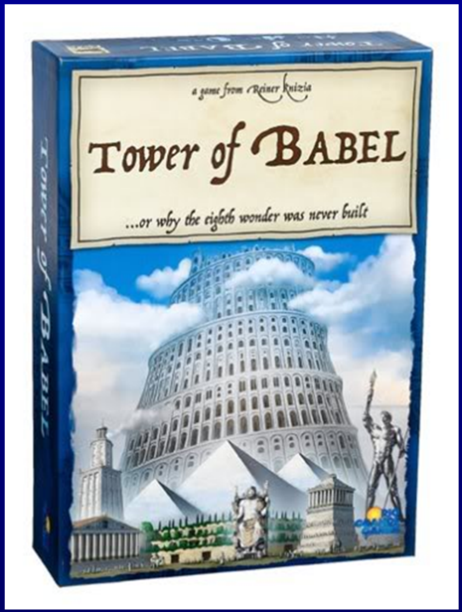
# *Translating Protocols Between Scanner Manufacturer and Model*

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President, Upstate Medical Physics

# *Objectives*

- Understand the complexities and pitfalls of translating protocols between manufacturers and models
- Use the CT Protocol Tools on the AAPM Web to translate protocols
- Apply the tools to real life examples

# *Outline*

- Basic CT Parameters common to all manufacturers
  - Proprietary names, manufacturer specific
  - The AAPM Lexicon website
- Expected results
  - $CTDI_{vol}$ within range
  - Time related factors (motion, mA, effective mAs, pitch, etc.)
  - Thickness/resolution and noise requirements in the reconstructed images
    - Retro recon capabilities/limitations?
- Start with most common exams, with ACR MAP data
  - Adult head, abdomen, ped abdomen
- Chest protocol examples (Mayo)
- Example using AAPM Web site for Routine Head scan (WIP)
- Balance specific features of different manufacturers

# Single manufacturer, multiple scanners

- Seems easy right?.....
- Different scanner characteristics
  - Max mA
  - Tube rotation time
  - Detector configuration
- Two approaches
  - Standardization: All scanners same protocols
    - Easier for Radiologists to compare
  - Optimize using max capabilities of each scanner
    - Select patients/exams for optimum clinical benefit

# *Multiple manufacturers, multiple scanners*

- This gets complex in a hurry
- Different scanner characteristics
  - Max mA
  - Tube rotation time
  - Detector configuration
- Two approaches (Standardization – Optimization)
- Make optimal use of features
  - Smartphone, texting, etc.
- Nomenclature, nom, nombre, Namen haben

# *When is a rose not a rose?*

- Names are different
- Challenge for staff
- Big challenge for medical physicists
- Concern discussed at 2010 CT Dose Summit, and in many venues by leaders within AAPM
- AAPM jumped into action!

# *Working Group on Standardization of CT Nomenclature and Protocols (WG)*

1. To **develop consensus protocols** for frequently performed CT examinations, summarizing the basic requirements of the exam and giving several model-specific examples of scan and reconstruction parameters. General comments on contrast administration may be included, as appropriate.
2. To develop by consensus a set of **standardized terms for use on CT** scanners, including all parameters that control the scan acquisition or reconstruction that are programmed by the user, displayed on the final image or included in a DICOM-specified tag, or described a fundamental CT principle (such as a beam-shaping filter).

With AAPM leadership, we will seek support of the ACR and ASRT. Also work with MITA so that the standardized terms are eventually adopted by the IEC

# WG Members

- AAPM
- ACR
- ASRT
- FDA

- MITA
- GE
- Hitachi
- Philips
- Siemens
- Toshiba

Members:

| | |
|---|---|
| AAPM: | Cynthia McCollough (Chair) |
| | Dianna Cody (Co-chair) |
| | Dustin Gress |
| | James Kofler |
| | Michael McNitt-Gray |
| | Robert Pizzutiello |
| ACR: | Mark Armstrong |
| | Theresa Branham |
| | Priscilla Butler |
| ASRT: | Virginia Lester |
| DICOM: | David Clunie |
| | Kevin O'Donnell |
| FDA: | Thalia Mills |
| MITA: | Gail Rodriguez |
| GE: | John Jaeckle |
| Hitachi: | Mark Silverman |
| Philips: | Mark Olszewski |
| Siemens: | Christianne Leidecker |
| Toshiba: | Richard Mather |

- Biweekly conference calls since RSNA 2010

# *First deliverable: The Lexicon*

**CT scan parameters: Translation of terms for different manufacturers**

**Introduction**

- For the CT technologist who operates multiple scanner models, perhaps from multiple manufacturers, the variability in names for important scan acquisition and reconstruction parameters can lead to confusion, reduced comfort and an increased potential for error. **The intent of this CT terminology lexicon is to allow users to translate important CT acquisition and reconstruction terms** between different manufacturers' systems.

- This website will be updated as the terminology standardization work progresses.

- The generic descriptions or terms in the first column are intended to orient the user to the relevant concepts; they are not consensus "preferred terms." The generic descriptions are not based on any single existing or pending terminology standard; however the references cited below were consulted in developing the generic descriptions. Future efforts of this Working Group include making recommendations for standardized terminology.

- A number of individuals and groups have advocated for terminology standardization in CT, including at a **March 30-31, 2010 FDA public meeting** entitled "Device Improvements to Reduce Unnecessary Radiation Exposure from Medical Imaging" (transcripts available at: http://www.fda.gov/downloads/MedicalDevices/NewsEvents/WorkshopsConferences/UCM210149.pdf; see p. 153-155). Participants proposed a cooperative effort among professional organizations (AAPM, ASRT, ACR, etc.), industry, FDA, and standards organizations to accomplish this task, as is now being undertaken by this Working Group.

