Peer Review of CT Examination Quality at the University of Alabama at Birmingham Hospital

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PURPOSE

To improve CT examination quality through technologist and radiologist peer review, involving monthly random audits for quality and completeness. Results are shared with staff for continuous improvement.

METHODS

Based on comments from radiologists, a radiologist's assistant, and CT technologists, problems were identified with inconsistency of CT examination quality, including oral and intravenous contrast administration, patient positioning; and unnecessary artifacts. The Department of Radiology Vice Chair for Quality Improvement, Senior Vice Chair for Operations, and Hospital Radiology Administration met to discuss these concerns.

As a result, a process improvement team was created and charged to develop a methodology to review CT exams for quality and completeness, and then use the results for feedback to staff. These goals were achieved by: 1) Establishing a process improvement team consisting of radiologists, CT technologists, and a team leader/facilitator; 2) Developing a random sampling methodology to select the examinations to be reviewed; and 3) Developing an audit tool and scoring criteria to use when reviewing CT exams for quality and completeness.
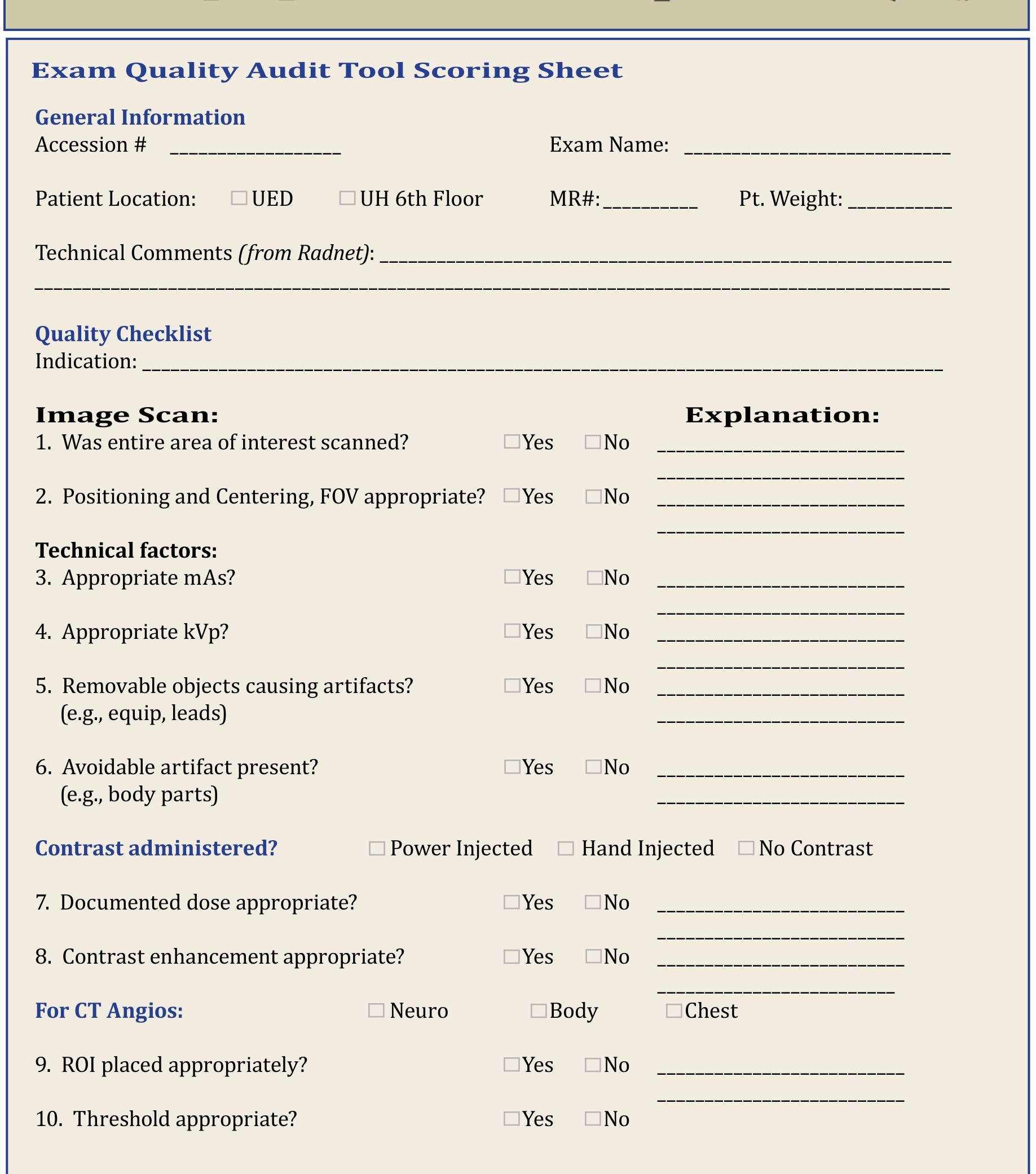
