volume in the CTA for PE protocol was updated to use Isovue 370 instead of a 300 mgI/cc strength agent.

An axial image of the heart was added to the PE protocol to show the smartprep location (i.e., we point out the location of the left ventricle).

## **Cardiovascular (CV) Protocols**

For sites without the Bayer Medrad P3T PA option, a weight-based chart for Isovue 370 is available in the Protocol Resources section of the Manual.

All CV reformats were changed to mimic the routine chest reformats.

If your scanner has the option, it is recommended that you turn on MARS to the run off protocol (i.e., lower extremity CTA) to mitigate metal artifacts from orthopedic implants. This is a selectable box on the reconstruction options tab on your scanner.

A lung recon was added to coronaries (this uses a boneplus reconstruction kernel).

If your scanner has the option, it is recommended that you turn on MARS for CTA Chest/Abd/Pel to reduce artifact from stents and other high-contrast implanted devices.

Retro/Prospective Coronary CTA breathing instructions were updated for all phases to now be consistent with each other; before the instructions varied between the timing bolus and the CTA.

It is recommended to send ECG trace information on gated studies to PACS. This will facilitate troubleshooting when the study does not come out as intended. Instructions for doing this are included in the Protocols Manual.

The Upper and Lower Extremity CTA protocols have been changed from using a timing bolus to using a smart prep.

Thoracic Outlet instructions are provided in the Protocol Resources section of the Manual. This indication is commonly scanned using MRI when available. A CT version is included here for sites who do not have access to MRI.

## **Musculoskeletal (MSK) Protocols**

New reformats for FAI (i.e. femoralacetabular impingement) were created as part of the routine bony pelvis protocol. FYI, “Femoral Anteversion” is a separate protocol.

For patients unable to raise their arms, instructions have been added throughout the MSK protocols for how to scan an extremity protocol with arms down at their sides.

If your scanner has the option, it is recommended that you turn on MARS for the metal extremity protocols.

## **Neuroradiology (Neuro) Protocols**

To make it easier to understand the reformat needs of the Neuro protocols, tables for CTA head and neck reformats have been added throughout the Neuro Protocols.

The injection rate was changed to 4 cc/sec for the CTA head/neck protocols.

The Brain (Axial Mode) protocol was changed from 20 mm to 10 mm beam collimation. This was done to lessen the slab-to-slab artifact that sometimes occurs when doing angled axials scanning.

Pediatric axial heads were changed to be scanned at 5mm slice thickness.

Sagittal reformats were added for all routine head without scans throughout the Neuro Protocols.

The ASiR percentage on the Neuro protocols was changed to 60% on 5mm and 80% on 1.25mm soft tissue reconstructions. This change affects the majority of the Neuro non-spine and non-angio protocols.

If your scanner has the option, it is recommended that you turn on smart MARS for any Spine with metal, CTA Head, CTA head/neck, routine neck, and maxiface protocols. This will help with artifacts from coils/clips/stents etc.

The Adult Routine Neck protocol was changed to scan top down, and the injection timing and contrast amount were changed from 110 mls to 100 mls.

The Cervical, Thoracic, and Lumbar Spine protocols were changed from standard to soft recon for the soft tissue reconstructions.

The University of Wisconsin Madison uses RAPID (iSchemaView Inc, Redwood City, CA) software for perfusion map processing and we reference this in our protocol’s networking section.

The CTA stroke deluxe CTA upper thorax/neck/head CTA phase was changed from 20 to 40mm beam collimation to speed up the scan and avoid venous contamination.

We added instructions to the neck protocol to use the small version (lower dose) on any sized patient that is being scanned as a follow up for lymphoma.

The slice thickness on the pediatric temporal bone protocol was changed to be the same as the adult.

The pediatric stereotactic head was changes from a 1 second to a 0.5 second rotation.

## **Pediatric Protocols**

MSK guidance for pediatric scanning (i.e., how to change the protocol to lower the dose) was created based on the adult MSK protocols and is included in the Protocol Resources section of the Manual. In addition, guidance for scanning pediatric bony pelvis and bony pelvis with spica cast was also created and can also be found in that section.

The indications in the Pediatric Chest With and Without IV Contrast protocols were updated, and the two protocols were combined to match the Adult Chest protocol.

The expiration phase hi-res chest without was updated to match the adult routine chest protocol.

