Enterprise-wide consistent protocol naming

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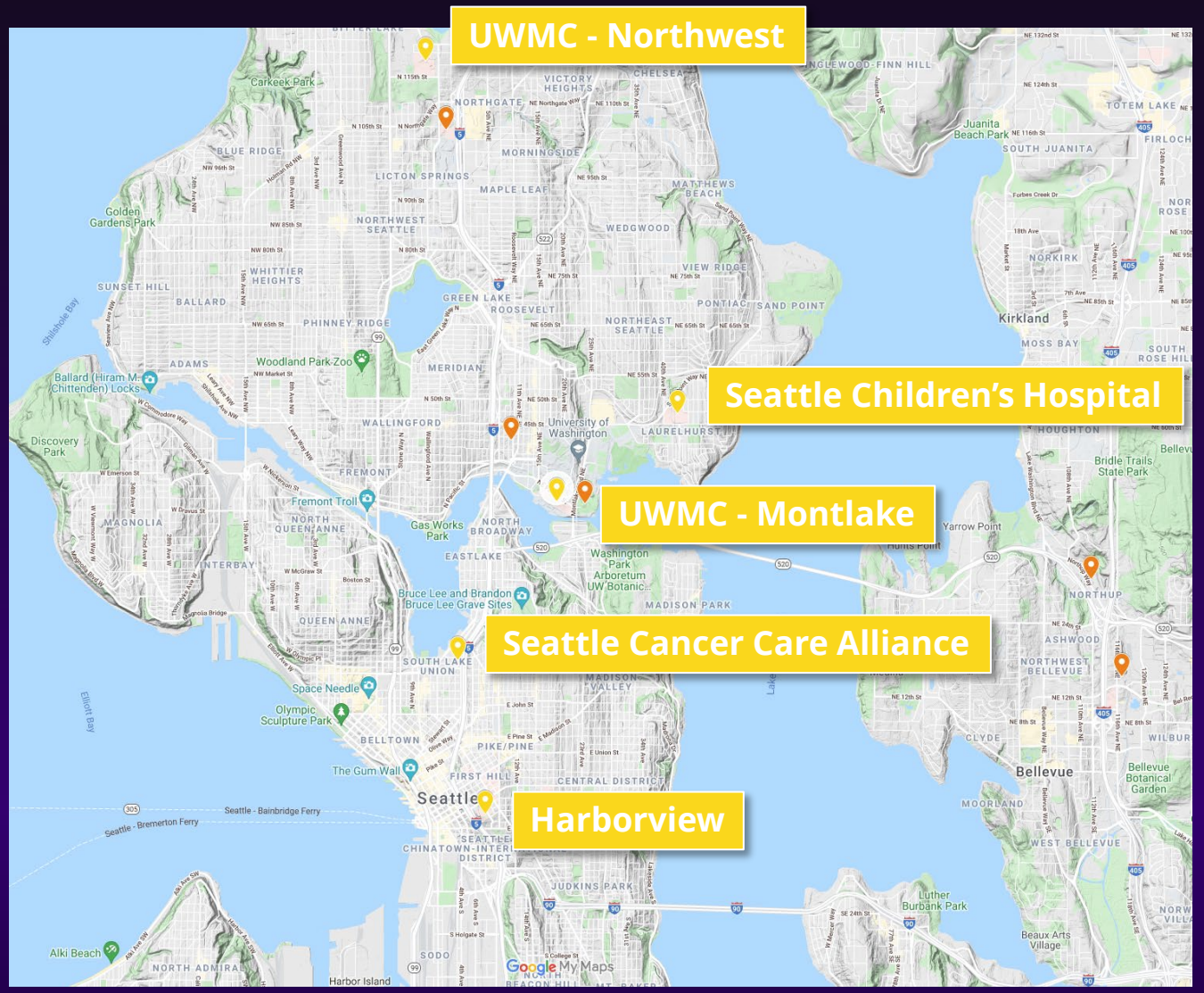
The challenge

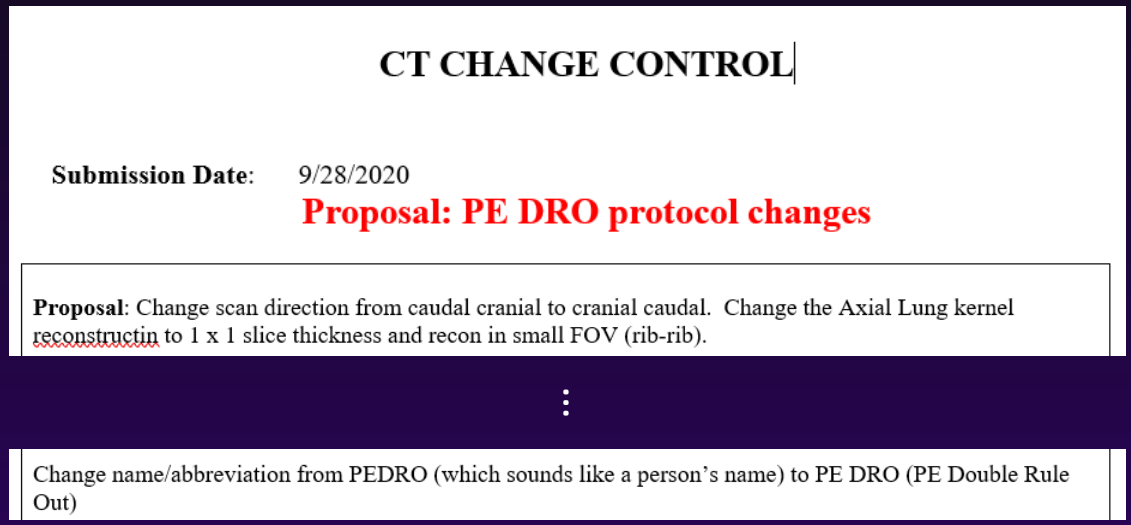
Hospitals

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



CT CHANGE CONTROL

Submission Date: 9/28/2020

Proposal: PE DRO protocol changes

Proposal: Change scan direction from caudal cranial to cranial caudal. Change the Axial Lung kernel reconstructin to 1 x 1 slice thickness and recon in small FOV (rib-rib).