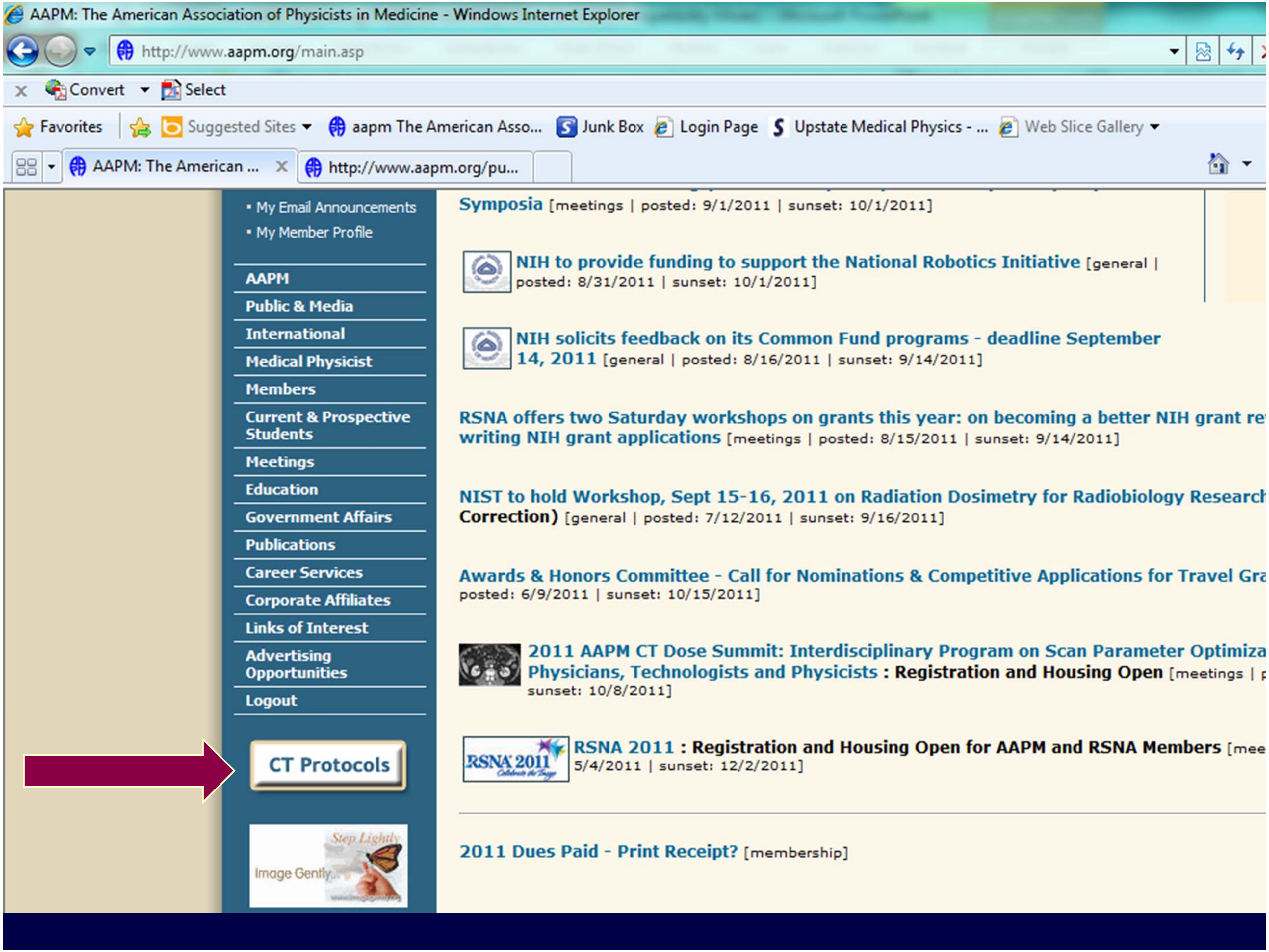
# First deliverable: The Lexicon

This represents a first step in the terminology standardization effort undertaken by this working group. Phase 2 of our work will:

1. Identify relevant terms from established standard lexicons (e.g. RadLex and DICOM) and other relevant literature and publish an expanded lexicon including these terms.

2. Form consensus recommendations on preferred terms.

1. Scan acquisition and user interface basics
2. Dose modulation and reduction tools
3. Multi-Slice Detector Geometry
4. Image Reconstruction and Display
5. Contrast Media Tools
6. Multi-planar formats and 3-D Processing
7. Service and Application Tools
8. Workflow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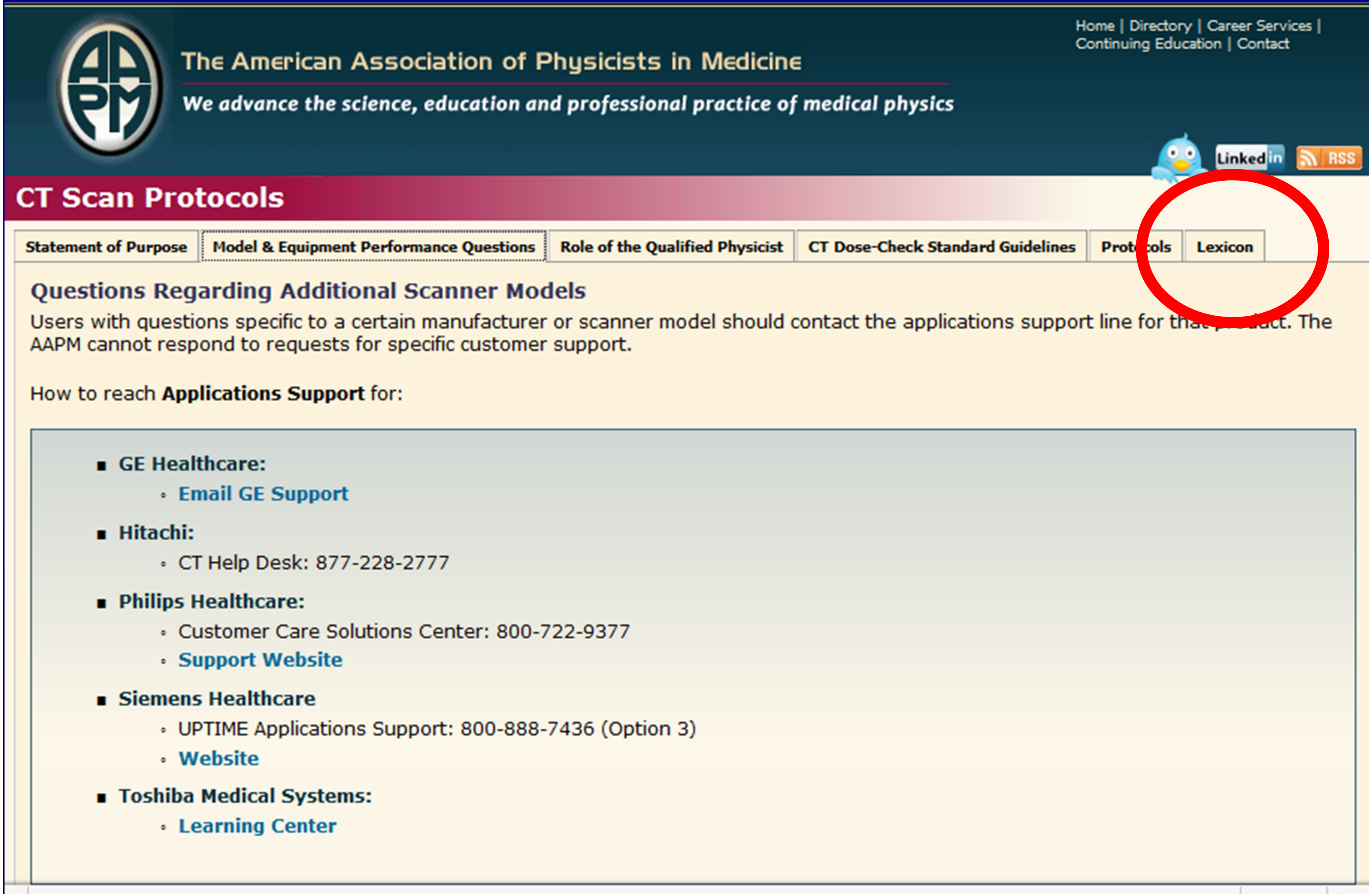
Corporate Affiliates
Links of Interest
Advertising Opportunities
Logout
CT Protocols
Image Gently
Step Lightly
Symposia [meetings | posted: 9/1/2011 | sunset: 10/1/2011]
NIH to provide funding to support the National Robotics Initiative [general | posted: 8/31/2011 | sunset: 10/1/2011]
NIH solicits feedback on its Common Fund programs - deadline September 14, 2011 [general | posted: 8/16/2011 | sunset: 9/14/2011]
RSNA offers two Saturday workshops on grants this year: on becoming a better NIH grant re
writing NIH grant applications [meetings | posted: 8/15/2011 | sunset: 9/14/2011]
NIST to hold Workshop, Sept 15-16, 2011 on Radiation Dosimetry for Radiobiology Research
Correction) [general | posted: 7/12/2011 | sunset: 9/16/2011]
Awards & Honors Committee - Call for Nominations & Competitive Applications for Travel Gra
posted: 6/9/2011 | sunset: 10/15/2011]
2011 AAPM CT Dose Summit: Interdisciplinary Program on Scan Parameter Optimiza
Physicians, Technologists and Physicists : Registration and Housing Open [meetings |
sunset: 10/8/2011]
RSNA 2011
RSNA 2011 : Registration and Housing Open for AAPM and RSNA Members [mee
5/4/2011 | sunset: 12/2/2011]
2011 Dues Paid - Print Receipt? [membership]

