Check, Mate: Integrating Checklists Within Diagnostic Radiology Departments

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Quality assurance measures have been at the forefront of medicine in the past decade. Many of these initiatives were generated in response to the 2000 Institute of Medicine report *To Err Is Human* [1], which attributed nearly 100,000 annual deaths to preventable medical errors. Numerous specialties established committees to address such concerns, with the goal of providing safe and effective health care. The ACR task force on safety and the Image Gently campaign are examples of such efforts within radiology.

The use of checklists for quality assurance is not unique to medicine. They are widely used in manufacturing, finance, and human resources, among numerous other fields. The industry that has received greatest acclaim in the medical literature for its adherence to checklists is aviation. The pressure to reduce errors is magnified when dozens of lives are at stake with every takeoff. Larson and Nance [2] elegantly characterized the aviation industry's approach to quality improvement. They contrasted the traditional method of quality improvement, identifying and removing poor individual performers, with the more modern method, which involves disseminating best practices to reduce errors at the system level. David Levin [3] recently offered his prior US Air Force experience to reinforce how heavily pilots rely on checklists in their workflow. Checklists in the flight industry serve as a common denominator to navigate safely in the context of various scenarios and levels of practitioner experience.

The use of checklists in the hospital setting has received the greatest public attention within intensive care and the operating room. This is largely a consequence of the work of Peter Pronovost and Atul Gawande, respectively. Pronovost is a leading critical care physician at Johns Hopkins University in Baltimore. In 2006, he and his coauthors published a landmark paper in the *New England Journal of Medicine* citing up to a 66% decrease in catheter-related bloodstream infections across 103 Michigan intensive care units after a simple intervention [4]. Before central line insertion, practitioners were required to (1) wash their hands with soap; (2) sterilize the skin insertion site with chlorhexidine; (3) drape the patient in a sterile fashion; (4) don a cap, mask, sterile gown, and gloves; and (5) cover the catheter and its insertion site with sterile dressing. Gawande used a similar approach in the Surgery Saves Lives program, conducted at 8 hospitals worldwide through the World Health Organization. Upon introducing a 19-item safety checklist, his team reported significant reductions in mortality and complication rates [5]. Gawande publicized his advocacy of checklists in a 2007 *New Yorker* article [6] and later expounded on that perspective in *The Checklist Manifesto* [7]. Concepts championed by these individuals and others have placed these safeguards squarely in the public eye.

Checklists have already gained traction among our interventional colleagues. New practices transitioned seamlessly from the operating room to the angiography suite, given similarity in work environments. These areas, along with the intensive care unit and emergency department, are the procedural hubs for most hospitals. Coordinating the actions of physicians, nurses, and staff members in caring for critically ill patients affords countless opportunities for errors at both the system and individual levels. At our institution, a "time-out" precedes any interventional radiology procedure. The patient's name and medical record number, the planned procedure including the correct side, and the names and roles of all participants are verbally identified at the start of every intervention. Checklist integration at these pause points is necessary to ensure that these procedures beget health, not harm. The time-out is an example of an increasingly prevalent culture of "equal footing" in quality assurance. Breakdown of hierarchy often must occur for checklist interventions to be successful. Malcolm Gladwell [8] recently highlighted this point in *Outliers: The Story of Success*. He described how Korean Air had more plane crashes than almost any other airline in the 1990s. He attributed a large portion of these failures to the Korean cultural hierarchy, which pressured individuals not to question their superiors. Pilots with authoritative rule over their copilots did not benefit from the safeguard provided by the latter, and the crews were more susceptible to preventable errors.

In our experience, diagnostic radiologists have been slower to embrace checklists than their clinical colleagues. There are several possible contributing factors. Checklists often facilitate rapid decision making in acute clinical settings, involv-

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ing input from multiple practitioners [4,5,9-12]. This is not the typical environment for most radiologists. Checklists may seem out of context when radiologists are not performing direct patient care. Furthermore, while performing much of our work alone, we continually rely on broad foundations of anatomy and physiology for image interpretation. Our visual pattern recognition skills have developed over years of experience. Although they are relevant for procedures, some believe that checklists are not applicable to this type of diagnostic work. The considerable variability in reporting styles may impede checklist integration, which will be discussed later. Finally, the art and science of checklists are decidedly mundane for many individuals. Although most physicians agree that checklists are necessary and augment patient care, few are enthused by their creation and propagation. This is particularly true when the pressure of potential procedural complication is not immediately looming.

