Olympic
HEALTH PHYSICS

COMPUTED TOMOGRAPHY SAFETY MANUAL

1st Edition

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CT Safety Manual

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APPENDICES

Documentation of the Qualified Medical Physicist, Lead Interpreting Physician, and Lead CT Technologist

Procedure Statement

To ensure there is adequate documentation of the Lead Interpreting CT Physician, Lead CT Technologist, and Qualified Medical Physicist.

Date: _____
Facility: _____
Scanner: _____

The Lead Interpreting Physician is: _____

The Lead CT Technologist is : _____

The Qualified Medical Physicist is : _____

Physician Oversight of CT Quality Control Program

Procedures Statement

To ensure there is adequate physician oversight of the CT Quality Control Program, compliance with recommendations of the medical physicist, and all other CT-related materials.

CT Program Oversight

The Lead Interpreting CT Physician will be responsible for implementing and reviewing the Quality Control program. This will consist of an annual review of the Quality Control data for each CT scanner required to perform Quality Control as well as a review of the CT physics reports and recommendations of the medical physicist. This review will be documented on an annual basis.

CT Quality Control Program

Tube Warm Up & Air Calibration

Prior to performing the Daily Quality Control, a tube warm up should be performed. Additionally, an Air Calibration should also be performed in accordance with manufacturer's instructions and recommendations.

Daily Quality Control

Quality Control will be performed on each day of clinical use. This consists of scanning a uniform section of the manufacturers QC phantom and drawing a 200 mm^2 box ROI over the center of the image. Each day should alternate between Axial and Helical scans. Water Number and Standard Deviation will be documented. Images will visually be evaluated for uniformity and artifacts.

Monthly Quality Control

Other items will be evaluated on a monthly basis. This includes the Monthly Visual Checklist and an evaluation of the Display Monitor using the SMPTE pattern.

Acceptable Criteria

The Water Number should be 0 ± 5 HU for both Axial and Helical scan modes. The acceptable criteria for the Standard Deviation will be set by the Medical Physicist for both scan modes. If the Standard Deviation falls out of acceptable criteria for 5 consecutive days, a call should be placed to Service.

All items for the Monthly Visual Checklist and SMPTE pattern should be acceptable each month.

CT Quality Control Protocol

The CT Quality Control Protocol may be designed by the Manufacturer or Medical Physicist.

CT Quality Control Documentation

CT Quality Control should be documented each day QC is performed. An example CT Quality Control sheet from the American College of Radiology can be located in Appendix A of this manual.

CT Quality Control Program Annual Review

Annual Review

I have reviewed the CT Quality Control Program and associated data for each CT scanner required to perform Quality Control.

_____ _____

Lead Interpreting CT Physician Date

CT Protocol Management Process

Policy Statement

To create a comprehensive policy that addresses all CT Protocol related items. This consists of initial and ongoing protocol review, changes to protocols, documentation of protocols, protection of protocols, and guidelines of variability.

Definition

"Protocol" means the collection of settings and parameters affecting CT dose and image quality that specify how data collection and reconstruction, patient positioning, and contrast administration are performed.

Protocol Storage

Protocols are stored in the CT Protocol Manual located next to the scanner. All CT Technologists have access to CT protocols.

Example Protocol Templates for GE and Siemens scanners are given in Appendix B of this manual.

Protocol Protection

All CT scanners have protocols protected by system passwords. Passwords will be maintained by the Lead CT Technologist and may be shared with Service Engineers, Supervisors, Managers, Physicians, and/or Medical Physicists.

Protocol Review

Initial Protocol Review

All protocols will be initially reviewed and approved by the medical physicist, lead interpreting CT physician, and lead CT technologist to ensure they are correct for the intended dose and image quality. This review includes all technical factors, CTDI comparison, scanning instructions, reconstructions of patient images, and appropriateness of the protocol. Protocols will be reviewed for both adult and pediatric patients considering patient age and/or size. Protocols may be set based on professional society standards, manufacturer recommendations, accreditation agency standards, and professional experience. Protocols will seek to balance image quality with appropriate radiation dose.

Ongoing Protocol Review

New or changed protocols will be reviewed on an annual basis and approved by the medical physicist, lead interpreting CT physician, and lead CT technologist to ensure they are correct for the intended dose and image quality. This review includes all technical factors, CTDI comparison, scanning instructions, reconstructions of patient images, and appropriateness of the protocol. In addition to new or changed protocols, six (6) protocols will be reviewed annually to include Pediatric Head, Pediatric Abdomen,

Adult Head, Adult Abdomen, High Resolution Chest, and Brain Perfusion. Other commonly used protocols may be substituted for those listed above if they are unavailable on the scanner.

Changes to Protocols

Changes to existing protocols or creation of new protocols must be reviewed and approved by the Lead Interpreting CT Physician, Medical Physicist, and Lead CT Technologist before implementation. Requests for protocol changes or creation of new protocols must be submitted in writing to the Lead Interpreting CT Physician.