Guidance and criteria for pediatric contrast administration was added to the Manual in the Protocol Resources Section, including IV access, needle, gauge, flow rate, etc.

The Pediatric Trauma Head and the Pediatric Routine Head were combined. Detailed instructions for the special reformats needed for trauma cases (3D NAT) have been provided in the Brain - Routine and Pediatric NAT/Trauma (Helical Mode) Protocol.



# Appendix C.

## Changes from Revision 3 to Revision 4

As part of our ongoing UW Madison CT protocol optimization, we have made the following changes between the Revision 3 and Revision 4 release. All of these changes have been internally reviewed and validated by our team of Radiologists, Physicists, and CT Technologists, thereby fulfilling The Joint Commission mandate on protocol review. Detailed documentation of our compliance with The Joint Commission Standards regarding the performance element for CT protocol review is posted on our website (<https://www.radiology.wisc.edu/protocols/CT/resources.php>).

### New Scanners Added

Protocols for the Revolution 256 CT platform and the LightSpeed 16 are now available.

### New Protocols Added

A Gemstone spectral imaging CT Head Without Contrast was created for scanners that have the feature intended for Brain Post Thrombolysis.

The Revolution 256 CT and LightSpeed 16 scanners have the same protocols as the existing scanners offered in the UW protocol set, with an additional GSA protocol for PE for the Revolution CT scanner.

### Global Changes Made to the UW Protocols

Series descriptions are now standardized for all protocols. They are vendor neutral and will assist with hanging protocols. A manual for this can be found on our website, <https://www.radiology.wisc.edu/uw-ge-ct-protocol-project/resources/>

Protocol guidance documents have been developed for all sections that enables the technologist and the radiologist to choose the proper protocol based on indication and the patients' disease. A manual for this can be found on our website, <https://www.radiology.wisc.edu/uw-ge-ct-protocol-project/resources/>

Guidance is now provided for Metal Artifact Reduction. Higher dose with metal protocols are no longer recommended to be used for spines and extremities. Users should turn on MAR if they have it. If the user does not have MAR, we don't advise turning up the kV and dose as it only minimally helps mitigate the metal artifacts. Direct patients to scanners that have MAR capabilities whenever possible.

### Abdominal Protocols

Added a 'Without' series for the Urothelial Tumor protocol.

Added a dynamic transition option for the following protocols: Liver Donor, Triphasic, CTA Pancreas Transplant, Biphasic, Mesenteric Ischemia, Hepatocellular Carcinoma, Liver Transplant Recipient, Trauma Chest, and Trauma Chest/Abdomen/Pelvis. Previous to this change, the technologist was required to

Lowered the dose in the Pancreas Transplant Without Contrast series.

Removed the Without Contrast series in the Pancreas Cancer Protocol and included the entire abdomen on the With Contrast series.

Turned on exam split Chest/Abdomen/Pelvis Without and the Chest/Abdomen/Pelvis with Contrast protocols.

## **Chest Protocols**

Added additional instructions for breathing on the PE protocol. These extra instructions are meant to avoid transient interruptions of contrast events from motivating a repeat scan.

## **Cardiovascular (CV) Protocols**

Added lung recons and reformats to the CTA Chest protocols. This change should enable better harmonization of protocols covering the same body region.

Increased the ASIR to 60% for the CTA Coronary exam.

Changed the CTA Upper Extremity contrast chaser from 100 mLs to 50 mLs of saline.

Moved the CTA Lower Extremity protocol from the Chest section on the scanner to the Knee section and turned on the series split.

## **Musculoskeletal (MSK) Protocols**

We are still providing our “with metal” MSK protocols that have higher kV and doses, but recommend using our regular MSK protocols with MAR turned on.

## **Neuroradiology (Neuro) Protocols**

The Pediatric CTA Head/Neck/Perfusion protocol is now using Isovue 370 for the entire scan.

Added guidance to retro recon the cervical spine from a CTA Neck to save patient dose.

All pediatric spines were changed to a soft reconstruction.

On scanners other than the Revolution CT, the ASIR level was increased from 30% to 60% on the standard recon for the following protocols: Orbit, Pituitary Gland, Temporal Bone, Routine Soft Tissue Neck, Brachial Plexus, CTA Head, CTA Neck, Stroke Deluxe, Venography, Parathyroid Adenoma and Salivary Gland.