Checklists have started to make inroads with radiology support staff members. In our department, for pediatric patients undergoing either CT or MRI, parents or guardians must complete detailed screening forms before the examinations. CT forms include a series of yes-or-no questions designed to identify children at higher risk for adverse contrast reactions. Similarly, MRI questionnaires assess potential risks within the magnet. Technologists review these forms with families to ensure completeness and clarity. Immediately before an examination, the technologist and radiologist assess the screening forms together. If a patient is deemed at high risk as a result of the checklist provided, the radiologist is alerted and the referring provider is contacted to discuss the potential red flag. Our technologists thus enable two pause points: reviewing the checklist first with the patient's family and then with the radiologist. The screening checklist provides the mechanism for these safeguards to occur. Posting checklists in visible locations may also be effective. For example, Table 1 shows a checklist posted on the wall outside the MRI suite at our institution, reminding all staff members and patients of our magnet safety protocols.

Table 1. MRI safety checklist (2 × 3 feet) posted on the wall of the MR suite for visual reference for technologists, nursing staff members, patients, and their families

Staff screening for non-MRI personnel

1. Determine who is going in the scanner room.
   a. Review screening sheet with MRI technologist.
   b. Remove metal: phone, pager, bobby pins, etc.
   c. Walk through the metal detector.

Patient screening

1. Time out.
   a. Check ID band.
   b. Check procedure.
2. Review screening sheet.
3. Determine what must go in scanner.
   a. Foley catheter: temperature probe?
   b. Pump
   c. Drain
   d. Other?
4. Move patient to MRI bed.
   a. Do not bring over used blankets or sheets.
5. Secure metal items entering scanner.
   a. Foley catheter
   b. Pumps
   c. Other?
6. Remove metal from patient.
   a. Medication patches
   b. Pulse oximeter
   c. Leads
   d. Bobby pins and hair ties
   e. Other
7. Visually inspect the patient.
   a. 10 fingers/10 toes
   b. Extra leads?
8. Verbally call out "metal free" before entering scanner room.

Radiologists most frequently use checklists during basic image interpretation. Performing such mental checklists forms a substantial portion of our diagnostic workflow, particularly for junior practitioners. For example, in the latest edition of *Felson's Principles of Chest Roentgenology*, Goodman [13] recommends an outside-in checklist approach to interpreting chest radiographs. "Are there many lung lesions?" is a mnemonic referring to evaluating the abdomen, thorax, mediastinum, and lungs in a sequential fashion. Checklists do not substitute for an experienced eye for the subtle or a robust understanding of complex pathophysiology. But they do provide templates for comprehensive image assessment and core concept reinforcement, with the goal of optimizing interpretive accuracy.

With increasing emphasis on checklists in medicine, we expect greater focus on standardized reporting in the future. Many authors have suggested that we will trend toward more structured reporting and a uniform lexicon [14-16]. Breast imaging has been the standard bearer for structured reporting in radiology, with the BI-RADS lexicon instituted by the ACR [14]. Our written reports are increasingly the currency of our specialty. When Ferris Hall [15] recently described "the radiology report of the future" in a 2009 *Radiology* article, he envisioned greater transparency and accessibility to patients and more structured organization. Cited benefits include consistent communication, enhanced data-mining capabilities, increasing technological support through software integration, and greater satisfaction among our clinical colleagues [16-18]. Barriers to structured reporting include possible distraction from the interpretive process, impractical applications in complex cases, and dissatisfaction among radiologists preferring individualized prose [18-20]. Although we acknowledge these limitations,

we believe that checklists should be incorporated to form the substrate of a comprehensive report and ensure the consistent inclusion of key concepts. Checklists can thus form the starting point for an individualized product, preserving radiologists' individual preferences while still translating to improved patient care.

Medical checklists are not the sole purview of clinicians. Diagnostic radiologists should be aware of their current and potential applications, as we will likely see greater permeation of our field in the future. Checklists have proven efficacy in both medical and nonmedical arenas. Our colleagues in other specialties have incorporated checklists in various ways to optimize patient care. With this goal in mind, we may be receptive to their integration into our workflow.

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