⋮

Change name/abbreviation from PEDRO (which sounds like a person's name) to PE DRO (PE Double Rule Out)

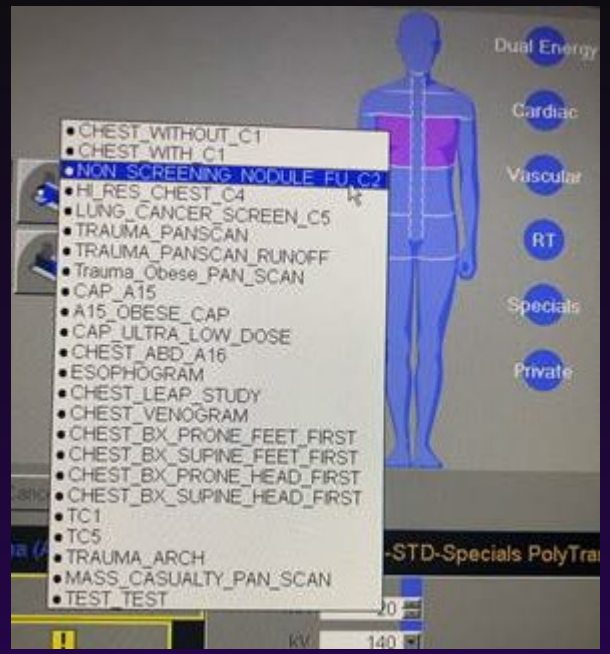
- Different protocol names add a layer of complexity to the translation between orders and procedures (multiple protocols per study type and indication)

- Streamline protocol management (cloud-based protocol managers)