Included a 30% ASIR to all soft recon for the Cervical, Thoracic and Lumbar Spines.

Moved the “size selection for Neck and C-spine” into the actual protocol for easier reference.

Updated the subclavian injection protocol for the dual head injector to inject 140 mLs of Isovue 370 at a rate of 4 ml/sec and then 10 mLs of contrast pre-mixed with 90 mLs of saline at a rate of 3 mLs/second.

Updated the Parathyroid Adenoma Dose Check Alert.

## **Pediatric Protocols**

In the Pediatric Chest/Abdomen/Pelvis, the smart prep location was changed to the pulmonary artery and a 20 second diagnostic delay was added, contrast peak at 30 Hounsfield units to create a later phase for the chest.

# Appendix D.

## Changes from Revision 4 to Revision 5

As part of our ongoing UW Madison CT protocol optimization, we have made the following changes between the Revision 4 and Revision 5 release. All of these changes have been internally reviewed and validated by our team of Radiologists, Physicists, and CT Technologists, thereby fulfilling The Joint Commission mandate on protocol review. Detailed documentation of our compliance with The Joint Commission Standards regarding the performance element for CT protocol review is posted on our website (<https://uwgect.wiscweb.wisc.edu/>).

### New Scanners Added

No new scanners were released with the Revision 5 protocol updates. UW protocols currently support the following scanners: Revolution EVO 32ch with ASiR; Revolution EVO 64ch with ASiR; Revolution EVO 64ch with ASiR-V; Revolution Frontier / Revolution Frontier ES / Revolution Discovery CT / Revolution HD / Discovery CT / Discovery CT750 HD; LightSpeed VCT; Optima CT580W; Revolution CT; and Discovery IQ PET/CT.

### New Protocols Added

For the Revolution CT platform only, a Pediatric CINE Airway protocol was added. This CINE protocol has a scan duration long enough to capture both inspiration and expiration (i.e., free breathing), and it is used to answer important clinical questions without the need for respiratory gating and pediatric sedation. It also assesses the central airways, particularly for tracheobronchomalacia or excessive dynamic airway collapse.

In addition, for the Revolution CT platform only, a Congenital Heart Disease (CHD) protocol was added for pediatrics. The chest is prospectively gated and includes a contrast injection protocol that opacifies both sides of the heart. This exam is intended for pre-op planning for devices to reduce pulmonary vascular resistance.

### Global Changes Made to the UW Protocols

The series descriptions for all protocols were standardized in Revision 4. If you still have not implemented this change, please see our website, (<https://uwgect.wiscweb.wisc.edu/resources/>) and click on the link titled "UW Vendor Neutral Series Naming/Description Manual".

TrueFidelity (DLIR) was added to the vast majority of protocols on the Revolution CT platform. Revolution CT does not allow you to prescribe Recon 1 with the DLIR option. It can only be used with a standard algorithm. For protocols using DLIR, we have ASiR-V on Recon 1 and DLIR on for subsequent recons. We advise setting DLIR to MEDIUM for all protocols, except thin neuro (2.0 mm and less) soft tissue recons should be set to HIGH.

On scanners that have the MARS option, an additional Standard recon with MARS turned on has been created. The protocols with these extra recons include: Stroke Deluxe; CTA Head Only; CTA Neck Only; Neck-Routine; Neck (Parathyroid Adenoma) Adult; Neck (Salivary Gland); Cervical, Thoracic and Lumbar Spines; Lower Extremity CTA; and all MSK protocols.

### Abdominal Protocols

All slice thicknesses for routine soft tissue "thick" slices were changed from 5 x 3 mm to 3.75 x 2.5 mm. With this change, the reformats for "SA Body" and "CO Body" were also updated to 3 x 2 mm. Please remember to update your manual and DMPR reformats.

Please see the section of this manual titled "Trauma Chest and CAP T-Spine Workflow". A major change was made in this procedure— we no longer retro recon the Thoracic Spine from the Trauma Chest. The dose on the Trauma Chest was also changed.

There is a special workaround to implement a series split which applies to the Revolution CT protocol set only. For multiphase scans that use a single series and multiple groups (e.g., biphasic liver, triphasic liver, liver donor, pancreas cancer, pancreas transplant, TIPS, HCC liver, and liver transplant work-up), a "dummy" recon 1 was created, which is present on the scanner but not meant to be sent to PACS. This allows you to send each phase/group of a single series to PACS separately.