Case review forms ("audit tools") included the following examination criteria: 1) Was the entire area of interest scanned? 2) Were patient positioning, centering, and Field-of-View appropriate? 3) Were the technical factors mAs and kVp appropriate? 4) Did removable objects cause artifacts? 5) Were other avoidable artifacts present? 6) Was the documented contrast dose appropriate? 7) Was the contrast enhancement diagnostic? and 8) For CT angiograms, was the region-of-interest cursor placed appropriately and was the threshold appropriate? The team developed guidelines for reviewers to apply these criteria to improve scoring consistency among reviewers.
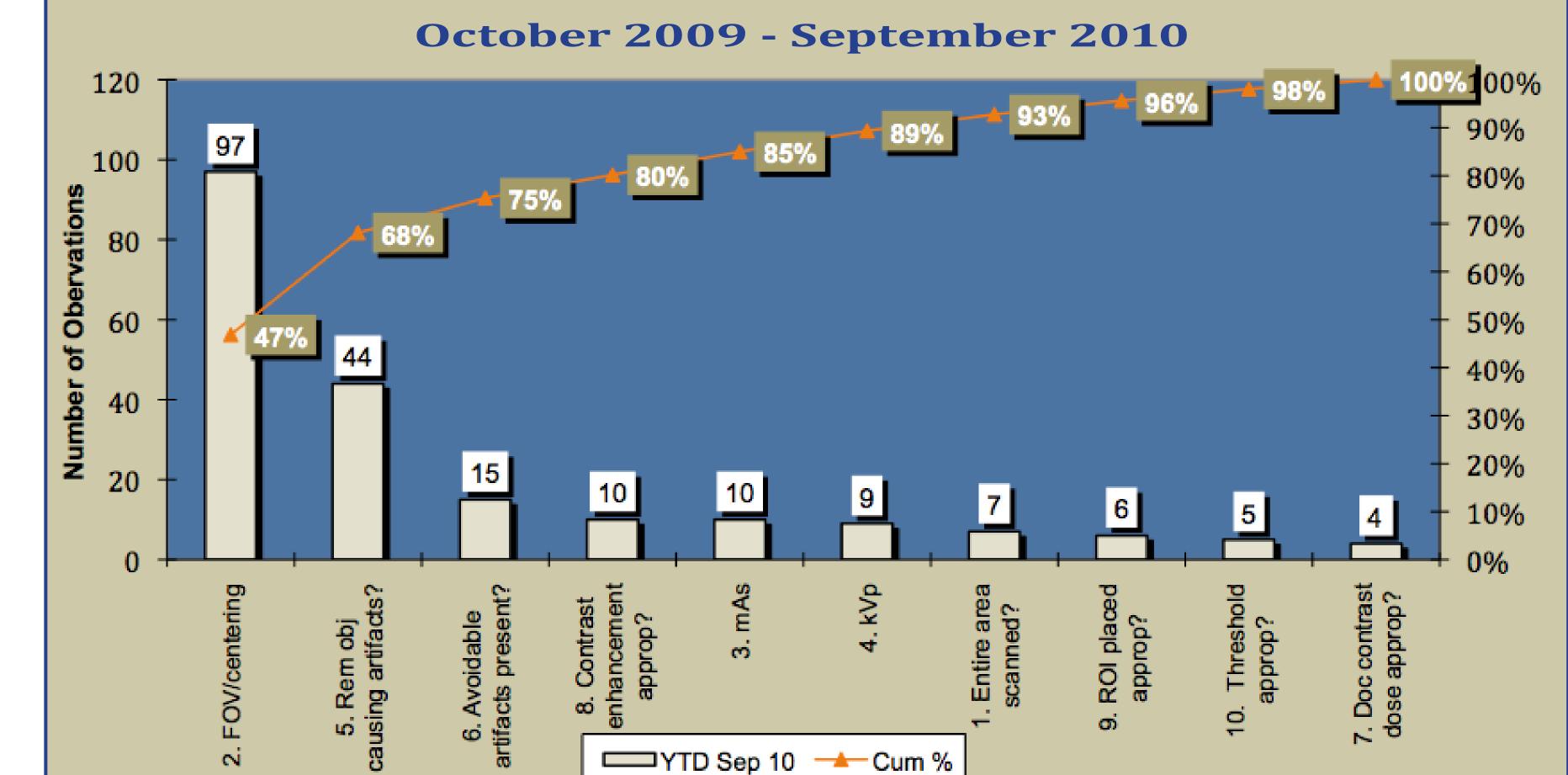
The team also implemented a process to determine which hospital CT examinations to review and audit. The designed process randomly selects the monthly sample size and the monthly UAB Hospital CT exams for review by team members. PACS worklists have been created for individual team members. On a monthly basis, these PACS worklists are populated with exams for review by the team members performing the monthly audits. The details of this process included: 1) Determining which technologists and radiologists would audit/review examinations and how to incorporate and train new staff in the audit process as needed; 2) Determining how to train staff on review criteria to promote consistent scoring among reviewers; 3) Developing a scoring methodology for the exam review process and methodology to monitor results, and 4) Disseminating results and providing feedback to technologists.