Current Workflow

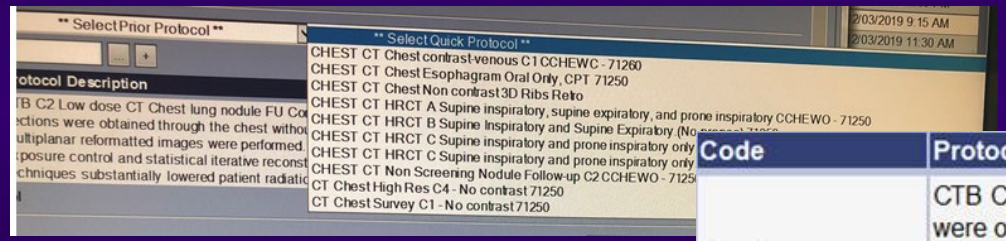
Ordering Physician
- Signs and Symptoms

<EMR>

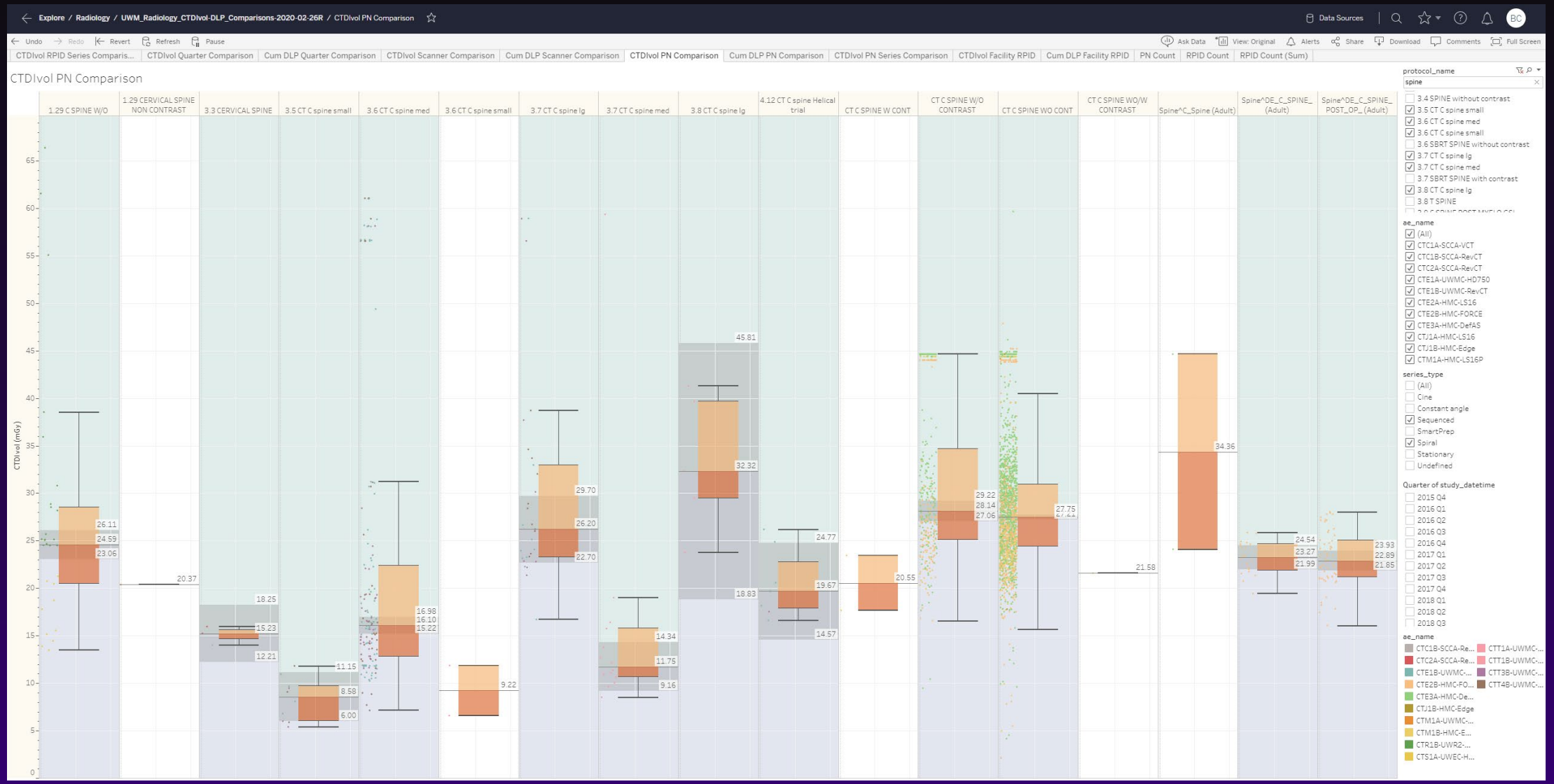


\+ CPT CODES → **Protocolled by Rads/Techs** → **CT Scanner**

- **Dose Monitoring Software**
- **PACS**
- **Processing Workstations**
- **Analytics tools**



Code	Protocol Description	Comments
CT C2	CTB C2 Low dose CT Chest lung nodule FU Contiguous axial sections were obtained through the chest without contrast. Multiplanar reformatted images were performed. Automated exposure control and statistical iterative reconstruction techniques substantially lowered patient radiation dose.	



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 techologist (instead of radiologist) protocoling for a larger portion of exams

Neuroradiology

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

Category	INDICATIONS	Protocol Code	Design Philosophy	Proposed Protocol name (HMC)	Proposed Protocol name (UWMC)
Brain – Helical GSI Routine with Angled Axial Reformations	Mental status change, trauma, stroke, fall, intracranial hemorrhage, hydrocephalus	NCH	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.	HEAD WO HEAD W IV DE HEAD WO DE HEAD W IV DE HEAD WO W IV or DE HEAD WW Siemens – underscore GE – has numbers	DE HEAD ROUTINE WO
Brain (Axial Mode)	Mental status change, trauma, stroke, fall, intracranial hemorrhage, hydrocephalus	NCH	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.		HEAD ROUTINE WO HEAD TRAUMA WO HEAD WO HEAD TRAUMA WO
Stealth Head (Whole Brain Treatment Planning)	Stereotactic guidance imaging for operating room	NCHSUR	This is a protocol which delivers thin section images for use in whole brain radiation treatment planning, intraoperative neuro navigation, and cranioplasty planning. Image requirements for the software associated with these uses varies, and verification of compatibility is recommended.	HEAD WO/SPLAN HEAD W IV/SPLAN HEAD NAV WO HEAD STEALTH WO HEAD NAV W IV HEAD STEALTH W IV	STEALTH HEAD WO
Orbit - Routine	Orbital Mass, Foreign Body, Trauma, Orbital, proptosis	NCFORB (NON-CON) NCFORBW (WITH IV)	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 maxillofacial.	ORBIT WO ORIBIT W IV ORBIT WO ORBIT W IV	ORBIT WO ORBIT W

Impact

J Digit Imaging (2017) 30:11–16
DOI 10.1007/s10278-016-9895-8

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

Peter B. Sachs[1] · Kelly Hunt[1] · Fabien Mansoubi[2] · James Borgstede[1]

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 →

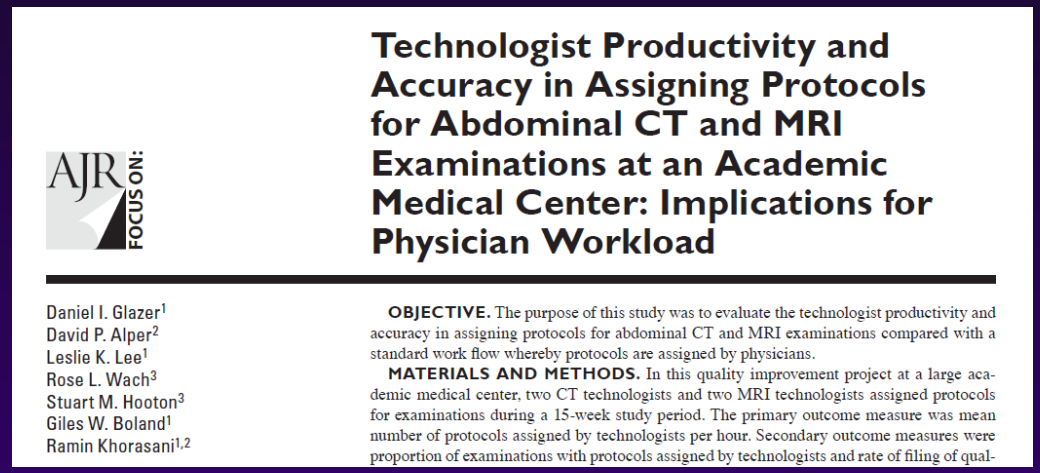
visit-type build effort is significant, each visit type can be tied to a unique performing resource (if required), and the correct time slot, protocol specific exam instructions, and prep can be sent to the patient electronically via the patient portal, email, or telephone. For

Protocoling before scheduling ↓

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



AJR FOCUS ON:

Technologist Productivity and Accuracy in Assigning Protocols for Abdominal CT and MRI Examinations at an Academic Medical Center: Implications for Physician Workload

Daniel I. Glazer[1]
David P. Alper[2]
Leslie K. Lee[1]
Rose L. Wach[3]
Stuart M. Hooton[3]
Giles W. Boland[1]
Ramin Khorasani[1,2]

OBJECTIVE. The purpose of this study was to evaluate the technologist productivity and accuracy in assigning protocols for abdominal CT and MRI examinations compared with a standard work flow whereby protocols are assigned by physicians.