When using the Mesenteric Ischemia protocols on the Revolution Frontier ES / Revolution Discovery CT / Revolution HD / Discovery CT / Discovery CT750 HD scanners, please confirm that your series Noise Index match the Noise Index given in this manual. These have been updated in the Revision 5 release.

The Adrenal Gland protocols were updated to use 120 kV for all phases and for all body sizes to facilitate CT number reliability. This indication relies on quantitative evaluation of the CT number.

Instructions were added to the R/O Hernia protocol for performing a limited hernia protocol. This is used for inguinal hernias. An image of the new scan range is included, which is meant to lower doses by using a smaller scan range.

## **Chest Protocols**

All slice thicknesses for routine soft tissue "thick" slices were changed from 5 x 3 mm to 3.75 x 2.5 mm. The lung reformats (CO and SA) have also been updated to 2.5 x 1.25 mm for the DMPR and manual reformats.

## **Cardiovascular (CV) Protocols**

For all CV protocols covering the chest, the lung reformats (CO and SA) were updated to 2.5 x 1.25 mm for the DMPR and manual reformats.

For the Revolution CT platform only, dynamic transition is turned on for the Non-Gated CTA Chest/Abdomen/Pelvis protocols. This will be consistent with the other Revolution CT non-gated CTA protocols.

In addition, for the Revolution CT platform only, the contrast volumes for the Prospectively-Gated Coronary CTA protocols were updated as follows: Patient weight <250 lbs. 60 mL Iodixanol (Visipaque 320) 320 MG/ML injection @ 5 mL/sec; Patient weight 251-299 lbs. 80 mL Iodixanol (Visipaque 320) 320 MG/ML injection @ 5 mL/sec; and Patient weight >300 lbs. 100 mL Iodixanol (Visipaque 320) 320 MG/ML injection @ 5 mL/sec.

In the Non-Gated CTA (Chest/Abd/Pelvis) protocols, the smartprep enhancement threshold was changed from 80 HU to 100 HU.

The smart prep location was changed from the femoral arteries to the aorta just above the common iliac bifurcation in the Lower Extremity CTA protocols. New pictures have been included in the protocol.

The Prospectively-Gated Coronary CTA protocols are compatible with HeartFlow.

## **Musculoskeletal (MSK) Protocols**

Instructions were added in the Wrist protocols for positioning, scanning and developing reformats for the limited "DRUJ instability wrist".

## **Neuroradiology (Neuro) Protocols**

For all scanners with MARS, in the Cervical, Thoracic, and Lumbar spine protocols, the UW "with metal" protocols were moved to the miscellaneous section of the scanner. We advise using our "regular" without metal protocols with MARS for spines presenting with metal. Please turn on an additional soft tissue recon with MARS. We advise sending both the with and without MARS recons to PACS for interpretation.

For the Parathyroid Neck and C-Spine protocols, the smartprep mA was changed from 80 HU to 40 HU.

In the Adult Routine Neck protocols, the contrast dose was increased for patients over 220 lbs. Please see protocol for more details.

The contrast was changed in the Orbit and Temporal Bone protocols to 120 ml of Iohexol delivered at 3 ml/sec with a 30 ml of saline flush at 3 ml/s. The timing delay is now constant for all patients; i.e., no more smart prep. The delay is 60 seconds after start of injection for adults and 45 seconds for peds. Peds dosing is 1.5 ml/kg of Iohexol at 2 ml/s with a 10 ml saline flush at 2 ml/s. Please remove the smart prep, and change the scout and scan locations.

In the Stroke Deluxe, CTA Head, and CTA Neck protocols, a new thin (0.625 mm x 0.625 mm) soft tissue reconstruction was added to optimize the performance for the RAPID CTA module, as well as for physician interpretation of small vasculature. Please auto send this recon to RAPID.

Also in the CTA Neck protocols, the reformats were changed from 2 x 1 mm MIPS to 10 x 2.5 mm MIPS, and a 3.5 x 1.5 mm sagittal soft tissue reformat was added.

## **Pediatric Protocols**

In the Triphasic Liver protocols, the smartprep enhancement threshold was changed from 50 HU to 80 HU.