# AAPM 2011 Summit on CT Dose



## 1. Scan acquisition and user interface basics

| Generic description | GE | PHILIPS | SIEMENS | TOSHIBA | HITACHI | NEUSOFT |
|---|---|---|---|---|---|---|
| The portion of the **user interface** where scans are prescribed | Exam Rx | Scan Procedure | Examination | eXam Plan | Scan Protocol | Scan Procedure (Neuviz 16);<br>Main Scan Interface (Neuviz DUAL) |
| Other portions of the **user interface**, such as were reconstructed images are viewed | Desktop | Active viewer | Various "task cards", such as "Viewing" | Active display | Image Viewer | Image Display Area (Neuviz 16);<br>Viewer (Neuviz DUAL) |
| **CT localizer radiograph** (i.e. the scanned projection radiograph, often acquired by the CT system to allow the user to prescribe the start and end locations of the scan range) | Scout | Surview | Topogram | Scanogram | Scanogram | Surview |
| **Axial scan mode:** Data acquisition while the patient table remains stationary; the table position may be incremented between x-ray exposures to collect data over a longer z axis range. | Axial | Axial | Sequence | Scan & View, Scan & Scan, Volume, Wide Volume (Aquilion One) | Normal | Axial |
| **Helical or Spiral scan mode:** Data acquisition while the patient table is continuously moving along the z axis. | Helical | Helical | Spiral | Helical | Volume | Helical |
| **Dynamic scan mode - single detector width:** Data acquisition at multiple time points over the same anatomic location(s) while the patient table remains stationary; x-ray exposure can be continuous or intermittent | Cine or zero interval Axial | CCT (Continuous CT) | Dynamic (continuous) or Serio (intermittent);<br>scan mode name: DynMulti or DynSerio. | Dynamic (Continuous or Intermittent) | Dynamic | CCT (Neuviz 16);<br>N/A (Neuviz DUAL) |
| **Dynamic scan mode - multiple detector widths**: Data acquisition at multiple time points over the same anatomic location(s) while the patient table cycles back and forth between designated start and end locations in order image a region wider than the detector | Shuttle | Jog | Adaptive 4D Spiral; scan mode name: DynMulti4D or DynSerio4D (ECG triggered) | N/A | N/A | N/A |
| **Interventional CT - Intermittent x-ray** | SmartStep | Single CCT | Model dependent: | CT Fluoro (CTF) | guideShot | Single CCT (Neuviz 16); |

# 1. Scan acquisition and user interface basics

| Generic description | GE | PHILIPS | SIEMENS | TOSHIBA |
|---|---|---|---|---|
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| **Dynamic scan mode - multiple detector widths**: Data acquisition at multiple time points over the same anatomic location(s) while the patient table cycles back and forth between designated start and end locations in order image a region wider than the detector | Shuttle | Jog | Adaptive 4D Spiral; scan mode name: DynMulti4D or DynSerio4D (ECG triggered) | N/A |
| **Interventional CT - Intermittent x-ray** | SmartStep | Single CCT | Model dependent: | CT Fluoro (CTF) |

