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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 "Revised Requirements for Diagnostic Imaging Services" published by The Joint Commission and effective July 1, 2015. 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)

Clinical Science Center
600 Highland Avenue
Madison, WI 53792-3252

Main Office: (608) 265-8231
Fax: (608) 263-0876
www.radiology.wisc.edu

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 25th, 50th, and 75th percentile dose values for CTDIvol, SSDE, and DLP for all UW CT Protocols*

PC.01.03.01, A26 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.

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/.

For your reference, itemized lists of major UW CT protocol changes made to-date are included with this letter.

Please refer Joint Commission auditors to this link, and show them the front of your UW CT protocol manual, which lists the changes made for each version. The University of Wisconsin-Madison continually reviews their CT protocols.

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

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.

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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 25th, 50th, and 75th 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/

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/

Radiologist: Myron Pozniak - mpozniak@uwhealth.org

Technologist: Carrie Bartels - CBartels2@uwhealth.org

Physicist: Timothy Szczykutowicz - tszczykutowicz@uwhealth.org

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.

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 of the manual.

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.