MATERIALS AND METHODS. In this quality improvement project at a large academic medical center, two CT technologists and two MRI technologists assigned protocols for examinations during a 15-week study period. The primary outcome measure was mean number of protocols assigned by technologists per hour. Secondary outcome measures were proportion of examinations with protocols assigned by technologists and rate of filing of qual-

radiologists. The number of unique CT and MRI protocols far exceeds the number of unique CT and MRI orders that can be placed in the EHR. Ideally, we attempt to assign protocols for imaging studies 1 week in advance. In practice, there are frequently same-day additions or incomplete protocols, requiring technologists to call the reading room for generation of a study protocol.

Protocol guide example

TABLE 1: Examples Provided to Technologists to Guide Mapping of Appropriate Body CT Protocols Based on Order in the Electronic Health Record and Patient Presentation

Order Entered by Referring Provider	Clinical Scenario	Correct Protocol	IV Contrast Administration	Oral Contrast Administration
Neck, chest, abdomen, pelvis	Malignancy, typically lymphoma	I+/O+ neck, chest, abdomen, pelvis	Yes	Iohexol
Chest, abdomen, pelvis	Suspected or known malignancy workup, weight loss, fever, pain, other	I+/O+ chest, abdomen, pelvis	Yes	Iohexol
Abdomen, pelvis	Abdominal pain, weight loss, fever, other	I+/O+ abdomen, pelvis	Yes	Iohexol
Abdomen, pelvis	Suspected or known malignancy workup	I+/O+ abdomen, pelvis	Yes	Iohexol
Abdomen, pelvis	Flank pain	I–/O– abdomen, pelvis (stone protocol)	No	No
Abdomen, pelvis	Suspected pancreatic mass, jaundice, chronic pancreatitis	I+/O+ dual-phase[a] abdomen, pelvis	Yes	Yes (water)
Urogram	Hematuria or hydronephrosis (typically painless)	I+/O+ three-phase abdomen, pelvis (urogram[b])	Yes	Yes (water)
Enterography	Inflammatory bowel disease	I+/O+ abdomen, pelvis	Yes	Yes (neutral agent)

Note—CT neck, chest, abdomen, pelvis and CT chest, abdomen, pelvis are included because protocols for these multipart examinations are assigned by the abdominal division. I+ = with IV contrast administration, I– = without IV contrast administration, O+ = with oral contrast administration, O– = without oral contrast administration.
[a]Dual-phase imaging is 45-second delay for abdomen followed by 70-second delay for abdomen and pelvis.
[b]Urogram is unenhanced for abdomen and pelvis, 100-second delay for abdomen, and 15-minute delay for abdomen and pelvis.

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

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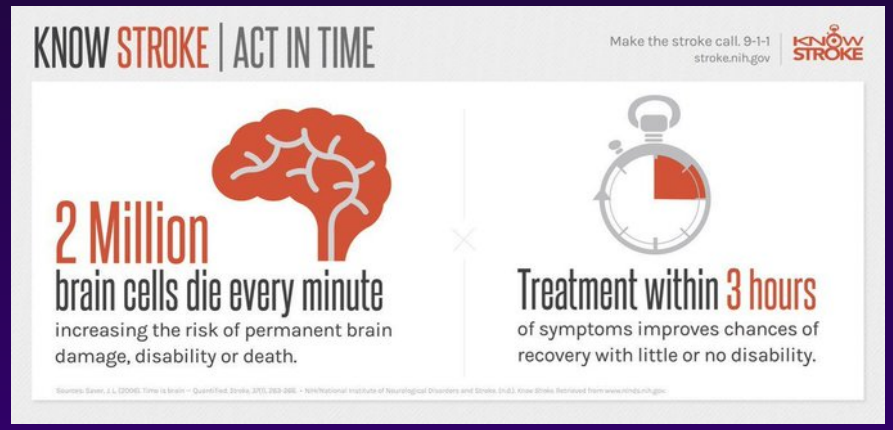
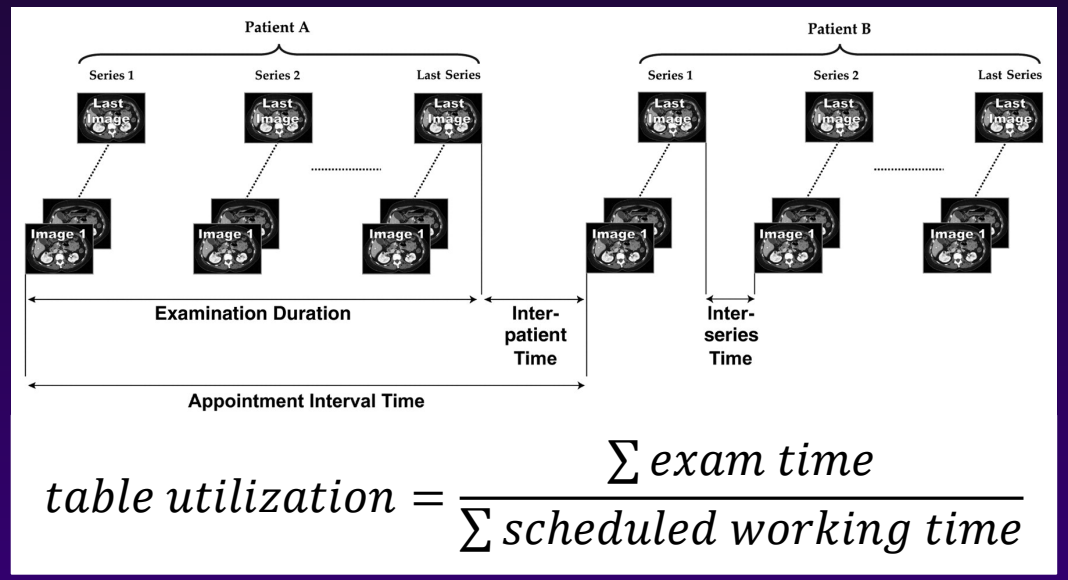
The challenge