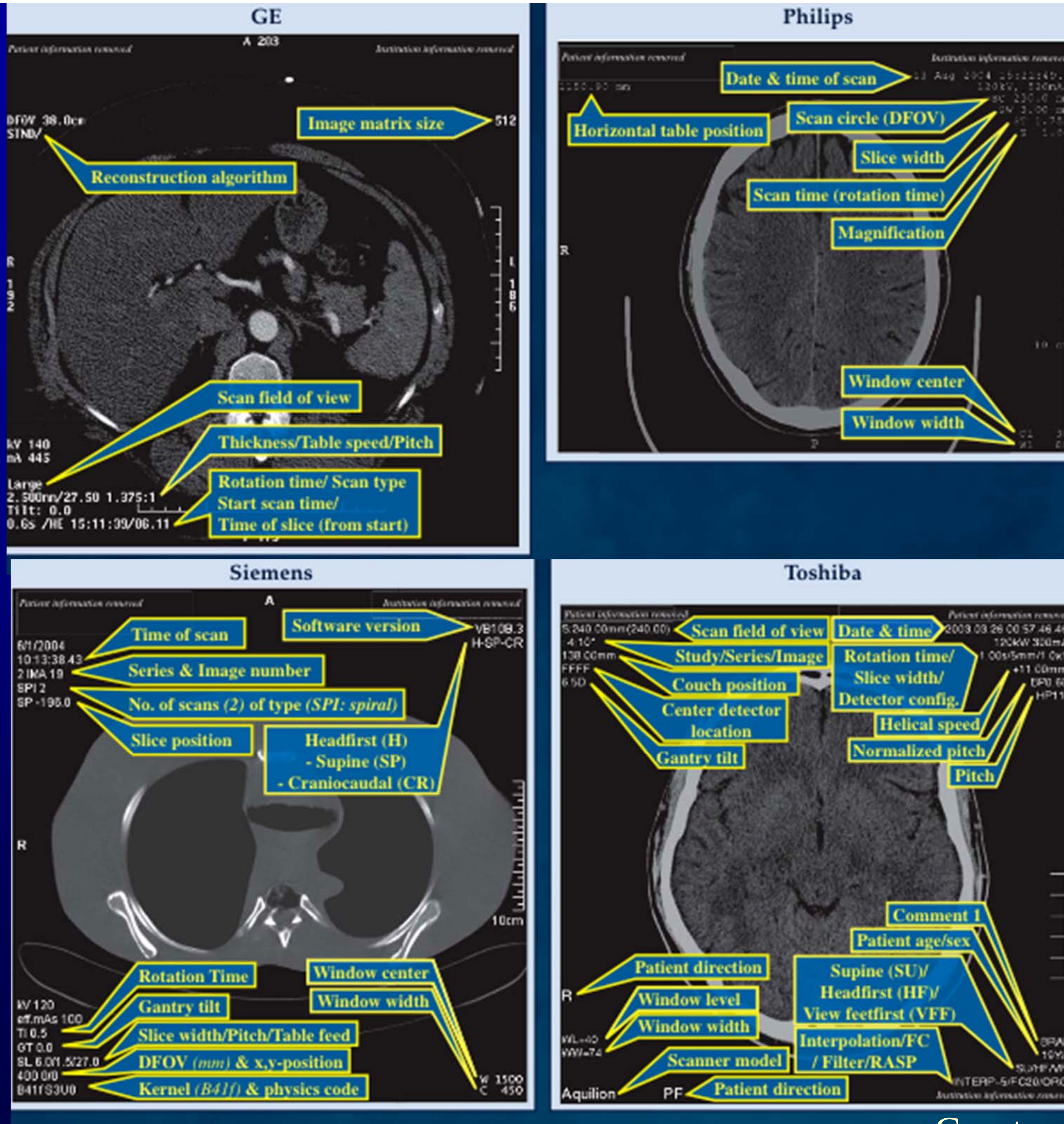
| Generic description | GE | PHILIPS | SIEMENS | TOSHIBA |
|---|---|---|---|---|
| **Table feed** per 360 degree rotation of the x-ray tube (helical scan mode) | Speed (mm/rot) | Table speed (mm/rot) | Table Feed (mm/rot)* | Couch speed (mm/Rot) |
| **Acquisition field of view:** Diameter of the circular region within the scan plane over which projection data are collected. Nominally equal to the diameter of the primary beam at isocenter in the axial plane. | Scan Field of View (SFOV, cm) | Not determined by tech; built into protocol | Not determined by tech; built into protocol | CFOV (Calibrated Field of View) |
| **Tube current:** Number of electrons accelerated across an x-ray tube per unit time, expressed in units of milliampere (mA) | mA | mA* | mA* | mA |
| **Tube current-time product:** The product of tube current and exposure time per rotation, expressed in units of milliampere • seconds (mAs). In axial scan mode, this is equal to tube current × (scan angle ÷ 360) × rotation time. In helical scan mode, this is equal to tube current × rotation time. | Not used on this system | mAs | mAs | mAs |
| **Effective tube current-time product:** In helical scan mode, this is the product of tube current and rotation time (expressed in units of milliampere • seconds (mAs) ÷ pitch) | Not used on this system | mAs per slice (= mAs/pitch) | Effective mAs (= mAs/pitch) | Effective mAs (= mAs/pitch) |
| **Tube potential:** The electric potential applied across an x-ray tube to accelerate electrons towards a target material, expressed in units of kilovolts (kV) | kV | kVp | kV | kV |
| **Pitch:** Unitless parameter used to describe the table travel during helical CT, equal to table travel (mm) per gantry rotation ÷ total nominal beam width (mm) | Pitch | Pitch | Pitch | CT Pitch Factor |
| **Automated patient instructions** | AutoVoice | Auto voice | API (Automated Patient Instructions) | Breath Control |

* Not able to be directly modified on the user interface. Value is calculated/determined by other settings.

| Generic description | GE | PHILIPS | SIEMENS | TOSHIBA |
|---|---|---|---|---|
| **Automatic exposure control (AEC)**: A scanner feature that automatically adapts the x-ray tube current to the overall patient size to achieve a specified level of image quality | Available in AutomA and SmartmA | Available in DoseRight Automatic Current Selection (ACS) | Available in CARE Dose4D | Available in SURE Exposure |
| **Angular tube current modulation** | SmartScan (CT/i only) | D-DOM (Dose Modulation) | CARE Dose | not available as a separate item |
| **Longitudinal tube current modulation** | AutomA | Z-DOM | not available as a separate item | SURE Exposure |
| **Angular and longitudinal tube current modulation** | SmartmA (x, y, z) | Work in progress | CARE Dose4D | SURE Exposure 3D (X, Y and Z Modulation) |
| **ECG-based tube current modulation** | ECG Modulated mA | DoseRight Cardiac | All features available in HeartView package (except (3), only available for SOMATOM Definition Flash)<br>(1) Retrospective gated spiral mode: use "Pulsing" settings in Trigger card | ECG Modulation |
| | | | (2) Prospective triggered sequence: use "Adaptive Cardio Seq." and "Pulsing" settings in Trigger card.<br>(3) Prospectively triggered spiral ("Flash" mode) | |
| **Image quality reference parameter for AEC** | Noise Index | Reference image | Quality reference mAs | Standard Deviation or standard, low-dose, or high-quality |

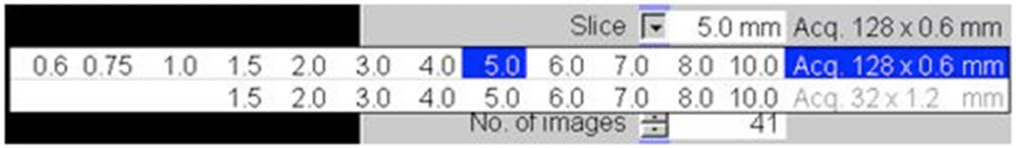
## 3. Multi-Slice Detector Geometry

| Generic description | GE | PHILIPS | SIEMENS | TOSHIBA | HITACHI | NEUSOFT |
|---|---|---|---|---|---|---|
| Multi-slice detector array design | Fixed | Model dependent: Fixed or Asymmetric | Model dependent: Adaptive or Fixed | Fixed (32 row and above); Adaptive (16 row and below) | Asymmetric-16 slice; Fixed-64 slice | Asymmetric (Neuviz 16); Fixed (Neuviz DUAL) |
| Detector configuration | Detector Configuration | Collimation N x T (mm) | Detector Configuration or Aqu (Acquisition) on Exam Card | Detector Configuration | Detector Configuration | Collimation N x T (mm) |