The instructions in the Chest Pectus protocols were changed from "inspiration" to "suspension" (stop breathing).



# Appendix E.

## Changes from Revision 5 to Revision 6

As part of our ongoing UW Madison CT protocol optimization, we have made the following changes between our Revision 5 and Revision 6 release. These changes have been internally reviewed and validated by our team of Radiologists, Physicists, and CT Technologists, thereby fulfilling The Joint Commission mandate on protocol review. Detailed documentation of our compliance with The Joint Commission Standards regarding the performance element for CT protocol review is posted on our website <https://uwgect.wiscweb.wisc.edu/>

### New Scanners Added

No new scanners were released with the Revision 6 protocol updates. UW protocols currently support the following scanners: Revolution EVO 32ch with ASiR; Revolution EVO 64ch with ASiR; Revolution EVO 64ch with ASiR-V; Revolution Frontier / Revolution Frontier ES / Revolution Discovery CT / Revolution HD / Discovery CT / Discovery CT750 HD; LightSpeed VCT; Optima CT580W; Revolution CT; Revolution CT (without DLIR Purchasable Option); Revolution CT ES; Revolution CT ES (without DLIR Purchasable Option); and Discovery IQ PET/CT.

### New Protocols Added

Multiple protocols were added to the package this year, including: CTA for PE with Abd/Pelvis; CTA Abd/Pelvis - Active Bleeder; Urothelial Tumor Follow-up; Subclavian CT Venogram; MAKO Hip; MAKO Knee; Brain Post Thrombolysis Helical (GSI); Neck (Papillary Hypervascular); 3D CT (Craniosynostosis, Congenital Facial Anomaly); Pituitary Gland and Cavernous Sinus; Neck (Salivary Gland); Pediatric Low-Dose Hydrocephalus; Pediatric Cervical Spine; Pediatric Thoracic Spine; and Pediatric Lumbar Spine.

### Protocols Removed

The CTA for PE GSI protocol was removed from the Revolution Frontier / Revolution Frontier ES / Revolution Discovery CT / Revolution HD / Discovery CT / Discovery CT750 HD, Revolution CT, and Revolution CT ES platforms. We have, however, placed the recommended GSI Profile for a CTA for PE Chest protocol on our website resource page titled "PE GSI Profile".

### Global Changes Made to the UW Protocols

Some protocols were re-numbered and the order of the sections and the protocols within each section were revised to be more consistent with where the protocols are located on the scanner.

TrueFidelity (DLIR) was adjusted on many of the protocols on the Revolution CT 256 platform. We advise setting DLIR to LOW for Body protocols; to MEDIUM for Chest, Pediatric Chest, Pediatric Body, and Adult Cardiovascular protocols, and Neuro recons 2.5mm or thicker; and to HIGH for Pediatric Cardiovascular protocols and Neuro recons thinner than 2.5 mm.

A DLIR Limitation Statement has been inserted under acquisition parameters to all scanners explaining instances where the parameters in the scanner may differ from the tables.

DLIR Limitations:

1. DLIR is not available on the Primary Recon.
2. DLIR is only compatible with the Standard Algorithm. So, in instances where the primary recon is Soft algorithm, (i.e. many Neuro Protocols) the subsequent recons will be in Standard Algorithm to enable DLIR. The slight difference between the Soft and Standard Algorithms is outweighed by the improvement in image quality with DLIR enabled.
3. DLIR requires an interval exactly half of the slice thickness.
4. DLIR doesn't allow an interval of 0.312 mm. So, if you are on a DLIR-enabled scanner, the thin 0.625 recon will be at 0.625x0.625 mm. On all other scanners, the thin recon will be at 0.625x0.312 mm.
5. DLIR is not available at 80 kVp.

A 16 and 32 Slice Scanner exception statement was inserted under acquisition parameters on all scanners explaining instances where the parameters in the scanner may differ from the tables.

## 16 & 32 Slice Scanner Exceptions:

1. The 0.625mm slice thickness x 0.312mm interval Recon should be 1.25mm slice thickness x 0.625 mm interval on 16 and 32 slice CT scanners. The 16 and 32 slice scanners are only able to recon down to 0.625mm slice thickness when using 10 mm and/or 20 mm beam collimation respectively. However, when using 20mm and/or 40mm beam collimation, they are only capable of reconstructing to 1.25mm slice thickness.
2. MARS feature is not an option.
3. IQ Enhance feature requires thin slices (1.25mm or less) with an interval of half (or less). On older scanner models, in order to enable IQ Enhance at 0.625 mm slice thickness, the interval must be set to 0.311 mm instead of 0.312 mm.

