Enterprise-wide consistent protocol naming

Christina Brunnquell, PhD, DABR
The challenge

Hospitals
- UWMC - Montlake
- UWMC - Northwest
- Seattle Children's Hospital
- Seattle Cancer Care Alliance
- Harborview

Clinics (some of them)
Why do protocol names matter?

• Practice consistency and clarity
  › Correct protocol for the patient
  › Reduce extra phases and contrast due to potentially unclear protocol variants
  › Appropriate recons, post-processing, and hanging protocols

• Different protocol names add a layer of complexity to the translation between orders and procedures (multiple protocols per study type and indication)

• Streamline protocol management (cloud-based protocol managers)
Current Workflow

Ordering Physician
- Signs and Symptoms
  <EMR>

Protocolled by Rads/Techs

CT Scanner

Dose Monitoring Software

PACS

Processing Workstations

Analytics tools
Why do protocol names matter?

- Utility of analytics tools across the enterprise – scanner utilization and scheduling, exam time blocks, radiation dose, …

- Example: Radiologist emails me asking what our typical c-spine doses are

We may have only 100-200 scan protocols on each individual CT scanner but...

- 776 lexical variants at UWMC, 652 variants at HMC, 371 variants at SCCA
Proposal: Consistent protocol naming

- Physicist (works across sites) work with group of site-specific technologists
- Establish baseline naming convention (and rules for future protocols)
- Create 1-1 link between protocol identifiers on EHR and scanners
  - Facilitate technologist (instead of radiologist) protocoling for a larger portion of exams
<table>
<thead>
<tr>
<th>Category</th>
<th>INDICATIONS</th>
<th>Protocol Code</th>
<th>Design Philosophy</th>
<th>Proposed Protocol name (HMC)</th>
<th>Proposed Protocol name (UWMC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain - Head (Routine)</td>
<td>Mental status change, trauma, stroke, fall, intracranial hemorrhage, hydrocephalus</td>
<td>NCH</td>
<td>For routine head imaging and emergent imaging including trauma, hemorrhage, hydrocephalus, tumor, and preliminary stroke screening. May need to add contrast for more sensitive evaluation of tumor or infection.</td>
<td>HEAD WO</td>
<td>HEAD W IV</td>
</tr>
<tr>
<td>Brain (Trauma Model)</td>
<td>Mental status change, trauma, stroke, fall, intracranial hemorrhage, hydrocephalus</td>
<td>NCH</td>
<td>For routine head imaging and emergent imaging including trauma, hemorrhage, hydrocephalus, tumor, and preliminary stroke screening. May need to add contrast for more sensitive evaluation of tumor or infection.</td>
<td>HEAD ROUTINE WO</td>
<td>HEAD TRAUMA WO</td>
</tr>
<tr>
<td>Stealth Head (Whole Brain Treatment Planning)</td>
<td>Stereotactic guidance imaging for operating room</td>
<td>NCHSU</td>
<td>This is a protocol which delivers thin section images for use in whole brain radiation treatment planning, intraoperative neuronavigation, and cryosurgery planning. Image requirements for this software associated with these use cases, and verification of compatibility is recommended.</td>
<td>HEAD WO</td>
<td>HEAD W IV/3PLAN</td>
</tr>
<tr>
<td>Orbit - Routine</td>
<td>Orbital Meso, Foreign Body, Trauma, Orbital processes</td>
<td>NCOFORB (NEO-CON) NCOFORB (WIV)</td>
<td>For evaluation of infection, inflammatory, or neoplastic processes. May add contrast as needed to increase sensitivity. May also be used for trauma, blunt or penetrating, localized to the orbit. Not to evaluate diffuse facial trauma or infection/inflammatory processes, as this requires a CT examination.</td>
<td>ORBIT WO</td>
<td>ORBIT W IV</td>
</tr>
</tbody>
</table>

When in doubt, please ask/double check/call referring provider!
Impact

CT and MR Protocol Standardization Across a Large Health System: Providing a Consistent Radiologist, Patient, and Referring Provider Experience

Peter B. Sachs¹ · Kelly Hunt¹ · Fabien Manouachi² · James Borgstede¹

and formation of a governance structure. We utilized rapid improvement events (1 day for CT, 2 days for MR) and reduced 248 CT protocols into 97 standardized protocols and 168 MR protocols to 66. Additional steps are underway to further

filiations, if desired). The protocol standardization across all regions of our health system insures the continuity of these protocols and will significantly decrease the work effort for the information technology teams as expansion continues. We

EMR exam order identifier: “Visit type” Redefined as unique protocol/region combination

Protocoling before scheduling

visit-type build effort is significant, each visit type can be tied to a unique performing resource (if required), and the correct time slot, protocol specific exam instructions, and prep can be sent to the patient electronically via the patient portal, email, or telephone. For

have been proven to work well. A key advantage of this system, however, is preventing the need to obtain repeat insurance authorization if a protocol is changed after scheduling, a step which occurs with some frequency in the current system.
Impact