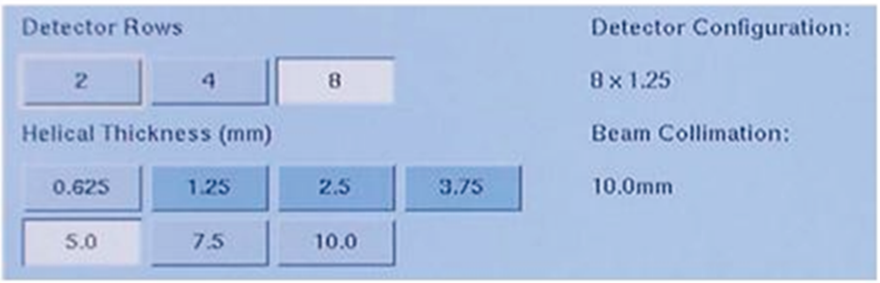

Courtesy C. McCollough

**Siemens Slice Thickness (T) selection (N determined by the scan protocol)**

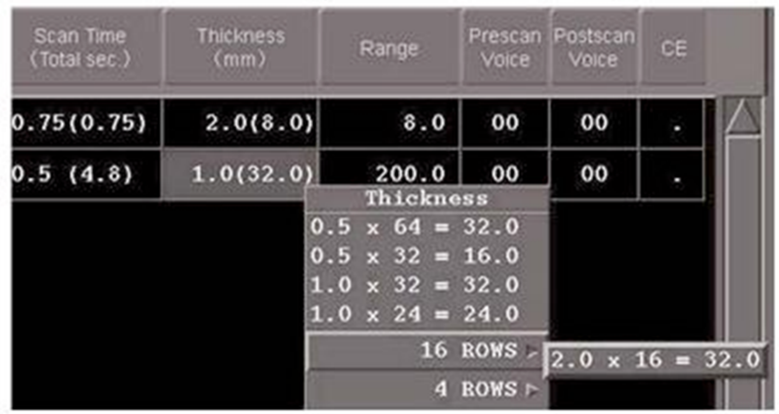



**Hitachi Detector Rows (N) and Slice Thickness (T) selection**

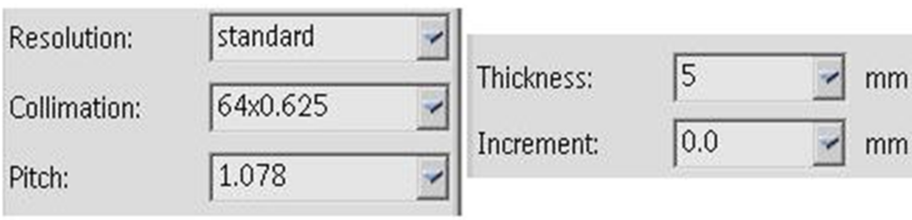

**GE Detector Rows (N) and Slice Thickness (T) selection**



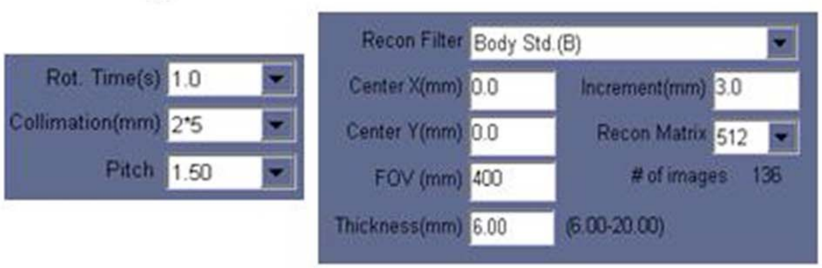

**Toshiba Detector Rows (N) and Slice Thickness (T) selection**



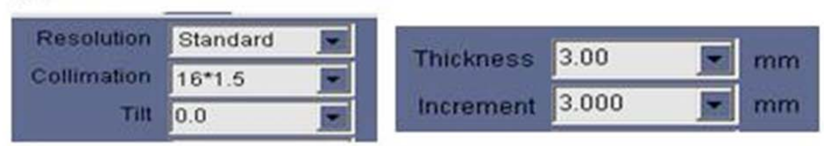

**Philips Detector Rows (N) and Slice Thickness (T) selection**




**Neusoft (Neuviz DUAL) Detector Rows (N) and Slice Thickness (T) selection**




**Neusoft (Neuviz 16) Detector Rows (N) and Slice Thickness (T) selection**

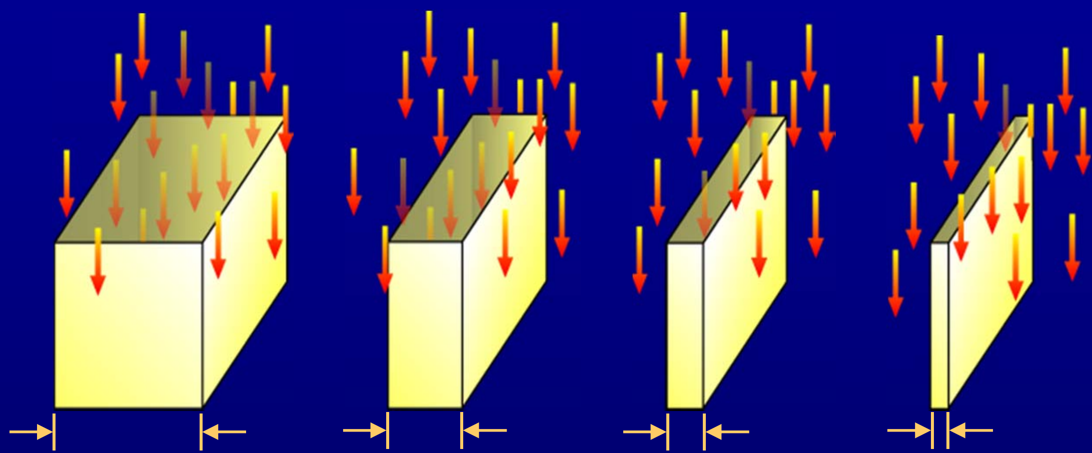


# *Noise, Image Thickness and Pitch*

- Fundamental relationship
  - Noise increases as fewer photons form the image
- In spiral CT, image noise is dependent on pitch
  - mAs must be changed as pitch is changed
  - Relationship is linear on some systems, but not all
- Siemens
  - Effective mAs = mAs/pitch
- Review how manufacturers handle noise