The CT Perfusion Appendix page has been optimized to provide guidance on what type of CT Perfusion is needed for your specific scanner, indication, and patient size. All Cine Perfusions have been removed from the protocols. You should never use "CINE" mode for perfusion scanning. CINE mode does not allow for gaps between acquisitions. This means the beam is always on, which is not needed for perfusion. Perfusion protocols have been provided that utilize Shuttle Mode when available, and Axial mode when Shuttle is not available or when less coverage is required. When using the Axial mode perfusion settings, please be sure the interval is "0". While parameters have been set in the CTA Stroke Total Cerebrovascular protocols and CTA Head only protocols, keep in mind there are multiple options depending on specific scanner, scanner options, and coverage you desire. Please consult the perfusion section of this manual for more details.

Guidance is included on how to combine a Routine CT Chest and/or CT Chest/Abd/Pelvis with a CT Neck. These instructions apply to both adults and pediatric patients. They include order of operations, contrast volumes, and shorter scan delays for the CT Neck due to lower contrast volume. These instructions are located in your Table of Contents in the Body and Pediatric sections. There are no protocol numbers listed as you use the respective acquisition parameters for a Chest, or Chest/Abd/Pel and Neck.

The Metal Artifact Reduction Software (MARS) Guidance page has been updated. Both "with metal" and "without metal" protocols are provided for MSK. The "with metal" protocols use a higher dose. We provide guidance for using metal artifact reduction on both versions. In the presence of metal, we find using MARS with the "without metal" protocols sufficient. However, if the image quality is still not to your liking, we suggest that you try the higher dose "with metal" protocol and enable MARS for the standard recon only.

Several other instructional pages have been updated as well. This includes DMPR Set-Up Instructions, Restore Manual (how to load our protocols onto the scanner), Scout Ranges and Anatomical Reference Guide, and Pediatric MSK Extremity Guidance.

The DMPR reformats for "SA BODY" and "CO BODY" have been updated to 350/50 ww/wl. The CV protocols previously used the "CO BODY" and "SA BODY" DMPRs. You will need to create new DMPRs for the CV protocols – "CO CV" and "SA CV" using 450/50 ww/wl. Please reference the DMPR Set-Up Instructions for guidance. The protocols affected are: Adult Non-Gated CTA (Chest/Abd/Pelvis), Adult Gated Chest and Non-Gated Abd/Pelvis CTA, Pediatric Gated Chest and Non-Gated Abd/Pelvis CTA, and Pediatric Non-Gated CTA (Chest/Abd/Pelvis).

In Revision 4, adult scout ranges were standardized. In this version, we have again standardized pediatric scout ranges. The scout ranges now increase with the pediatric size bin.

Smart Prep reference images are now included in the Scan Description section of all protocols that require a Smart Prep for contrast injection. These Smart Prep images demonstrate to the technologist a scout image and a cross sectional image referencing the anatomy to be visualized for the Smart Prep Location.

## Abdominal Protocols

All window width and window level (WW/WL) for routine adult body protocols were changed from 450/50 to 350/50. This change increases the apparent (i.e., displayed) contrast of the images. Our body radiologists found that with the WW/WL of 450/50, the images appeared to be "washed out". With this change, the reformats for "SA BODY" and "CO BODY" were also updated to 350/50. Please remember to update your manual and DMPR reformats.

We have enabled series split on all multi-phasic protocols on the Non-Revolution CT 256 (i.e., all non-wide axial) scanners (e.g., Biphasic Liver, Triphasic Liver, Pancreas Cancer, Hepatocellular Carcinoma Liver, and Trauma Chest/Abd/Pelvis), This allows one to send each phase/group of a single series to PACS separately. There is a special workaround to implement a series split which applies to the Revolution CT 256 protocol set. For multi-phasic scans that use a single series and multiple groups, a "dummy" recon 1 was created, which is present on the scanner but not meant to be sent to PACS.

