Acing the Joint Commission Regulatory Visit: Running an Effective and Compliant Safety Program

Ensuring the safety of patients and staff is a core effort of all health care organizations. Many regulatory agencies, from The Joint Commission to the Occupational Safety and Health Administration, provide policies and guidelines, with relevant metrics to be achieved. Data on safety can be obtained through a variety of mechanisms, including gemba walks, team discussion during safety huddles, audits, and individual employee entries in safety reporting systems. Data can be organized on a scorecard that provides an at-a-glance view of progress and early warning signs of practice drift. In this article, relevant policies are outlined, and instruction on how to achieve compliance with national patient safety goals and regulations that ensure staff safety and Joint Commission ever-readiness are described. Additional critical components of a safety program, such as department commitment, a just culture, and human factors engineering, are discussed.

Introduction

The safety of patients and staff is a critical mission for health care organizations. The safety of patients during their hospital stay is known to be at risk, with 4%–13% of patients experiencing adverse events after hospital admission owing to their exposure to preventable medical errors (1–3). Staff safety became a subject of focus in 1970 with the founding of the Occupational Safety and Health Administration to facilitate safe working conditions for all. Not surprisingly, owing to exposure to infectious diseases and ergonomic injuries incurred during patient care, the risk of work-related injury or illness is increased more than fourfold for health care personnel compared with the average risk of work-related injury or illness for workers in other industries (4).

Before attempting to improve safety, it is important to realize that operations involving people are prone to errors in approximately 10% of cases (5). Overall safety can be improved only by designing less vulnerable systems around operations. Most health care organizations address safety issues by using root cause analysis (RCA) of adverse events after harm has already occurred. Ideally, safety hazards should be addressed before they cause harm, at the stage of near misses rather than at the time of the full-blown adverse event. This can only be accomplished if concerns regarding potential safety hazards are freely and fully reported by frontline staff (6). Therefore, the culture of safety in an organization will be a deciding factor in the efficacy of its safety program, allowing more preemptive techniques such as failure mode and effect analysis (FMEA) (7) (discussed later) and thus helping to shape a safer environment.

In this review, we describe the necessary components of an effective safety program and highlight current challenges in patient and employee safety. We provide suggestions on how to manage safety.
There are multiple opportunities at the regional and national levels to nurture the development of quality officers in the radiology department, starting with the annual American College of Radiology Quality Conference and educational courses offered by the Radiological Society of North America, the American Roentgen Ray Society, and other subspecialty societies.

Collaboration with the institution’s health care quality department is a must. This collaboration enables the resources necessary for quality projects to be provided and presents an opportunity to recruit support personnel for quality initiatives within the radiology department. If a quality and safety program is not established in the radiology department, hospital guidelines and policies need to be followed. Adhering to these guidelines and policies may prove challenging, as operations vary between different areas such that policies may not be easily transferrable.

### Policies and Guidelines

Policies outline the standard of care that employees are to provide to patients (19, 20) and describe the context, goal, and/or purpose of a specific procedure. The term *procedures, or protocols,* is defined as the desired intentional steps to be taken by a person or group to achieve a certain objective in specific circumstances. Policies differ from guidelines in that policies must be followed every time, whereas guidelines merely provide decision support; they are recommended actions for a variety of clinical situations and are not prescriptive. Policies should be easily available for staff to review—either posted on a department website or provided in binders in work areas. So that policies are kept current, they need to be reevaluated and updated annually, and employees need to be informed of changes and new policies. Staff meeting discussions, with e-mail broadcasts of the meeting minutes to reach employees who are working off-shifts and weekends, are helpful. Marking new policies as such on websites for focused review also is useful.

### Cornerstones of a Safety Program

#### Human Factors Engineering

Historically, analyses of safety events in health care have been focused on identifying where human errors were made and who was responsible for them. Because health care systems are complex, multiple contributing factors or system failures must align before an active human error eventually causes an adverse event. If safety systems to alleviate system failures are in place, an active human error will not result in an adverse event.
Human factors engineering (HFE) is focused on the design and analysis of interactive systems that involve people, technical equipment, and the work environment (21). With HFE, one is informed by his or her knowledge of human characteristics, such as physical, emotional, and intellectual capabilities and limitations. He or she then applies this knowledge to the design and implementation of equipment, processes, and systems. HFE complements existing patient safety efforts by specifically taking into consideration that frontline staff, as human beings, will inevitably make mistakes (22). Therefore, the systems with which individuals interact should be designed to anticipate and mitigate and/or counteract human errors, a process known as user-centered design. The goal of HFE is to optimize the interaction between staff members and their work environment and technical equipment in an effort to maximize safety and efficiency.