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





Hu, Pavlicek, Liu *et al.* Radiographics 2011 31(2).

- What contributes to high- or low-efficiency operations?

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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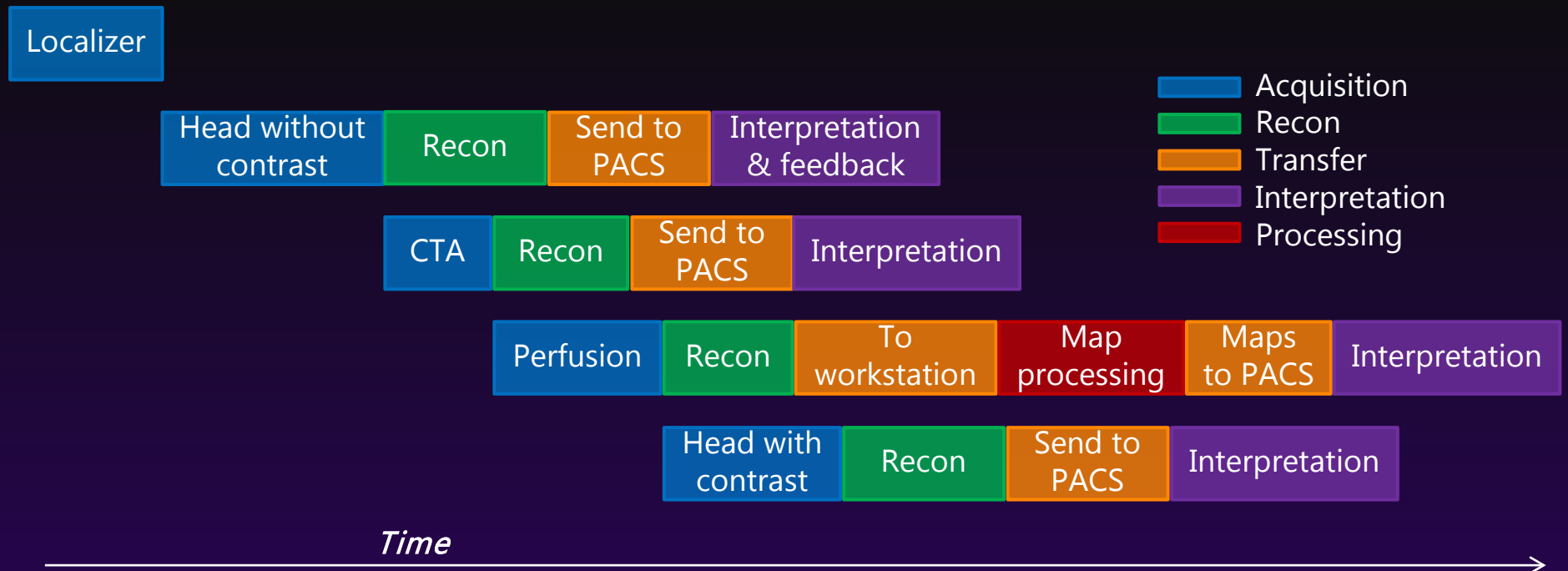
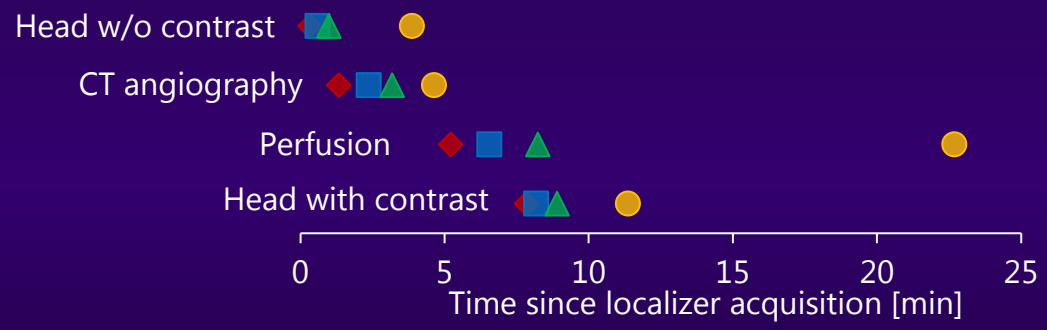
Workflow step	Digital record (i.e., "digital footprint")
Marks a study as reviewed in PACS	PACS system database
Image creation time	DICOM tag 0008,0033 (image pixel data creation time or waveform formation time)
Networking time (i.e., time point when a scanner or technologist transmits and image from the imaging device to another processing step or to a physician for interpretation)	Not a standard DICOM tag. Can be stored by object storage technologies (i.e., hyper-converged infrastructures), can be interrogated from PACS/VNA database system file creation time, can be obtained from an interface engine that stores file transfer times (e.g., Mirth, Nextgen Healthcare, Irvine, CA)

