THE ROLE OF THE TECHNOLOGIST IN A WIRED WORLD:

Working efficiently with RIS/PACS, DICOM, and IHE

By Murray A. Reicher, M.D.
DR Systems Chairman and Co-founder
Contents

Searching for Synergies in Employee Efficiency ................................................. 3

Workplace Activities of Technologists in a Filmless Environment .................. 4
  Communicating with the Patient .................................................................. 4
  Performing the Proper Exam Safely and Comfortably ................................. 4
  Providing Direct Input of Information into the Imaging Device ................. 4
  Assessing Image Quality .......................................................................... 5
  Consulting with the Radiologist or Other Imaging Physician ..................... 6
  Advanced Image Processing ....................................................................... 7
  Completing the Examination ..................................................................... 7
  Printing of Film or Paper ......................................................................... 8

Summary ......................................................................................................... 8

About the Author ............................................................................................ 9
  About Murray A. Reicher, M.D. ............................................................... 9
  About DR Systems, Inc. ........................................................................... 9
Searching for Synergies in Employee Efficiency

I am frequently asked, in a world of declining reimbursement, technologist shortages, and rising employee costs, “How can I use RIS/PACS or other related technologies to reduce my technologist costs (i.e. to improve my technologists efficiency)?” The follow-up question is frequently, “In a DICOM-wired world, can’t I eliminate most of the workplace activities for my technologists?”

Improving technologist efficiency is one of the primary goals of RIS and PACS products. In my view, as both the Chairman of a RIS/PACS provider and Chairman of a private imaging center chain, the most relevant question regarding technologists is:

“How can technologist efficiency increase, while simultaneously enhancing the accuracy and efficiency of radiologists, cardiologists, referring doctors, administrators, and IT professionals?”

I advise providers to look for “synergies in efficiency”, rather than creating technologies or workplace practices that improve the efficiency of one employee group at the expense of another, or at the expense of quality patient care and safety.
Workplace Activities of Technologists in a Filmless Environment

So what are the vital tasks that a technologist must perform in a DICOM, IHE-wired environment? Do technologist workstations promote efficiency and save labor costs, or do workstations create additional work? To answer this question, you must first understand the workplace activities of technologists in a filmless environment.

Communicating with the Patient

The technologist is responsible for providing a caring and communicative human experience for the patient. By soliciting and verifying information, the technologist can improve the accuracy and effectiveness of the entire medical imaging experience.

Performing the Proper Exam Safely and Comfortably

In order to provide an optimal exam, the technologist must have access to accurate exam scheduling information, patient allergies, previous exams for comparison/technique, and a concise imaging protocol for each individual examination. To work in a paperless environment, the technologist must have access to scanned documents (such as referral cards), and must occasionally be able to scan in documents (such as consent forms).

Providing Direct Input of Information into the Imaging Device

DICOM Modality Worklist is an excellent standardized technology that enables direct electronic input of information from RIS and PACS to the imaging device, thereby eliminating redundant and error-prone data entry. But what about existing imaging devices that do not yet support DICOM Modality Worklist? How can technologist efficiency be further improved for those legacy devices?

Since vital technologist tasks remain essential in a filmless environment, technologists' computers must provide access to:

- Their scheduled exams
- Other exams scheduled on these patients
- Complete histories
- Scheduling notes
- Allergies
- Exam orders
- Transportation data
- Exam priority
- Ordering location
- Scanned documents, and more. Technologists can edit this information or scan in additional documents.
Edits should be sent back automatically to other information systems, as well as distributed throughout the RIS/PACS/Billing network.

When DICOM Modality Worklist is not available on the imaging device, the technologist workstation must ensure that information typed into the scanner is reconciled against existing information in the RIS/PACS in order to avoid erroneous duplication.

When the HIS is down, an independent RIS/PACS database should ensure that technologists can continue to image patients without inadvertently creating duplicate medical records. For old non-DICOM imaging devices, the technologist workstation should enable connectivity without the need for a third-party interface, and still convert captured images into DICOM format.

RIS/PACS solutions that fail to provide technologists this information and capability do not eliminate the technologist requirements to receive, modify, or input this data.

Instead, they negatively impact technologist efficiency by requiring the technologist to go to multiple other systems, locations, or track paperwork before completing an exam.

Assessing Image Quality

Technologists must assess the technical quality of the images they produce. They typically perform this task using the imaging device itself, but even in a DICOM world, technologists can frequently enhance the quality of medical images using PACS in many ways.