When HFE is applied, the technical equipment is evaluated for its ease of use and its effectiveness in completing the intended task. The work environment is assessed for factors such as lighting, noise, and other distractions, with the goal of optimizing environmental conditions. Evaluation of the work environment includes an assessment of the demands that an activity places on the person performing a task, such as required skills, physical demands, and mental workload. Factors related to teamwork, such as the dynamics of the team, authority gradient, and institutional culture of safety, also are taken into account. An example of the use of HFE to address high mental workload at the end of an interventional procedure at our institution was the development of a postprocedural closeout checklist (discussed later).

Department Commitment
A department’s or practice’s commitment to safety can be successful only if every employee (including scheduling staff, transport staff, nurses, technologists, physician trainees, and attending physicians) supports the effort. The safety efforts undertaken by designated health care quality personnel and/or the department safety officer are bound to fail without support from the entire group. Therefore, it is important that responsibility for safety becomes a part of everyone’s job description and code of conduct; this protocol has become the standard in such industries as the military and aviation (23). In addition, safety needs to be part of the responsibilities of those in department leadership positions, such as modality managers and section chiefs, and there should be dedicated personnel (eg, health care quality officer and/or nurse) overseeing all department quality and safety efforts.

Just Culture and Culture of Safety
As quality and safety initiatives rely on the staff’s reporting of safety events, a culture in which all employees feel safe to report their observations and concerns needs to be established. This requires the reassurance that there will be no repercussions for either the person reporting the error or the one who made it. Punishment for making errors has been identified as the greatest impediment to error prevention in the medical industry. In a just culture (24), staff members who make unintentional errors (ie, mistakes due to slips or lapses) are not punished. Only errors due to reckless behavior should be consequential for an individual.

Of equal importance is the assurance that there will be no repercussions for employees who report errors. A recent sentinel event alert from The Joint Commission (18) emphasizes this fact and recommends the creation of policies for reporting errors in an effort to “recognize care team members who report adverse events and close calls, who identify unsafe conditions, or who have good suggestions for safety improvements.” While it is not difficult to create the administrative structure for a safety program, the development of a robust department culture of safety requires a long-term commitment and active management.

Authority gradient is defined as the perceived difference in status and decision-making power among members of a team. The presence of authority gradients between the attending physician staff and other health care employees working together has been shown to interfere with open reporting (25–27). However, despite the presence of authority gradients, the airline industry and the military have made great progress in improving safety by developing a team approach to safety (28,29) through crew resource management (30).

Patient Safety
Every year, The Joint Commission announces a new set of NPSGs. These goals are used to identify areas in health care that need improvement and include guidelines on how to achieve these improvements. Six of the seven NPSGs for 2018 (17) are relevant for radiology: correct patient identification, improved staff communication, safe use of medications (ie, medication labeling in procedural areas, management of anticoagulation before and after procedures, medication reconciliation), safe use of alarms, infection prevention (hand hygiene), and prevention of mistakes in surgery. The five processes recommended by The Joint Commission for implementation to minimize risks, referred to as elements of performance, are described in the following sections.
Correct Patient Identification

It is important to think of the concept of correct patient identification broadly, as a directive that offers a great deal of opportunity to increase the precision of patient care. The Joint Commission Universal Protocol, also known as the preprocedural time-out, addresses issues centered around two NPSGs: preventing identification of the wrong patient and preventing mistakes from surgery (eg, performed at wrong site, wrong type performed) (31). Before any procedure is performed, the identity of the patient should be confirmed by using two identifiers, usually the name and the date of birth. However, other identifiers that are unique to the patient, such as the medical record number and the social security number, also are acceptable.

A universal multistep protocol is mandated for interventional procedures and requires that the type and site of the procedure be specified. Active involvement of the entire procedure team is mandatory, and all other activities of all parties involved must come to a complete stop. Involvement of the patient and, if needed, the family is sought if logistically possible. While no such protocol for performing diagnostic studies exists, a similar script is followed when the site of an examination (right vs left) is reviewed with the patient and compared with the requisition.