# *Image Thickness*

$$\text{Noise} \propto \frac{1}{\sqrt{\#\ \text{Photons}}}$$



| | | | | |
|---|---|---|---|---|
| **Image (mm):** | **5** | **2.5** | **1.25** | **0.625** |
| Rel. Noise: | 100% | 141% | 200% | 283% |
| Req. mAs (for = noise): | 100% | 200% | 400% | 800% |

- **Better z-resolution (less partial vol. averaging)**
- **Increased image noise**
- ***Potential* for increased radiation dose**

Courtesy J. Koefler

# *Let's look at some specific protocols*

- Chest
- Examples from Mayo Clinic Protocols
- Chosen to make optimal use of each scanners capabilities
- Courtesy C. McCollough

# Routine Chest

| GE | LS Ultra-8 | LS 16 | LS 64 |
|---|---|---|---|
| Scan Type | Helical | Helical | Helical |
| Rotation Time (s) | 0.5 | 0.5 | 0.5 |
| Det Configuration | 8 x 1.25 | 16 x 1.25 | 64 x 0.625 |
| Pitch | 1.35 | 0.938 | 0.984 |
| Speed (mm/rot) | 13.5 | 18.75 | 39.36 |
| kVp | Chest CHART | Chest CHART | Chest CHART |
| mA | | | |
| Auto-mA | OFF | OFF | OFF |
| SFOV | Lg Body | Lg Body | Lg Body |
| Breath-hold | Inspiration | Inspiration | Inspiration |
| Prep Delay (s) | 20 | 20 | 20 |
| *Min. Retro (mm)* | *1.25* | *1.25* | *1.25* |
| *CTDI (mGy)* | *11* | *12.96* | *14* |

Courtesy C. McCollough

# Routine Chest

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| Breath-hold | Inspiration | Inspiration | Inspiration |
| Prep Delay (s) | 20 | 20 | 20 |
| *Min. Retro (mm)* | *1.25* | *1.25* | *1.25* |
| *CTDI (mGy)* | *11* | *12.96* | *14* |

Courtesy C. McCullough

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Courtesy C. McCollough

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| kVp | Chest CHART | Chest CHART | Chest CHART |
| mA | | | |
| Auto-mA | OFF | OFF | OFF |
| SFOV | Lg Body | Lg Body | Lg Body |
| Breath-hold | Inspiration | Inspiration | Inspiration |
| Prep Delay (s) | 20 | 20 | 20 |
| *Min. Retro (mm)* | *1.25* | *1.25* | *1.25* |
| *CTDI (mGy)* | *11* | *12.96* | *14* |

Courtesy C. McCollough

# Routine Chest

| | RECON 1 | RECON 2 | RECON 3 (optional)* | Reformat 1 |
|---|---|---|---|---|
| Series Description | Chest Routine | HiRes Chest | Thin Nodule | MIP Chest |
| Created From | --- | --- | --- | RECON 2 |
| Type | Axial | Axial | Axial | Axial-MIP |
| Start | Above Apices | Above Apices | Above Nodule | Above Apices |
| End | Thru Lung Base | Thru Lung Base | Below Nodule | Thru Lung Base |
| Angle | None | None | None | None |
| Image Order | Sup to Inferior | Sup to Inferior | Sup to Inferior | Sup to Inferior |
| Algorithm | STD/FULL | BONE | STD/FULL | BONE |
| Thickness (mm) | 5 | 1.25 | 2.5 | 20 |
| Interval (mm) | 5 | 1.25 | 1.25 | 10 |
| DFOV (cm) | Patient | Patient | 15 | Patient |

Courtesy C. McCollough

# Routine Chest

| SIEMENS | Sens-16 | Sens-40 | Sens-64 | Def-64 | Def-AS+ | F-128 |
|---|---|---|---|---|---|---|
| Scan Type | Spiral | Spiral | Spiral | Spiral | Spiral | Spiral |
| Rotation Time (s) | 0.5 | 0.5 | 0.33 | 0.33 | 0.33 | 0.28 |
| Collimation | 16 x 0.75 | 40 x 0.6 | 64 x 0.6 | 64 x 0.6 | 128 x 0.6 | 128 x 0.6 |
| Pitch | 1.1 | 1.15 | 0.9 | 0.9 | 0.9 | 0.9 |
| *Feed (mm/rot)* | *13.2* | *13.2* | *17.8* | *17.8* | *34.6* | *34.6* |
| kVp | 120 | 120 | 120 | 120 | 120 | 120 |
| Quality ref. mAs | 180 | 140 | 180 | 180 | 180 | 180 |
| CARE Dose4D | ON | ON | ON | ON | ON | ON |
| API | Inspiration | Inspiration | Inspiration | Inspiration | Inspiration | Inspiration |
| Prep Delay (s) | 20 | 20 | 20 | 20 | 24 | 24 |
| *Min. Retro (mm)* | *0.75* | *0.6* | *0.6* | *0.6* | *0.6* | *0.6* |
| *CTDI (mGy)* | *14.04* | *15.02* | *14* | *12.98* | *12.13* | *12.16* |
| *Base Protocol* | *ThoraxRoutine* | *ThoraxRoutine* | *ThoraxRoutine* | *ThoraxRoutine* | *ThoraxRoutine* | *ThoraxRoutine* |

Courtesy C. McCollough

# Routine Chest

| | RECON 1 | RECON 2 | RECON 3 | RECON 4 (optional)* |
|---|---|---|---|---|
| Series description | Chest Routine | HiRes Chest | MIP Chest | Thin Nodule |
| Type | Axial | Axial | SPO-MIP Thins | Axial |
| Start | Top of Lungs | Top of Lungs | Top of Lungs | Above Nodule |
| End | Bottom of Lungs | Bottom of Lungs | Bottom of Lungs | Below Nodule |
| Angle | None | None | None | None |
| Image Order | Craniocaudal | Craniocaudal | Craniocaudal | Craniocaudal |
| Kernel | B40 | B46 | B50 | B40 |
| Slice (mm) | 5 | 1.5 | 20 | 2 |
| Increment (mm) | 5 | 1.5 | 10 | 1 |
| FOV (mm) | Patient | Patient | Patient | 150 |

Courtesy C. McCollough

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# CT Scan Protocols



## Questions Regarding Additional Scanner Models

Users with questions specific to a certain manufacturer or scanner model should contact the applications support line for that product. The AAPM cannot respond to requests for specific customer support.