The Lead Interpreting CT Physician, Medical Physicist, and Lead CT Technologist will review the change request within 30 days. Protocol changes will be documented and the appropriate protocol(s) will be updated by the Lead CT Technologist. Protocols will contain the initial protocol review date as well as the dates of protocol changes. Implementation of protocol changes will be performed by the Lead CT Technologist.

Nothing in this section precludes a physician from making point of care changes to protocols for individual patients.

Guidelines of Variability

Procedure Statement

CT Technologists have the ability to adjust any scan technique as appropriate in an effort to obtain adequate image quality. Technologists should make changes based on considerations of image quality, patient size, and patient dose. Technologists may not make adjustments to scan protocols that would exceed CTDI Alert Values of 600 mGy for pediatric patients or 1000 mGy for adult patients without consulting a Radiologist or Medical Physicist.

CT Technologists must consult with a Radiologist before making changes to image reconstructions or image reformats.

Procedures to Record and Retrieve CTDI, DLP, or SSDE

Procedure Statement

Dose indices are readily available at the end of each exam on the protocol summary page for each CT scanner. The protocol summary pages are routinely sent to PACS for archival. Patient specific CT dose information is considered protected health information and release of such information must be compliant with existing laws and policies.

Procedure to Record CTDI, DLP, or SSDE

1. CT Technologists will send each protocol summary page to PACS at the completion of each CT exam.

Procedure to Retrieve CTDI, DLP, or SSDE

1. Requests for estimated patient dose for an individual study must be made in writing and follow Organizational Policies.
2. When the written request is received, the Lead CT Technologist will consult with the Medical Physicist in order to provide an estimated patient dose to an individual within ten business days of the patient request.
3. The Lead CT Technologist will retrieve the dose indices from the protocol summary page in PACS. The Medical Physicist may perform additional measurements or calculations to improve the accuracy of the dose index for the patient.

CT Event Investigation and Findings

Procedure Statement

To ensure that the facility properly investigates CT Events. CT Events are defined as any individual pediatric study that has a $CTDI_{vol}$ in excess of 600 mGy, any individual adult study that has a $CTDI_{vol}$ in excess of 1500 mGy, or any CT procedure that results unanticipated hair loss, erythema, or functional damage to an organ or physiological system.

Notification of Event

1. The Lead CT Technologist will set Alert Values for all CT systems. Alert Values will be 600 mGy for any pediatric protocol and 1000 mGy for any adult protocol.
2. Alert Values require the CT technologist to enter a password in order to proceed with the scan. When an Alert Value is exceeded, the medical physicist and the Lead CT technologist is immediately notified.
3. Within 24 hours, the performing CT technologist must complete a variance report.

Conducting the Investigation

1. For all CT Events a root cause analysis is performed in consultation with the medical physicist, Lead Interpreting Physician, Lead CT Technologist, and performing CT technologist.
2. The Root Cause Analysis will be performed in accordance with institutional policies.
3. The investigation will be completed within 10 business days.

Documentation

Documentation of the Root Cause Analysis and corrective action plans for CT Events will be retained for a minimum of 10 years.

CT Staff Annual Education

Procedure Statement

All new CT technologists will receive CT dose education within six months of initial employment. All current CT Technologists will receive CT dose education on an annual basis.

Educational Content and Training Records

All CT technologists will complete annual CT Radiation Safety & Dose Education Training with the medical physicist or other vendor. This education covers general CT radiation safety and hazards of radiation exposure to patients and staff.

Records of participants will be kept for each CT technologist in the department.

Retaking or Repeating CT Exams

Procedure Statement

This policy recognizes that patients undergoing a CT scan may require a repeat study. The purpose of this policy is to define when a CT Technologist can repeat a CT scan on a patient.

Adults (> 15 years old)

A technologist may repeat CT acquisition without contrast for reason of motion artifacts once. Additional repeated acquisition would require consultation with attending Radiologist.

Consultation with attending Radiologist is required for repeated CT acquisition for reasons other than motion artifacts.

Any repeat scans that will cover entire area previously covered (repeating entire examination) will need Radiologist approval to proceed. An exception to obtaining Radiologist approval is allowed if, in technologist opinion, timing of the repeat examination is critical with respect to IV contrast bolus.

Any repeat scan that requires additional IV contrast will need Radiologists approval to proceed.

Pediatrics (< 15 years old)

CT scans with or without IV contrast that may need to be repeated, must be approved by Radiologist.