Workflow step	Digital record (i.e., "digital footprint")
Medicine Administration Record data entry	EHR (medication administration record)
End patient exam on scanner	Possible to obtain this from scanner system logs or on modalities that print exam summaries, the end exam time will correspond to the image creation time of the summary DICOM object (e.g., dose screen save or SR dose object in CT)
End patient exam on schedule	RIS

Szczykutowicz, Brunnquell, Avey *et al*. J Digit Img 2018 31:201-209.



Single patient:

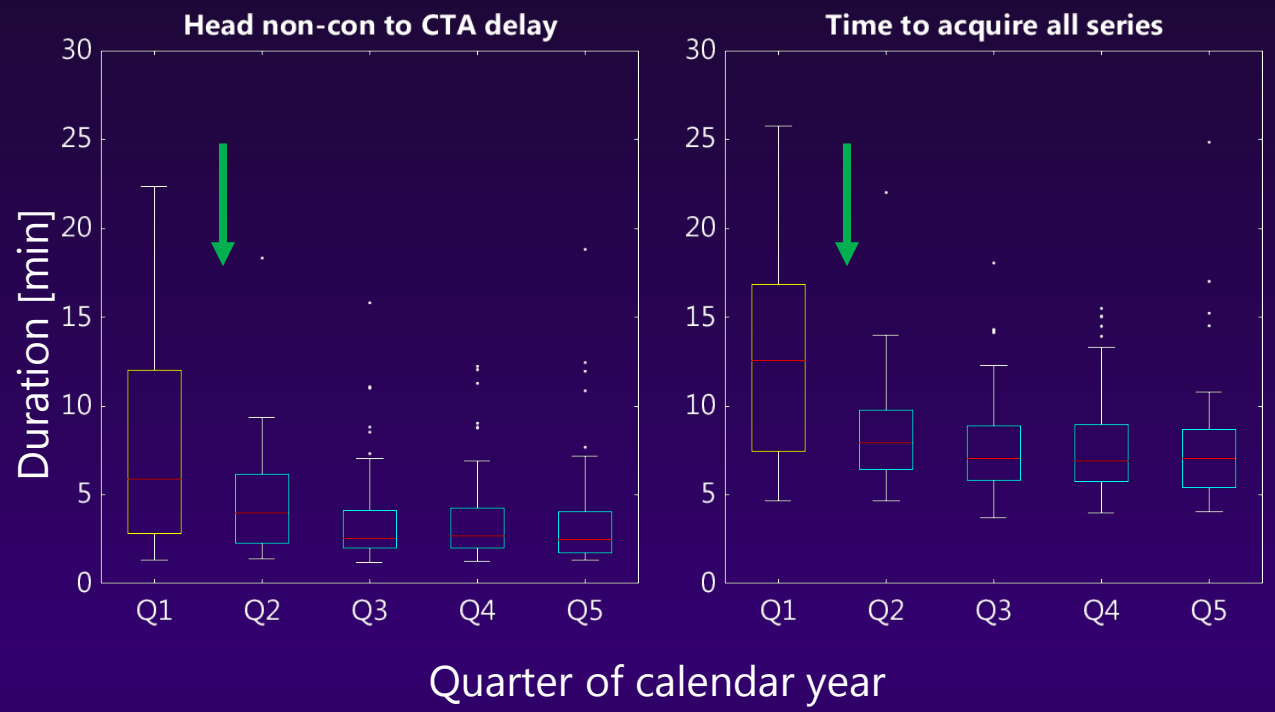


Event	Corresponding timestamp
Series set-up	DICOM (0008,0031)
Acquisition	DICOM (0008,0032)
Reconstruction	DICOM (0008,0033)
Available in PACS	PACS file time