How to reach **Applications Support** for:

- **GE Healthcare:**
  - Email GE Support
- **Hitachi:**
  - CT Help Desk: 877-228-2777
- **Philips Healthcare:**
  - Customer Care Solutions Center: 800-722-9377
  - Support Website
- **Siemens Healthcare**
  - UPTIME Applications Support: 800-888-7436 (Option 3)
  - Website
- **Toshiba Medical Systems:**
  - Learning Center

# Practical Example – Routine Adult Head Work in Progress

- Start by defining expected results
  - D – **$CTDI_{vol}$ within range**
  - t – **Time related factors**
    - (motion, mA, effective mAs, pitch, etc.)
  - N – **Thickness/resolution and noise requirements in the reconstructed images**
    - How is Noise reference applied, by mfr? First recon?
    - Retro recon capabilities/limitations?
- Check "CT Protocols" on AAPM web site
- In Routine Head example, look at these parameters

# ROUTINE HEAD (BRAIN) - *Indications*

**Partial List**

A. Acute head trauma.
B. Suspected acute intracranial hemorrhage.
C. Immediate postoperative evaluation following brain surgery
D. Suspected shunt malfunctions, or shunt revisions.
E. Mental status change.
F. Increased intracranial pressure.
G. Headache.
H. Etc.

# Diagnostic Task

**Use these to guide discussions of image quality requirements (thickness, noise, etc.)**

- Detect collections of blood
- Identify brain masses
- Detect brain edema or ischemia
- Identify shift in the normal locations of the brain structures including cephalad or caudal directions
- Evaluate the location of shunt hardware and the size of the ventricles
- Evaluate the size of the sulci and relative changes in symmetry

# *Radiation Dose Management*

- Tube Current Modulation (or Automatic Exposure Control) may be used, but is often turned off.
- According to ACR CT Accreditation Program guidelines:

D
- the reference level CTDIvol is 75 mGy
- the pass/fail limit is 80 mGy.

- These values are for a routine head and may be significantly different (higher or lower) for a given patient with unique indications, etc.
- NOTE: All CTDIvol are for 16 cm diameter phantom

# *General Scan Instruction Suggestions*

- Table height at External Auditory Meatus (EAM).
- **PATIENT POSITIONING**: Patient supine, head first,

t **head in head-holder.**

D ***To reduce or avoid ocular lens exposure***, the scan angle should be parallel to a line created by the supraorbital ridge and the inner table of the posterior margin of the foramen magnum.

This may be accomplished by either by head tuck or gantry tilt in most situations.

## ***EXAMPLE PROTOCOLS** of both AXIAL/SEQUENTIAL and HELICAL scans are provided.*

- There are advantages and disadvantages to using either axial or helical scans for routine heads.
- The "best choice" varies by patient, by indication and by scanner.
- Users of this document should consider the following and consult with both the manufacturer and a medical physicist to assist in determining which mode to use and when.

## ***EXAMPLE PROTOCOLS*** *of both AXIAL/SEQUENTIAL and HELICAL scans are provided.*

- AXIAL SCANS generally have less artifact, but the scan takes slightly longer
- HELICAN SCANS may have more image artifact, especially for scanners with < 16 detector rows, but can give close to or equivalent performance for scanners with $\geq$ 64 detector rows.

# *HEAD – ROUTINE (SEQUENTIAL): SELECTED SIEMENS SCANNERS*

- Topogram: Lateral, 256 mm.
- Patient positioning: Patient lying in supine position, arms resting along the body, secure head well in the head holder, support lower legs.

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- Gantry tilt is available for sequence scanning, not for spiral scanning.

  Gantry tilt is not available for dual source scanners.

# *HEAD – ROUTINE (SEQUENTIAL): SELECTED SIEMENS SCANNERS*

- For all head studies, it is very important for image quality to position the patient in the center of the scan field. Use the lateral laser beam to make sure that the patient is positioned in the center.
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center. No recon job with a field of view exceeding those limits will be possible. Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.

# HEAD – ROUTINE (SEQUENTIAL): SELECTED SIEMENS SCANNERS

| Parameter | Sensation 16 | Sensation 64 | Definition (dual source, 64 slices) | Definition AS (128 slices) | Definition Flash (dual source, 128 slices) |
|---|---|---|---|---|---|
| **Software version** | VB30 | VB30 | VA34 | VA27 | **VA34** |
| **Scan mode** | seq | seq | seq | seq | **seq** |
| **Tube voltage / kV** | 120 | 120 | 120 | 120 | **120** |
| **Effective mAs / Qual ref mAs*** | 270/310 Base/Cerebrum | 380 | 380 | 420 | **340** |
| **Rotation time / s** | 1.0 | 1.0 | 1.0 | 1.0 | **1.0** |
| **Collimation / mm** | 12×0.75/12×1.5 Base/Cerebrum | 24×1.2 | 30×0.6 | 60×0.6 | **32×1.2** |
| **Pitch** | n.a. | n.a. | n.a. | n.a. | **n.a.** |
| **Dose modulation** | n.a. | n.a. | n.a. | n.a. | **n.a.** |
| | | | | | |
| **Scan area** | head | head | head | head | **head** |
| **Scan length / mm** | 40.5/81.0 Base/Cerebrum | 138 | 120 | 138 | **133.06** |
| **Scan time / s** | 1.0/1.0 Base/Cerebrum | 1.0 | 2.0 | 2.0 | **2.0** |
| **CTDIvol (16 cm phantom)** | 60.5/59.5 Base/Cerebrum | 53.0 | 59.6 | 59.7 | **58.9** |
| | | | | | |
| **Reconstruction I** | | | | | |
| **Kernel** | H31s | H31s | H31s | H31s | **H31s** |
| **Slice / mm** | 4.5/9.0 Base/Cerebrum | 4.8 | 6.0 | 6.0 | **5.0** |
| **Slice increment / mm** | n.a. | n.a. | n.a. | n.a. | **n.a.** |
| | | | | | |

# HEAD – ROUTINE (SPIRAL): SELECTED SIEMENS SCANNERS

- Gantry tilt is available for sequence scanning, not for spiral scanning.
  Gantry tilt is not available for dual source scanners.
- For all head studies, it is very important for image quality to position the patient in the center of the scan field. Use the lateral laser beam to make sure that the patient is positioned in the center.