A new requirement for 2018 is the institution of a preprocedural verification process. During this process, all available patient information (including coagulation parameters and prior pathology analysis results) and the procedure request are reviewed. In addition, the equipment needed for the procedure is determined and secured. The preprocedural verification can be performed at any time before the patient is brought into the procedure room, from the time of preadmission testing to the time spent in the preprocedural holding area.

A similar process is outlined for specimen labeling, which should occur in the presence of the patient to ensure accuracy. This can be performed within the context of a postprocedural closeout (Fig 1), a process that mirrors the preprocedural time-out.

The process issues related to radiologic procedures usually fall into one of three categories: retained foreign bodies, specimen handling issues, and inappropriate medication management. Retained foreign bodies have been reported to occur in 0.3 to one in 1000 surgeries (32). In radiology, retained foreign bodies are most commonly wires retained from central line placement. Retained plastic stiffeners used during abscess drainage with the Seldinger technique can lead to a nonfunctioning catheter and represent the second most common foreign body retained during radiologic procedures.

Specimen handling errors include the complete lack of or incorrect labeling, the submission of a specimen suspended in the wrong medium, lost specimens, and failure to obtain all required specimens. To prevent patient identification errors, a new patient safety goal requires the labeling of each specimen in the presence of the patient. Inappropriate medication management can pose its own safety risks. A critical example is that of not restarting anticoagulation in a timely fashion after a procedure, increasing the patient’s risk for a thrombotic event such as pulmonary embolism, stroke, or myocardial infarction.

These vulnerabilities can be addressed in a scripted postprocedural closeout checklist that is initiated by the radiologist while sterile access is still available for additional work. The radiologist confirms that all previously introduced foreign bodies have been removed and that all requested samples have been obtained, placed in the correct container, and labeled appropriately. He or she also identifies a responsible staff member to transfer the specimens to the laboratory. Discharge instructions regarding anticoagulation are discussed with the radiology nurse and documented in the patient’s chart. To decrease staff injuries caused by sharp instruments that are left on the procedure table or accidentally placed in a regular trash bag, the closeout checklist should include “disposal of sharps.” This responsibility should be assigned to a team member.

Improved Staff Communication

Notifying the ordering physician of critical test results is a cornerstone of improved staff communication and important for the continuity of patient care (33–37). It is widely reported that communication issues are involved in more than 70% of adverse events. Consequently, The Joint Commission has made handoff communications a priority. As a consulting service, radiology interfaces with patients throughout their continuum of care. This requires that the flow of information to and from providers be efficient and reliable. Each patient encounter represents an opportunity for handoff or communication error. Therefore, to reduce the risk during handoff, it is important to standardize the process for communicating to the ordering physician or next providers and documenting the occurrence of this communication.

The elements of performance assessed by The Joint Commission include defining the diagnoses that represent critical results that must be communicated in a timely fashion (38) and determining which staff member(s) can make these communications, which staff member(s) can receive them, and in what time frame the results must be...
received. The timeliness of communications should be documented, and audits must be performed to ensure compliance. Ideally, critical results should be communicated in person or by phone. Electronic systems may be used to communicate critical results; however, a built-in receipt confirmation mechanism is mandatory for such systems (39).

Communication errors can occur when critical results are being communicated and at all other steps of the imaging process (eg, ordering, scheduling, performing an examination, and interpreting images) (40). During these stages of patient care, communications involve technologists, nursing and scheduling staff, the patients themselves, and other additional health care personnel. These communications account for the majority of communication errors in radiology, with almost 40% of them negatively affecting patient outcomes (41). To avoid miscommunications, written documentation, such as that involving the electronic ordering of CT and intravenous or oral contrast material, is preferable whenever possible. Verbal communications are prone to errors due to misunderstood or incorrectly remembered conversations. Therefore, The Joint Commission has established a write-down and read-back policy for emergent situations when written documentation cannot be obtained (39).
Safe Use of Medications

To ensure the safe use of medications, practices have focused on the labeling of medication, the reduction of harm from anticoagulation agent use, and medication reconciliation.

It is absolutely necessary to label all medications used during a procedure, both in and out of the sterile field, even if only a single medication is to be used. An exception to this labeling process guideline applies if a medication is immediately administered—that is, an authorized staff member prepares or obtains the agent, takes it directly to a patient, and administers it to that patient without any break in the process. After being drawn up, medications must be labeled with the drug name, drug strength, amount of medication (if not apparent from the container), and expiration date and time, unless they are discarded after the procedure.