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



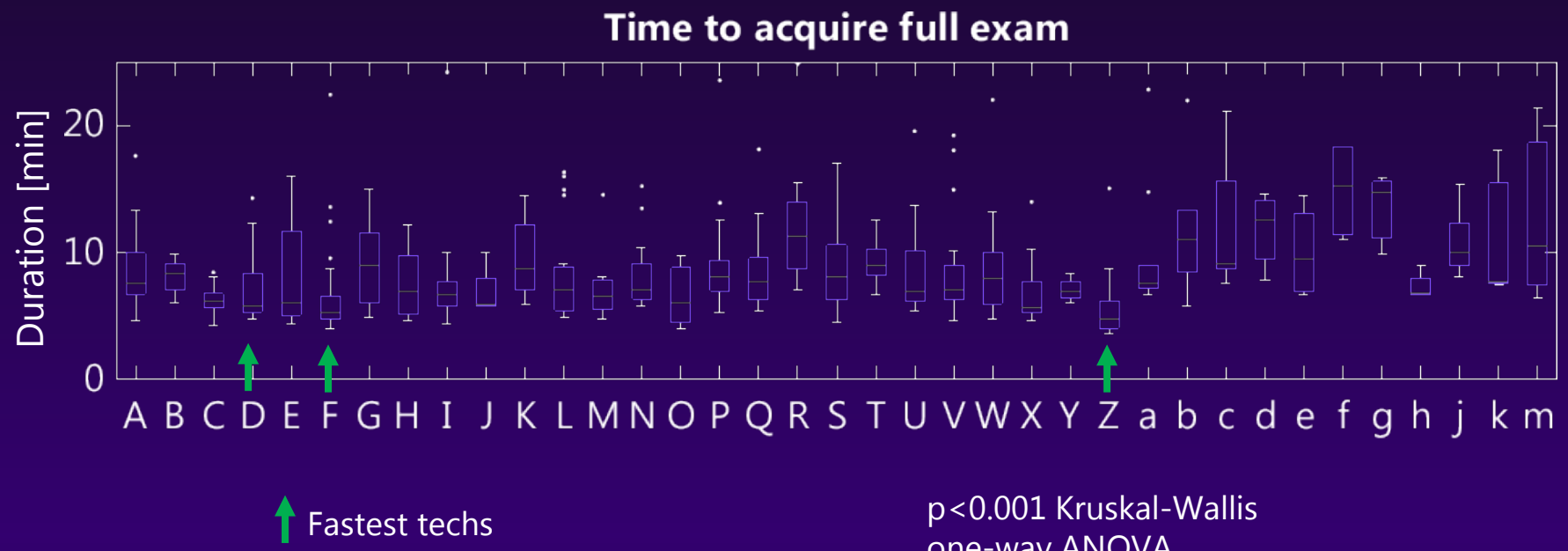
p<0.001 Kruskal-Wallis one-way ANOVA

Median time to aquire 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 ($p<0.001$)



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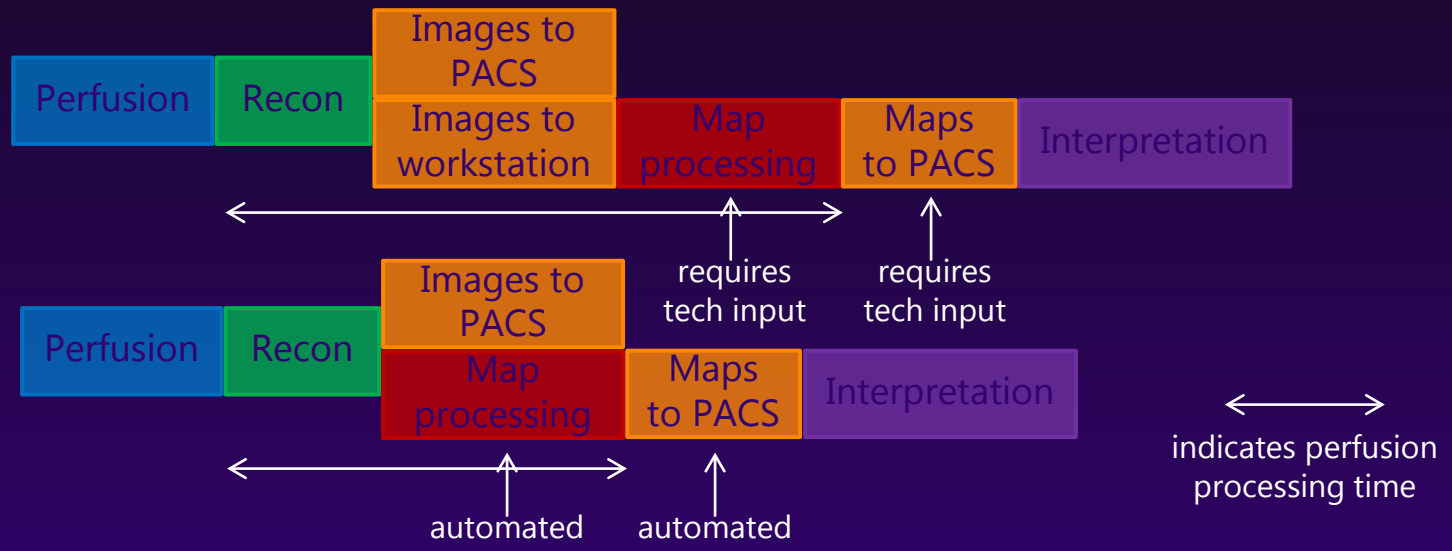
Other measured impacts