We have included guidance on how to combine a Routine CT Chest and/or CT Chest/Abd/Pelvis with a CT Neck. These instructions apply to both adults and pediatric patients. They include order of operations, contrast volumes and shorter scan delays for the CT Neck due to lower contrast volume. These instructions are located in your Table of Contents in the Abdominal section. There are no protocol numbers listed as you use the respective acquisition parameters for a Chest, or Chest/Abd/Pel and Neck.

The previously titled Low-Dose Renal Stone (including limited follow-up) protocol has been renamed to Limited Follow-up Kidneys Only. Instead of the previous three options for flank pain scanning, we now only have two options. This hopefully eliminates any confusion with dose/coverage.

The Pre-IVC Filter Removal protocol has been re-named CT Venogram, and the prep delay was adjusted from 180 seconds down to 120 seconds.

Small Bowel Enterography exams have been changed from a set 150 mL contrast injection volume to our P3T weight-based contrast injection protocol. We are still using a neutral (negative) oral contrast, but the brand we reference in the protocols has changed from Volumen to Breeza.

A guideline has been created to help physicians decide between ordering the Urography protocol or the Urothelial Tumor Follow-Up protocol in patients with hematuria and no known history of Transitional Cell Carcinoma. In general patients less than age 45 with hematuria should use the Urography protocol and patients older than age 45 should use the Urothelial Tumor Follow-Up protocol. Regarding follow up of patients with known TCC, physicians can choose between these two protocols. Use the High Image Quality Cancer Follow-Up Abd/Pelvis protocol for patients with known metastatic disease or screening for metastatic disease (i.e., the patient history contains a reference to metastatic disease). Or use the Urothelial Tumor Follow-Up protocol for all others (i.e., the patient history contains reference to the need to assess for recurrence, evaluating urothelium, or the patient is at high risk for TCC).

The CTA Abd Mesenteric Ischemia protocol has been updated to slightly increase both the speed and dose for the Venous Phase to improve image quality.

The Cholangiocarcinoma protocol has been removed and incorporated into the clinical indication guide (available on our website). If your site finds the need for a Cholangiocarcinoma Protocol, we recommend scanning a High Image Quality Abd/Pel, followed by a delayed phase scanned at 12 minutes post contrast injection. Please use the routine abdomen/pelvis protocol (lower dose than a High Image Quality Abd/Pel) parameters as a "high" dose should not be necessary for the delayed phase.

## **Chest Protocols**

CTPA for PE now utilizes the Direct Multi Planar Reformats (DMPRs) for their coronal and sagittal lung reformats. These have been set to auto batch to save time.

## **Cardiovascular (CV) Protocols**

The Cardiovascular protocols have been updated to reflect a weight-based IV contrast model. You will see IV contrast injection tables with weight bins in each protocol to help determine how much contrast to inject for each specific patient size.

Both CTA Extremity protocols have been updated. The field of view on the Upper Extremity CTA increased to 30 cm to include aortic arch. The Lower Extremity CTA has two Smart Prep adjustments: enabling dynamic transition and increasing the diagnostic delay to 12 seconds to allow time for the contrast bolus to better opacify the lower extremities.

The Prospectively-Gated Left Atrial Appendage protocol has had some minor changes to allow for better image quality and timing of the delayed phase. The rotation time on the delayed phase was increased from 0.28 to 0.35 to provide a slight increase in dose. The prep delay between the arterial and delayed series was decreased from 1 minute down to 30 seconds to allow for better contrast opacification in the Left Atrial Appendage. The breathing instructions were turned "OFF" between the two scans and the technologist must manually breathe the patient. In other words, the instructions are "ON" for pre-arterial series and post-delay series, but the technologist must manually breathe post-arterial and pre-delay series. Images have been added to the protocol to illustrate what and where the Left Atrial Appendage is.

All Gated Chest protocols (both Prospective and Retrospective) have had the Padding Override and the Smart Arrhythmia features enabled. The Prospectively-Gated Coronary CTA (Large size protocol), for the Revolution CT 256 platform only, has been adjusted to account for the unique needs of bariatric patients. The Smart-Prep enhancement threshold was increased to 100 HU; the kV Assist was turned off and set at 140kVp; and DLIR was increased to HIGH.

During the validation of the Prospectively-Gated Coronary CTA protocol on the Revolution CT 256 platform, we noticed some phases realized minimal motion during lower dose phases. These lower dose phases, for some patients, reduced diagnostic confidence in the images. We are in the process of altering the default GE gating CCTA profile to increase the tube current for "off phase" reconstructions. This should allow for better image quality at any phase where there is data available. You will see this change in version 7 of the UW protocol release.