# HEAD – ROUTINE (SPIRAL): SELECTED SIEMENS SCANNERS

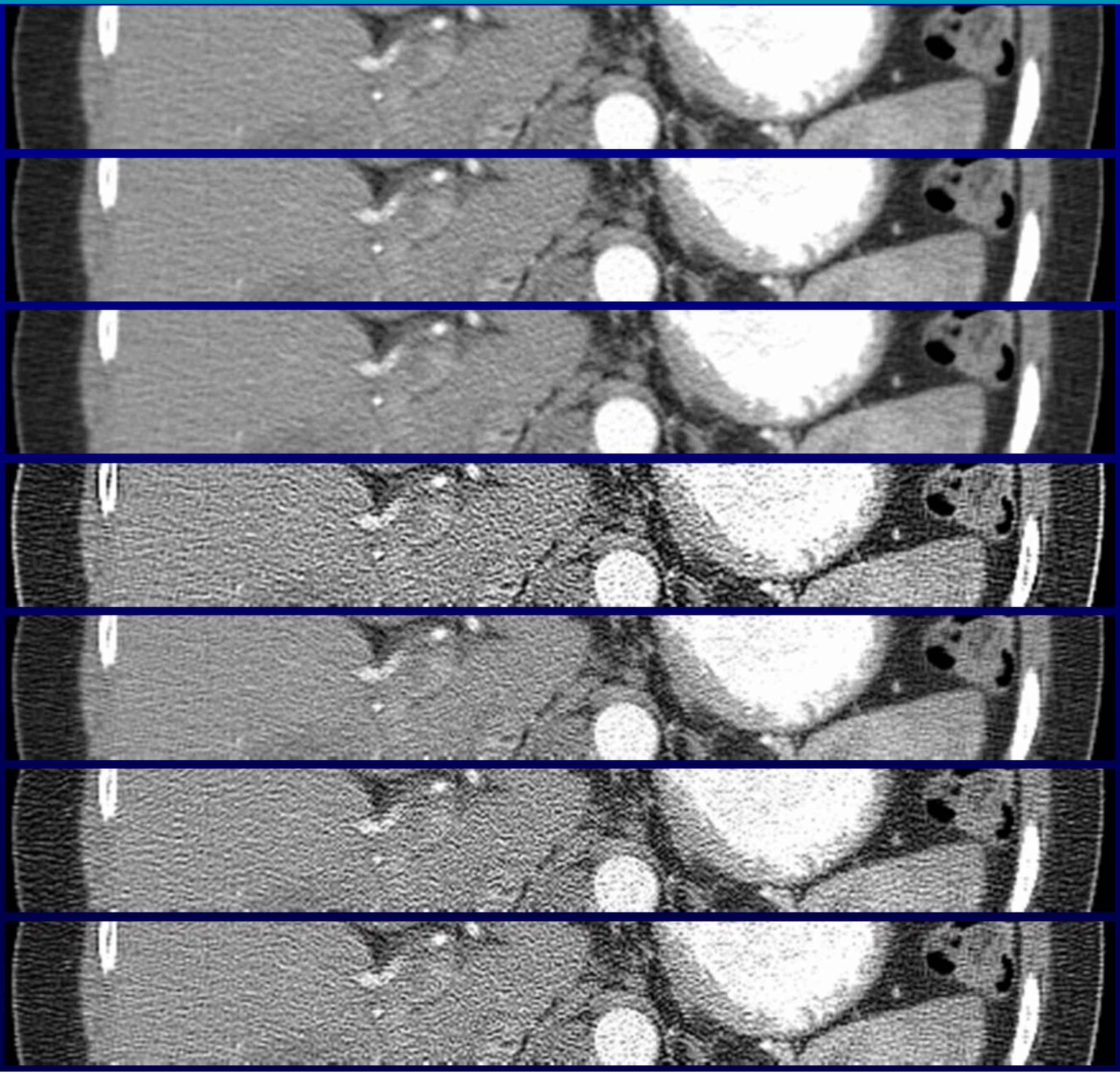
- In order to optimize image quality versus radiation dose, scans are provided within a maximum scan field of 300 mm with respect to the iso-center.
- No recon job with a field of view exceeding those limits will be possible.
- Therefore, patient positioning has to be performed accurately to ensure a centered location of the skull.

**TOPOGRAM:** Lateral , 256, 120 kV, 50 mA, direction is craniocaudal.

# *HEAD – ROUTINE (SPIRAL): SELECTED SIEMENS SCANNERS*

| Parameter | Sensation 64 | Definition (dual source, 64 slices) | Definition AS (128 slices) | Definition Flash (dual source, 128 slices) |
|---|---|---|---|---|
| **Software version** | VB30 | VA34 | VA27 | **VA34** |
| **Scan mode** | spi | spi | spi | **spi** |
| **Tube voltage / kV** | 120 | 120 | 120 | **120** |
| **Effective mAs / Qual ref mAs*** | 380 | 390 | 410 | **390** |
| **Rotation time / s** | 1.0 | 1.0 | 1.0 | **1.0** |
| **Collimation / mm** | 64×0.6 | 64×0.6 | 128×0.6 | **128×0.6** |
| **Pitch** | 0.85 | 0.55 | 0.55 | **0.55** |
| **Dose modulation** | CARE Dose | CARE Dose | CARE Dose | **CARE Dose** |
| **CTDIvol** | 59.7 | 59.3 | 58.9 | **59.6** |
| | | | | |
| **Reconstruction** | | | | |
| **Recon Start** | Top of Frontal Sinus | Top of Frontal Sinus | Top of Frontal Sinus | **Top of Frontal Sinus** |
| **Recon End** | Vertex | Vertex | Vertex | **Vertex** |
| **Kernel** | H31s | H31s | H31s | **H31s** |
| **Slice / mm** | 5.0 | 5.0 | 5.0 | **5.0** |
| **Slice increment / mm** | 5.0 | 5.0 | 5.0 | **5.0** |
| | | | | |

# GE Recon Algorithms



Soft

Standard

Detail

Lung

Bone

Edge

Bone Plus

Courtesy C. McCollough

# *Siemens Recon Kernels*

- B10 → B90 Body (90 is sharpest)
- H10 → H90 Head
- U30 → U90 Ultra High Resolution
- T20 → T81 Topogram
- Lower number smoother
- Higher number sharper
- Multiples of 10 are the "basic" kernels
- In between values are "special" kernels

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# Review

- Basic CT Parameters common to all manufacturers
  - The AAPM Lexicon website
- Expected results
  - $CTDI_{vol}$ within range
  - Time related factors (motion, mA, effective mAs, pitch, etc.)
  - Thickness/resolution and noise requirements in the reconstructed images
    - Retro recon capabilities/limitations?
- Start with most common exams, with ACR MAP data
  - Adult head, abdomen, ped abdomen
- Chest protocol examples (Mayo)
- Example using AAPM Web site for Routine Head scan (WIP)
- Balance specific benefits of features for each manufacturer