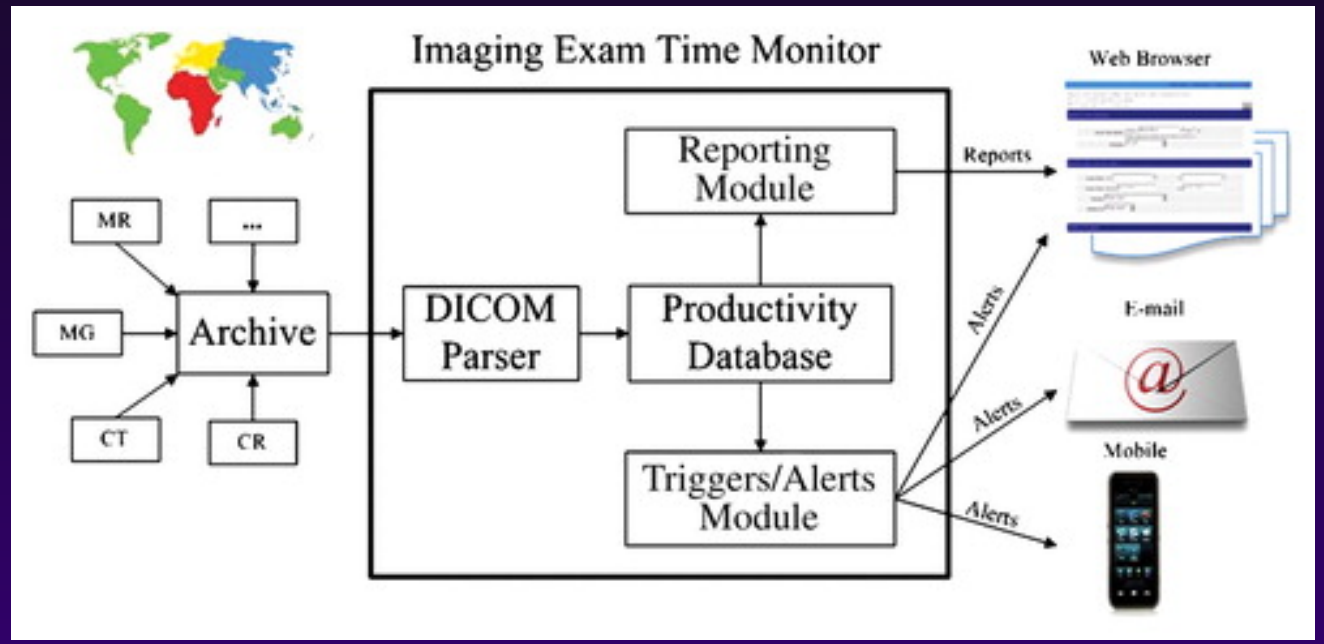
- Purchase of processing software with streamlined workflow: reduced time from perfusion acquisition to maps in PACS by 6 min

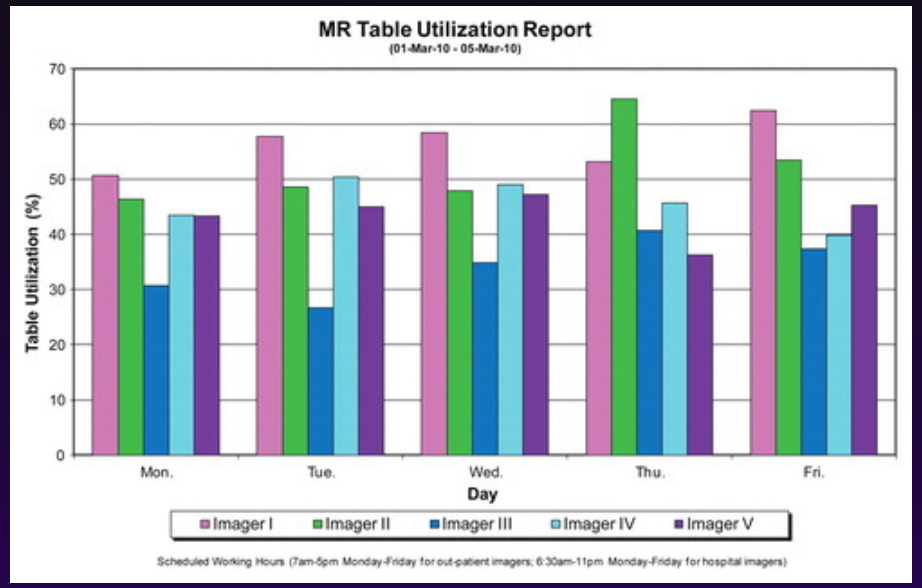


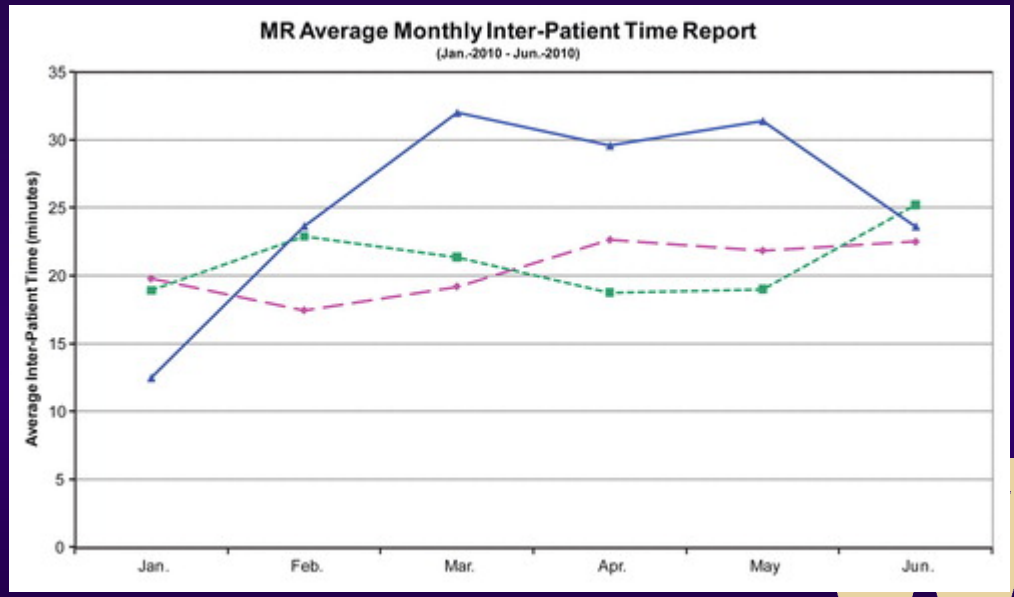
- Comparison between 4 scanners used for acute stroke cases (at 2 sites): 1 site took
  - 37% longer to acquire acute stroke exams (2.5 min)
  - 35% longer for full exam to be available in PACS (7.7 min)

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

Impact







Hu, Pavlicek, Liu *et al.* Radiographics 2011 31(2).