The Pediatric Gated Chest and Non-Gated Abd/Pelvis CTA, and Pediatric Non-Gated CTA (Chest/Abd/Pelvis) protocols have had DMPR enabled to auto batch the CO CV and SA CV. Also, for the Pediatric Non-Gated CTA (Chest/Abd/Pelvis) protocol, instructions on a CTA Abd/Pel were included for instances when the Chest is not ordered.

Lung recons for all Pediatric CV protocols are set to Smart phase (previously Center Phase).

## **Musculoskeletal (MSK) Protocols**

We have determined that MARS is best utilized with the Standard algorithm and have turned MARS off on Bone recons. "With Metal" and "Without Metal" protocols have been included for all scanners (even scanners with MARS capability) and guidance has been provided on when to use MARS. Guidance for scanning Pediatric Extremities has been updated and included in each MSK Extremity protocol. Located just above the clinical indication field, you will see "Pediatric Patients Under 13 years of age: See Appendix for Technique Instruction".

## **Neuroradiology (Neuro) Protocols**

The Neuro protocols have been updated to reflect our weight-based IV contrast model. You will see IV contrast injection tables with weight bins in each protocol to help determine how much contrast to inject for each specific patient size.

Many of Neuro protocols were renumbered, which places them in a new location on the scanner and in the Table of Contents.

For the Revolution CT 256 platform only, the Enhanced Contrast 2 (EC2) filter has been enabled for all Neuro protocol. The Ultra Recon has also been enabled on the Facial Trauma, Sinuses, and Temporal Bone protocols (22 FOV recons).

The Temporal Bone protocol now contains only one series. If the need arises to scan a Temporal Bone without AND with IV contrast, simply repeat series and scan at the recommended prep delay (Adults: 60 seconds; Peds: 45 seconds).

The window width and window level (WW/WL) for the Sinus exams were changed from 450/50 to 400/30.

The CT Venography Head & Neck protocol now has a set diagnostic delay of 7 seconds.

The Cervical, Thoracic, and Lumbar Spines (Adult and Pediatric) have been set to 16 FOV for uniformity. The technologist can adjust this as needed to include all anatomy. For scanners with MARS, the MARS feature has been turned off for all Bone recons on Neck and Spine protocols, and only remains on the Standard recons.

We have included guidance on how to combine a Routine CT Chest and/or CT Chest/Abd/Pelvis with a CT Neck. These instructions apply to both adults and pediatric patients. They include order of operations, contrast volumes and shorter scan delays for the CT Neck due to lower contrast volume. These instructions are located in your Table of Contents in the Body section. There are no protocol numbers listed as you use the respective acquisition parameters for a Chest, or Chest/Abd/Pel and Neck.

Pediatric Neuro protocols have been split into three (3) age groups--Infant: 0-2 years, Child: 3-6 years, and Adolescent: 7-17 years. The Scan FOV for the Blue/ Orange (38-43 cm) size was increased from Small body to Medium or Large body (depending on scanner capability).

Protocols for Pediatric Temporal Bone, Facial Trauma, Sinuses, and Orbit have all changed to a set prep delay rather than a Smart Prep.

## **Pediatric Protocols**

For the Revolution CT 256 platform only, Routine Pediatric Chest, Chest/Abd/Pelvis, and Abd/Pelvis protocols are being offered with kV Assist 2.0 (i.e., Auto Prescription). This feature allows for Pediatric patients of any size (Newborn to 18 years old) to be scanned under these protocols. Within the Auto Prescription feature are three (3) different "size profiles" that the scanner automatically selects based on patient measurements. Though these protocols are technically "One-Size Fits All", they have been placed in their respective location via protocol number and patient size/color grouping to avoid any confusion.

For the Revolution CT 256 platform only, the diagnostic delay on the Pediatric Chest/Abd/Pelvis protocol was increased from 20 seconds to 27 seconds because the scan duration on the Revolution CT 256 platform is so much faster relative to other scanners we provide this protocol for.

All our Pediatric protocols have been updated to scan faster. This is ideal in the pediatric patient population to decrease motion as most young patients are unable to hold still for long periods of time or follow breathing instructions.