A special category of risk in radiologic procedures is that related to procedures performed in patients who are treated with anticoagulation medications. A discussion between the radiologist performing the procedure and the physician who prescribed the given anticoagulant(s) for the patient must ensue to assess the risk-benefit ratio (ie, bleeding versus thrombotic event) associated with the periprocedural cessation of the anticoagulant(s). Approximately 4% of patients have a myocardial infarction (42) or stroke (43) within 6–12 days after the discontinuation of anticoagulation medication. Peripheral arterial and pulmonary embolisms also have been reported in this setting. Similarly, harm can result from failure to restart a patient on anticoagulation medication after a procedure if this responsibility has not been clearly assigned to the referring physician or radiologist. It is far safer for radiologists to assume this responsibility.

Contrast media (44) are considered medications and thus are subject to NPSGs related to medication reconciliation. The coordination of information during transitions of care, patient education, and communications to other physicians must be ensured. It is mandatory to document contrast material–related events and allergies in the patient’s medical record and allergy profile. Additional communication to the referring physician is helpful, particularly in the outpatient setting, where the referring physician may not have easy access to the electronic medical record. For easier communication in the radiology department, adverse events related to contrast material use should also be documented in the radiology report. At the time of the contrast medium–related event, a technologist usually provides the patient with educational material, in the form of handouts, regarding the allergic reaction to the agent that the patient experienced and what to do if he or she needs that contrast material administered in the future.

Moderate sedation is frequently used in radiology owing to the increasing number of interventional procedures (45). With use of a combination of opioids and benzodiazepines for pain control and sedation, patients are able to undergo procedures that otherwise could not be easily tolerated with local anesthesia alone. The administration of a moderate sedative requires detailed preprocedural assessment that includes a medical history and physical examination, Mallampati airway and American Society of Anesthesiologists assessments, and patient compliance with fasting instructions. Although moderate sedation is usually induced by an independent practitioner, the radiologist is ultimately responsible for knowing the patient’s medical history, especially anything that might cause increased risk during conscious sedation. Moreover, the radiologist must be able to manage complications and be familiar with the use of reversal agents. In patients with complex conditions, prior consultation with an anesthesiologist is beneficial.

Safe Use of Alarms

The increased frequency with which alarms are being used has led to concern regarding alarm fatigue. Alarm fatigue is defined as the lack of response to an alarm alert due to an excessive number of alarms, which has resulted in sensory overload and desensitization (46). When an alarm is perceived as a nuisance, employees may silence or disable the alarm device or ignore the alarm. This undermines the value of the alarm in making the environment safer. Alarm fatigue led to 566 deaths between 2005 and 2008 that were reported to the U.S. Food and Drug Administration (47).

The Joint Commission requires health care providers to evaluate the patient risks that would incur if a particular alarm device in a work environment were unattended. In radiology practices, alarms include those for the fluoroscopy dose unit, medication refrigerator, patient monitor, and medication pump. Department guidelines that outline how to respond to alarms, define who can disable them and when, and define how thresholds are established and who can change them need to be developed.

Fluoroscopy alarms generally are set for 5 minutes of fluoroscopy time. During long interventional procedures that have the potential to exceed radiation dose limits, a system for continuous dosimetric monitoring should be in place. Ideally, this monitoring should be performed by a person other than the interventionalist, such as a technologist, nurse, or other employee, since the
operator could lose track of the radiation dose while focusing on the procedure. This designated individual should be responsible for recognizing high doses and communicating them to the radiologist performing the procedure (48) before reportable doses are reached.

Alarm maintenance includes monitoring and confirming accurate settings, proper operation, and capability for precise detection of what is to be measured. For equipment that is used throughout the hospital, such as medication refrigerators and intravenous pumps, hospital-wide alarm policies can be adopted. However, specific guidelines that define which personnel are able to disarm equipment accompanying or connected to a traveling patient in the radiology department may need to be developed.