- **Image cropping**: For example, in most MRI devices prior to PACS, images were cropped prior to filming or display (such as axial spine images). Despite this, most DICOM MRI devices fail to send out cropped images, unless a less-efficient secondary capture technique is performed. Another example: Most CR devices offer some type of image shuttering, but image cropping results in higher resolution image display and printing. Generally, image cropping is only accomplished on a PACS.

- **Image Organization**: Should images be ordered by slice location, slice number? Should sagittal images be ordered from left to right or from right to left? Should axial images be ordered from top to bottom or bottom to top? Should images be segmented into different series depending on slice thickness or field of view? DICOM scanning devices handle image organization in very different ways. As a result, one practice may own two MRI scanners where the image ordering convention differs within the same practice, creating a potentially serious clinical hazard.

- **Image Orientation**: The classic example occurs when a patient undergoes a CT or MRI scan in the prone position. For decades, medical imaging practices have “flipped” these images prior to filming, so that, for example the “left side” of a coronal sinus CT is the same as the “left side” on the same patient’s head CT or chest x-ray. DICOM, as implemented in the real world today, typically fails to account for automatic image flipping upon transfer of images between systems.
• **Color rendering and alteration of color maps:** Application of various color maps, particularly for Nuclear images even after the exam is received by the PACS, may be extremely clinically useful.

• **Annotation:** Even with the latest DICOM innovations such as Presentation State and Key Object Notes, no standard method has yet been defined for annotation of color images. Yet, color images are common, and annotation and storage of these annotations is frequently requested. Annotations include image labeling of ROI’s, SUV’s, text, and other measurements. With monochrome images, the vast majority of installed DICOM imaging devices don’t enable labeling within the DICOM standard because so few devices installed today support Presentation State and other relatively recent DICOM innovations.

• **Series Re-labeling, Splitting, and Creation:** Most imaging vendors fail to label, sort, and create image series in a way that is optimal for subsequent viewing or printing. In some selected circumstances, there is a substantial clinical benefit provided by the technologist performing these tasks.

• **Image management.** The properly designed technologist workstation provides a highly efficient interface where technologists can edit, annotate, delete, rotate, flip, crop, edge enhance, color map, organize, create, measure (angles, areas, ROI’s, SUV’s), label, rename series, create series, window/level, split exams, and more. Thus, the image management you feel is essential for safety and quality can be performed without leaving the patient.

  When a system does not include a technologist workstation, image management is left to the radiologist, untrained clinician, or requires the technologist to inefficiently leave the patient. Don’t be fooled by the premise that the lack of a proper tool (a technologist workstation) eliminates the required work—when in fact, the presence of the proper tool simply helps expedite or automate the required work.

### Consulting with the Radiologist or Other Imaging Physician

Technologists must frequently consult with radiologists or other physicians while a patient is in the middle of an exam in order to determine how to best complete the study. In addition, technologists must themselves often analyze findings in order to determine how to best proceed.

The ideal technologist workstation enables the technologists and all other physicians on a WAN to view images while in progress, and discuss the findings while looking at the same exam. This enhances the efficiency of consultation for all parties, and improves clinical care. In addition, by providing technologists tools such as interactive 3-D cross-referencing, we improve the ability for technologists to analyze an imaging finding themselves. For example, a technologist may make an observation on a sagittal lumbar MRI, and have difficulty seeing the same finding on an axial image. A 3-D cross-referencing tool makes it easier to find the pathology in multiple planes, in order to determine how and where to perform additional imaging sequences.
Advanced Image Processing

Advanced image processing is becoming a standard element of most CT, MRI, and PET practices. This image processing includes: MIP's, MPR's, MinIP's, volume rendering, tissue segmentation, color rendering, surface shading, slabs, virtual colonoscopy, virtual bronchoscopy, curved rendering, cross-curves, stent graft planning, dental CT, and others. Technologists can perform these tasks, saving time for other users, increasing reimbursement, creating new types of useful and billable medical imaging exams.

The modern RIS/PACS technologist workstation must also double as an advanced image processing application. This saves the costs of added training, added interfaces, and also ensures integration of processed 3-D or other images with the remaining images in a patient’s exam.