The audit process was test-piloted for several months to streamline and refine the review process and scoring methodology. The team also developed a plan to educate CT technologists on the review/scoring process as well as provide feedback for improvement based on the results. Additionally, processes were designed to: 1) educate newly hired CT technologists about the review process and exam quality criteria during new-hire orientation; 2) describe the CT examination quality review process and review criteria to staff at CT technologist section meetings; and 3) develop ways to recognize CT technologists who achieved 100% image quality scores.

UAB Hospital CT Exam Quality Peer Review — FY 2010 CT Exam Audit Scores

Month	Score
Oct-09	73%
Nov-09	86%
Dec-09	91%
Jan-10	86%
Feb-10	81%
Mar-10	84%
Apr-10	86%
May-10	85%
Jun-10	87%
Jul-10	91%
Aug-10	91%
Sep-10	89%

CT Exam Quality Peer Review: Opportunity for Improvement — October 2009 - September 2010

Category	Number of Observations	Cum %
2. FOV/centering	97	47%
5. Rem obj causing artifacts?	44	68%
6. Avoidable artifacts present?	15	75%
8. Contrast enhancement approp?	10	80%
3. mAs	10	85%
4. kVp	9	89%
1. Entire area scanned?	7	93%
9. ROI placed approp?	6	96%
10. Threshold approp?	5	98%
7. Doc contrast dose approp?	4	100%

Legend: YTD Sep 10 · Cum %

Exam Quality Audit Tool Scoring Sheet

General Information

Accession # _____   Exam Name: _____

Patient Location: ☐ UED   ☐ UH 6th Floor   MR#: _____   Pt. Weight: _____

Technical Comments *(from Radnet)*: _____
_____

Quality Checklist

Indication: _____

Image Scan: **Explanation:**

1. Was entire area of interest scanned?   ☐Yes ☐No   _____

2. Positioning and Centering, FOV appropriate? ☐Yes ☐No   _____

Technical factors:

3. Appropriate mAs?   ☐Yes ☐No   _____

4. Appropriate kVp?   ☐Yes ☐No   _____

5. Removable objects causing artifacts?   ☐Yes ☐No   _____
(e.g., equip, leads)

6. Avoidable artifact present?   ☐Yes ☐No   _____
(e.g., body parts)

Contrast administered?   ☐ Power Injected   ☐ Hand Injected   ☐ No Contrast

7. Documented dose appropriate?   ☐Yes ☐No   _____

8. Contrast enhancement appropriate?   ☐Yes ☐No   _____

For CT Angios: ☐ Neuro   ☐ Body   ☐ Chest

9. ROI placed appropriately?   ☐Yes ☐No   _____

10. Threshold appropriate?   ☐Yes ☐No

Audit Tool Scoring Criteria

1. *Was the entire area of interest scanned?* Per exam defined protocol, was the entire area of interest scanned, and was the entire pathology of question scanned?

2. *Positioning and centering, FoV appropriate?* Depending on body habitus and considering the reason for exam and what the clinician is looking for, is the positioning/centering and field of view (FoV) appropriate? Was the table raised appropriately to center the patient both vertically and horizontally in the gantry? No panning, no zooming?

3. *Appropriate mAs?* As an example using an mAs of 250 for an "average" patient for an abdominal CT exam, adjust accordingly based on patient body size: decrease mAs for thinner patients, increase mAs for larger patients. If patient is pregnant, expect images to be grainy. Images for non-pregnant patients that are too grainy or too clear most likely did not have appropriate mAs. The mAs for neuro exams may range from 120 – 500.