APPENDIX A
CT EQUIPMENT QUALITY CONTROL DATA FORM

Facility Name: _____

Month: _____ Year: _____ CT Scanner: _____

Day	Warm Up	Air Cals	Mode	CT_{water} (HU)	Noise (SD)	Artifacts	P/F	Initials
1			Axial					
2			Helical					
3			Axial					
4			Helical					
5			Axial					
6			Helical					
7			Axial					
8			Helical					
9			Axial					
10			Helical					
11			Axial					
12			Helical					
13			Axial					
14			Helical					
15			Axial					
16			Helical					
17			Axial					
18			Helical					
19			Axial					
20			Helical					
21			Axial					
22			Helical					
23			Axial					
24			Helical					
25			Axial					
26			Helical					
27			Axial					
28			Helical					
29			Axial					
30			Helical					
31			Axial					
Action Limits:			CT_{water} = 0 ± 5 HU		SD: A: _____-_____ H: _____-_____			

Comments/Corrective Action

Monthly Visual Checklist ☑

GANTRY	Table height indicator functioning.....	
	Table position indicator functioning.....	
	Angulation indicator functioning.....	
	Laser localization light functioning.....	
	Acceptable smoothness of table motion.	
	X-ray on indicator functioning.....	
CONTROL CONSOLE	Exposure switch functioning.....	
	Panel switches/lights/meters working.....	
	X-ray on indicator functioning.....	
	Warning labels present.....	
	Intercom system functioning.....	
OTHER	Postings present.....	
	Service records maintained/accessible....	

Monthly Display Monitor Gray Level ☑

SMPTE PATTERN	5% patch in 0%-5% is discernible.....	
	95% patch in 95%-100% is discernible.....	
	Distinct gray level steps.....	

Window: Level:

Monthly Large Artifact Check

If available, scan manufacturer's large phantom

Artifacts:

Date of Monthly QA: Initials:

PASS = P or ✓ FAIL = F NOT APPLICABLE = NA

A = Axial H = Helical

Notes:
Warm up and Air Cals frequency are per manufacturer recommendation.
Continue Comments/Corrective action on back of sheet, if needed.

Qualified Medical Physicist Reviewer

Date of Review

CT HEAD W/O

Indications Headaches, CVA, Subdural Hematoma, Trauma

Patient Prep No Prep

IV Contrast None

Scout Lateral - 10 mA, 120 kV
Range: Below base of skull through vertex.

Positioning Head First Supine. Use the Head Holder.
Position the patient's head to superimpose the supraorbital ridge and the inner table of the skull at the foramen magnum along a line.

Scanning Instructions
- If With & Without do not let patient move between scans, scan in the same way.
- Avoid scanning through lens of eyes.
- Check pre-scan CTDI

Dose Information

Reference $CTDI_{vol}$	48.95 mGy
Expected $CTDI_{vol}$ Range	35 mGy – 60 mGy
Notification Value	80 mGy

Scan Technique

Scan Type	Rotation Time	Detector Configuration	Slice Thickness	Interval	Pitch	SFOV	DFOV	kV	mA	Noise Index	Min-Max mA	Smart mA	Auto mA	ASiR %	Reference Noise Index	Recon Type
Axial	1.0s	64 x 0.625	5 mm	20 mm	N/A	Head	22.0	120	255DR	N/A	N/A	No	No	20	N/A	Standard

Reconstructions

Reconstruction 1
Standard 5mm x 5mm
WW 80 / WL 35, SS 30

Reconstruction 2 (Thins)
Standard 0.625mm x 0.625mm
WW 80 / WL 35, SS 30

Reconstruction 3
Bone 5mm x 5mm
WW 2000 / WL 500, SS 70

Reformats

Coronal Reformats
2mm x 2mm Standard

Sagittal Reformats
2mm x 2mm Standard

True Axial Reformat
5mm x 5mm Standard

Image Transfer
All images should be sent to Philips PACS

Patient Instructions
None

CT HEAD W/O

Indications Headaches, CVA, Subdural Hematoma, Trauma

Patient Prep No Prep

IV Contrast None

Scout Lateral - 10 mA, 120 kV
Range: Below base of skull through vertex.

Positioning Head First Supine. Use the Head Holder.
Position the patient's head to superimpose the supraorbital ridge and the inner table of the skull at the foramen magnum along a line.

Scanning Instructions
- If With & Without do not let patient move between scans, scan in the same way.
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Dose Information

Reference $CTDI_{vol}$	48.95 mGy
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Notification Value	80 mGy

Scan Technique

Scan Type	Rotation Time	Detector Configuration	Slice Thickness	Feed	Pitch	SFOV	DFOV	kV	mAs	CARE Dose4D	Quality Ref. mAs	CARE kV	Reference kV	Admire	Recon Type
Axial	1.0s	64 x 0.6	5 mm	20 mm	1	250	300	120	255	Off	Off	N/A	N/A	20	J40s medium

Reconstructions

Reconstruction 1	Reconstruction 2 (Thins)	Reconstruction 3
Standard 5mm x 5mm	Standard 0.6mm x 0.625mm	Bone 5mm x 5mm
WW 80 / WL 35, SS 30	WW 80 / WL 35, SS 30	WW 2000 / WL 500, SS 70

Reformats

Coronal Reformats	Sagittal Reformats	True Axial Reformat
2mm x 2mm Standard	2mm x 2mm Standard	5mm x 5mm Standard

Image Transfer
All images should be sent to Philips PACS

Patient Instructions
None