• Facilitation of technologist or automated protocoling

Protocol guide example

800,000 imaging exams per year
  › 5000 CT exams in 15-week study
  › 1650 by technologists in
  › 5 hours of CT technologist time per week
  › <0.2% error rate (3/1650)
  › Radiologist protocoling responsibilities decreased by ~25-35%
Timeliness analytics
The challenge

• **Efficiency** is essential
  › For emergent patients, imaging efficiency directly impacts patient outcomes
  › For routine imaging, reducing exam blocks can impact volumes immensely ($$)

![Image of stroke awareness](image)

![Diagram of patient scheduling](image)

\[
\text{table utilization} = \frac{\sum \text{exam time}}{\sum \text{scheduled working time}}
\]


• What contributes to high- or low-efficiency operations?
<table>
<thead>
<tr>
<th>Before scanning</th>
<th>During scanning</th>
<th>Before next patient</th>
<th>Before interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Scanner prep</td>
<td>• Coach patient</td>
<td>• Finish recons &amp;</td>
<td></td>
</tr>
<tr>
<td>• Open exam and</td>
<td>• Prescribe scans,</td>
<td>reformats at scanner</td>
<td></td>
</tr>
<tr>
<td>prepare protocol</td>
<td>adjust parameters</td>
<td>• End patient exam</td>
<td></td>
</tr>
<tr>
<td>• Contrast prep</td>
<td>• Perform scans</td>
<td>• On scanner</td>
<td></td>
</tr>
<tr>
<td>• Patient</td>
<td>• Reformats</td>
<td>• On schedule</td>
<td></td>
</tr>
<tr>
<td>arrival, escort</td>
<td>• Contrast</td>
<td>• Escort patient</td>
<td></td>
</tr>
<tr>
<td>to scan room</td>
<td>delivery</td>
<td>out</td>
<td></td>
</tr>
<tr>
<td>• Patient</td>
<td></td>
<td>• Clean up</td>
<td></td>
</tr>
<tr>
<td>positioning</td>
<td></td>
<td></td>
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<tr>
<td>and discuss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>exam</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Before interpretation
  - Networking
  - Post-processing
Where can we increase efficiency?

Before scanning
• Scanner prep
• Open exam and prepare protocol
• Contrast prep
• Patient arrival, escort to scan room
• Patient positioning and discuss exam

During scanning
• Coach patient
• Prescribe scans, adjust parameters
• Perform scans
• Reformats
• Contrast delivery

Before next patient
• Finish recons & reformats at scanner
• End patient exam
  • On scanner
  • On schedule
• Escort patient out
• Clean up

Before interpretation
• Networking
• Post-processing

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Szczykutowicz, Brunquell, Avey et al. J Digit Img 2018 31:201-209.
Localizer

Head without contrast

CTA

Perfusion

Head with contrast

Acquisition

Recon

Send to PACS

Interpretation

& feedback

Send to PACS

To workstation

Map processing

Maps to PACS

Interpretation

Time

Single patient:

Head w/o contrast

CT angiography

Perfusion

Head with contrast

0 5 10 15 20 25
Time since localizer acquisition [min]

Event

Series set-up

Acquisition

Reconstruction

Available in PACS

Corresponding timestamp

DICOM (0008,0031)

DICOM (0008,0032)

DICOM (0008,0033)

Available in PACS

PACS file time

Brunnquell, Avey, Szczykutowicz. JACR 2018 15(6).
**Measured impact of workflow change**

**Protocol change:** Proceed directly to CTA after head non-con without waiting for further instruction from attending neurologist after hemorrhage exclusion.

- **Head non-con to CTA delay**
- **Time to acquire all series**
  - $p < 0.001$ Kruskal-Wallis one-way ANOVA
  - Median time to acquire reduced from 12 to 7.5 min

Brunnquell, Avey, Szczykutowicz. JACR 2018 15(6).
Measured impact of technologist variability

- Striking variability between technologists
  - Median time to acquire full exam: **4.75-15.28** minutes (p<0.001)
  - Median time to PACS: 15.4-51.8 minutes (p<0.001)

![Time to acquire full exam](chart)

- Fastest techs
- p<0.001 Kruskal-Wallis one-way ANOVA

Brunnquell, Avey, Szczykutowicz. JACR 2018 15(6).
Other measured impacts

• Purchase of processing software with streamlined workflow: reduced time from perfusion acquisition to maps in PACS by 6 min

• Comparison between 4 scanners used for acute stroke cases (at 2 sites): 1 site took
  • 37% longer to acquire acute stroke exams (2.5 min)
  • 35% longer for full exam to be available in PACS (7.7 min)

Brunnquell, Avey, Szczykutowicz. JACR 2018 15(6).
Impact