4. *Appropriate kVp?* The kVp is usually 120 for most exams, is lower for children/small adults and is higher for larger patients. The kVp is stated in protocol. Chest kVp may range from 80 – 120, and head CT exams may be 140. For CT Angio chest exams, kVp is noted in technical comments.

5. *Removable objects causing artifacts?* Removable objects include those objects which may be removed and not hinder patient care. Examples include but are not limited to earrings, jewelry including any body piercings, keys, belt buckles, bra straps, leads or wires that are NOT connected to any equipment (are not in use for patient care). Examples of types of objects that are necessary for patient care that should NOT be removed include c-collar, halo, EKG leads, etc.

6. *Avoidable artifact present?* Avoidable artifacts include artifacts from body parts such as an arm resting on the chest, etc. If the patient can not move his arms out of the scan view, the tech should note this in a brief comment, e.g., "patient can not move arm", under technical comments.

7. *Documented contrast dose appropriate?* Exam protocol determines appropriate contrast dose which is calculated based on patient weight and renal function.

8. *Contrast enhancement diagnostic?* Dependent on how enhanced vessels (arteries and veins) and organs appear. Do not want images to be washed out.

9. *For CT Angios: ROI placed appropriately?* Was the region of interest placed at the appropriate vessel?

10. *For CT Angios: Threshold appropriate?* Look on the graph accompanying the images to determine if scanning was started at the appropriate threshold during the exam.

RESULTS

The following represent data items collected before and after implementing the exam audit process:

Before:

1) Radiologists did not often provide feedback for image quality improvement to CT technologists; 2) CT technologists were often unaware of image quality issues; 3) Image quality was not always consistent among staff; 4) No process was in place to audit CT examinations for image quality; 5) No process was in place to disseminate information about improving examination quality based on systematic reviews.

After:

1) A CT Examination Quality Review process was established to review examination quality and score it on a monthly basis; 2) A process was established to recognize examination quality issues and provide feedback for improvement to technologists; 3) Audits have demonstrated improved examination quality. Quarterly scores improved from a baseline score of 73% in October 2009 to a fourth quarter FY10 average of 90% (July – September, 2010); 4) CT technologists are recognized for optimal image quality; and 5) There is a widespread impression of improved examination quality among technologists and radiologists which has been achieved within a collegial environment.
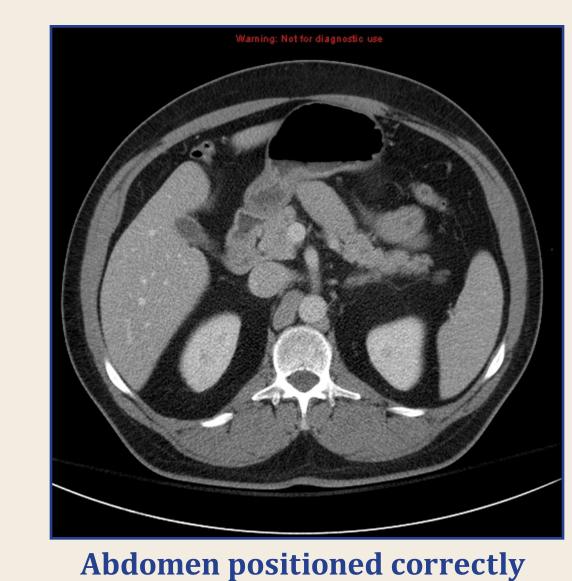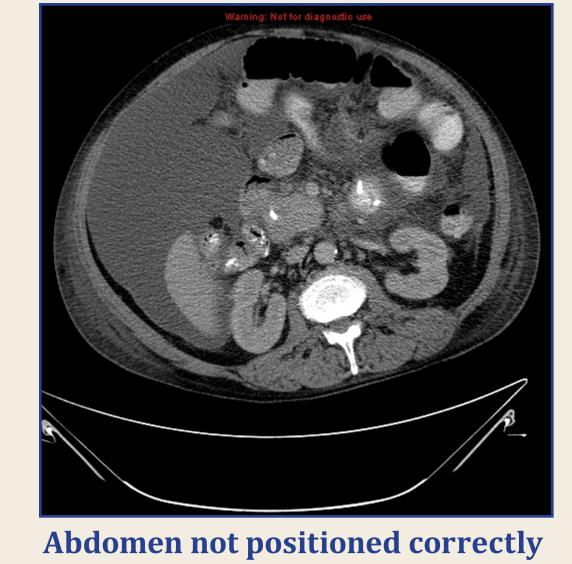
CONCLUSION