Completing the Examination

Relatively recent additions to the DICOM standard have defined the “end of an image series”, but for exams with multiple image series, even the latest DICOM standard does not provide a message that definitively indicates “the final image of an exam.” Technologists play a vital role in indicating that all images are present on the PACS and the exam is ready for review. Final information edits can also be entered. Examples include final changes in Exam Types (for example, the exam scheduled as a CT with and without contrast was only performed without contrast because of no I.V. access), allergic reactions, modifications of exam indications, updates of clinical histories, addition of supply charges, and more.

Today’s technologist workstation must be more than a PACS QC Station. It must also serve as an integrated RIS terminal that enables appropriate information edits. Technologists often must also scan in worksheets or other paperwork they receive from the patient, such as consent forms, referral cards, or more. As importantly, technologists must indicate that all images have been received by the PACS Server and the exam is ready to read. Special requests (“please call Dr. Smith immediately, the patient has an appointment this afternoon”) must be entered, as well as allergic or other incidences that occurred during the exam. Notes must be entered, such as findings from the ultrasound technologists.

When a technologist workstation is omitted or limited in functionality, there is often no quality control step to verify that all images are available prior to image review. When cases are placed “on-line automatically” based on a DICOM data stream timing out, this can result in several hazards. For example, a single exam can be incorrectly segmented into two exams, or worse, images can be added to an exam after the case is interpreted unknown to either the technologist or reading doctor.

When there is no technologist workstation, technologists still have to notify the radiologist of special requests, changes in history, allergies, and exam type edits, but they have to go to other systems, learn other interfaces, and typically interrupt their workflow and leave the patient to accomplish these tasks.
Printing of Film or Paper

In most clinical sites, technologists are often responsible for printing medical images when requested by referring doctors. Technologists may also be responsible for tracking paper requisitions or reports of prior examinations.

The ideal technologist workstation completely eliminates the need for technologists to create printed images or track paper documents.

The DR Systems RIS/PACS provides:

- A database of individual referring doctor print preferences
- Storage of image presentation states

This combination removes technologists from printing or collating responsibilities. Any required printed output should instead be completely automated in the Medical Records department, using less costly personnel.

Freeing the technologist from paperwork and film/paper production is a major benefit of the proper technologist workstation and RIS/PACS.

Summary

Technologists do useful and essential work every day. In recent years, RIS/PACS vendors have taken two fundamentally different approaches with regard to technologists. Some vendors offer limited or no technologist workstations, and promote the theory that "no workstation means no work." Others provide powerful and robust technologist workstations that enhance efficiency for technologists by enabling them to do their jobs at the highest clinical standard while remaining at the patient’s side.

In my experience, the bottom line improves only when technology and workflow enables technologists to do their essential work more efficiently and safely, while eliminating the need for non-essential work, like film production or paperwork. The proper tools improve technologist efficiency and enhance the overall productivity of other users, including radiologists, cardiologists, and referring physicians, all while improving the safety and efficacy of medical imaging.
About the Author

About Murray A. Reicher, M.D.

Dr. Reicher is a Board certified diagnostic radiologist with subspecialty CAQ in Neuroradiology. Dr. Reicher joined Radiology Medical Group in 1986 and continued to make numerous significant contributions of teaching, scientific publications, and research in the area of neuroradiology, musculoskeletal MRI, and related MRI technologies. In 1992, he founded one of the world’s most successful PACS companies, DR Systems, Inc. He is the past President of Radiology Medical Group, Inc. and currently serves as Chairman of Radiology Service Partners, LLC.

About DR Systems, Inc.

DR Systems, Inc. is a leading provider of film-free medical image and paperless information systems with integrated RIS/PACS that includes dictation, reporting and Internet-based distribution solution for hospitals and medical imaging centers. DR Systems’ DICOM-compliant system includes the Dominator Diagnostic Reading Station with available DR Instant Reporter (automated voice recognition, dictation, and report distribution), the Catapult Technologist QC Workstation, the RIS Admin Station, the DR Central Server and Communicator Web Server, the Ambassador Clinical Review Station, the Messenger Diagnostic Portal, and the Guardian Archive System. DR Systems’ ease of implementation and user training allows customers to rapidly achieve financial and clinical success. With a modular design scalable for growth, DR Systems RIS/PACS can handle current and future medical image and information management needs.

DR Systems, Inc.
10140 Mesa Rim Road
San Diego, CA 92121
Toll Free: (800) 794-5955
Tel: (858) 625-3344
Fax: (858) 625-3334
Email: info@dominator.com
Web: www.dominator.com

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