The efforts of this project have resulted in numerous benefits, including: 1) Fostering of teamwork among radiologists and technologists to establish examination quality criteria and working towards the common goal of optimizing CT examination quality; 2) While establishing the criteria for review, radiologists and CT technologists on the team learned from one another and have been able to look at examination quality from one another's perspective; 3) Overall CT image quality has improved and the department has received favorable feedback from "customers" such as surgeons and other staff who have favorably commented to radiologists on the high quality CT images produced; and 4) As technologists have become more aware of the image quality scoring criteria, image quality has improved subjectively and objectively, as reflected in audit scores.
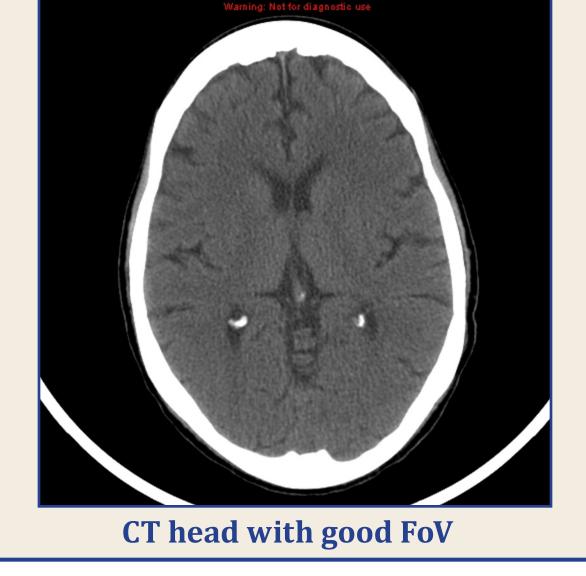
NEXT STEPS

At the end of fiscal year 2010, the team agreed that the review process was improving overall image quality and decided to continue performing the monthly exam audits. In the spirit of continuous improvement, the next steps that the team will be working on include the following.
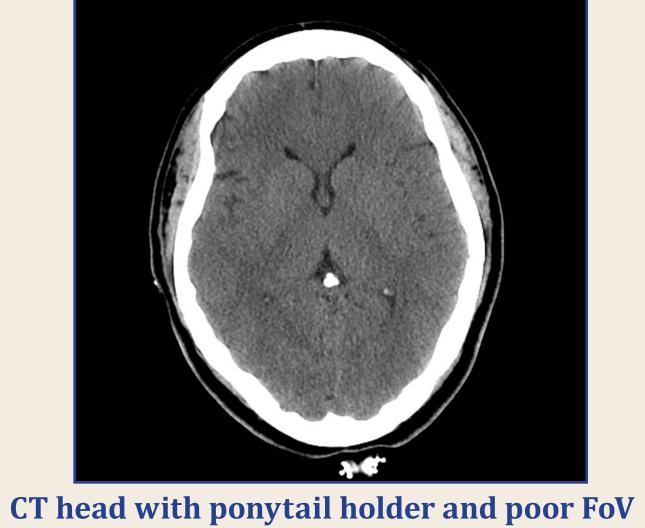
1. Create a process to provide real time notification when quality related issues are observed. While the audit tool is able to capture specific data on exam quality, there are some things that may not be realized when reviewing CT image quality retrospectively. For example, in order for radiologists or CT technologists to identify exam quality related issues such as technologists deviating from radiologists requesting special protocol, the team is in the process of creating a user friendly method to notify the CT manager or lead tech of quality related issues in more real time. As a result, we are in the process of establishing a "CT Quality Hotline" where staff can call a designated phone number to document pertinent information related to CT exam quality. This will allow the opportunity for the CT manager to investigate the issue in real time and provide immediate feedback to staff.

2. Upon implementation of the new PACS (expected early in 2011), it is hoped that the team will be able to create a more automated method of populating the reviewer's worklists with the CT exam images that are randomly selected for review.

3. During the development of the exam scoring criteria, team members raised the question, "How do we know for sure if the mAs and kVp are appropriate?" As a result, a team of physicists and radiologists are in the process of collecting parameters and reviewing images in an effort to create a technique chart for mAs and kVp.

Team Members

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Pam Shurett, R.T. (R)(CT)(ARRT), Clinical Educator, UAB Hospital Radiology
Michael Yester, PhD, Professor, Radiology

Abdomen positioned correctly

Abdomen not positioned correctly

Abdomen with unattached leads and large FoV

CT head with good FoV

CT head with ponytail holder and poor FoV