Reduce the Risk of Health Care–associated Infections
Health care–associated infections are a major safety issue in all organizations, affecting approximately 1.7 million patients each year (49), with an estimated annual prevalence of 4.5% and corresponding to 9.3 infections per 1000 patient days. Adherence to hand hygiene guidelines from the Centers for Disease Control and Prevention and the World Health Organization (50) decreases the risk of infections; thus, these recommendations must be followed. Once a hand hygiene program is in place, goals for improving hand-cleaning practices need to be developed, and compliance must be monitored. Additional measures to reduce infections include adhering to precautions regarding contact with epidemiologically significant multidrug-resistant organisms and cleaning and disinfecting the equipment and patient care environment.

While many aspects of this NPSG, such as monitoring multidrug-resistant organism acquisition and transmission, are addressed on an institutional level, radiology departments should develop their own hand hygiene programs and improvement plans and collect relevant data. In addition, high-level disinfection processes, such as cleaning endocavitary US probes, must be monitored. Any disinfecting of equipment (including lead aprons) and cleaning of the patient care environment should be performed according to manufacturer instructions. Staff competency in cleaning and disinfecting should be documented initially and then annually thereafter to ensure the preservation of skills (51).

For interventional radiology, emphasis is placed on preventing infections of central lines and surgical sites. Data on infections must be collected and shared with all stakeholders. Standard protocols and catheter checklists have to be followed and used, respectively (52).

Staff Safety
Work-related safety risks for employees in radiology departments range from radiation exposure to needlestick injuries and the ergonomic challenges associated with moving patients or using imaging equipment (53). Additional risks in the hospital environment include exposure to infectious diseases from patient contact.

Risk of Radiation Exposure
Due to the inherent risk of exposure to radiation, dose management and monitoring are critical, particularly for staff who work in interventional radiology settings. Preventative measures include strict programs for dosimetry involving monthly collection and analysis of radiation exposure data. The use of lead aprons is mandatory, and staff members must be educated regarding the proper use and storage of hanging devices to avoid breakage. The folding of aprons is not recommended, as it can lead to lead breakage, rendering the aprons defective. A program for assessing the intactness of lead aprons is needed, and the aprons should be marked so that employees know which aprons are safe to use.

Exposure to Contagious Body Fluids
Staff working in procedure areas are at risk for needlestick injuries and exposure to contagious body fluids. Needlestick injuries are common among interventional radiologists, 91% of whom reported having at least one needlestick injury and 31% of whom reported having a needlestick injury involving a human immunodeficiency virus–positive patient (54). As most needle injuries result from recapping needles, preventative measures need to include raising awareness regarding and minimizing this practice. Needle pads can safely hold exposed needles in the surgical field. The use of blunt needles, which can be used to draw up medication, also reduces injuries to environmental staff when the needles are inadvertently disposed of in the regular trash. These types of injuries can be avoided by using a postprocedural closeout protocol, in which the responsibility to clear sharp items from a procedure table is assigned to a specific person.

Exposure to body fluids can also occur as a splash injury. Preventative measures include the use of protective garments and devices such as gowns, gloves, and splash protectors on masks. Annual training in infectious disease prevention is recommended.

Ergonomic Injuries
Ergonomic injuries can result from moving patients from stretchers to examination tables, using heavy movable equipment such as portable
radiography and US machines, and repetitive stress injuries from performing US examinations. The lifting equipment used to help move patients is highly useful. However, using it may take additional time and thus be perceived as an impediment to the workflow. Staff training on the proper use of equipment and ergonomic US techniques is helpful (53). Ergonomic injuries also have been reported among radiologists (55). Consequently, when designing the reading room, emphasis should be placed on the purchase and proper ergonomic setup of equipment such as monitors, mouse devices, and keyboards.

Managing Safety Data

Data Collection
Data on safety can be obtained by using a variety of mechanisms. These mechanisms include direct observation during gemba walks, team discussions during safety huddles, audits of predetermined safety metrics, individual employee record entries in safety reporting systems, and discussions during monthly quality assurance (QA) meetings involving dedicated staff.

Gemba Walk.—An optimal assessment of safety risks and potential hazards can be performed during a real-time visit to areas where patient care is being provided, for a personal observation of the work environment. This process is known as a safety walkabout or gemba walk (56). In contrast to a safety audit, during which large quantities of data on safety metrics are collected, a gemba walk provides the opportunity to observe staff in their work environment and perform a spot check. Safety hazards can be identified in real time, issues can be discussed on the spot, and potential barriers to safety can be identified. This interaction between the leadership and staff provides real-time learning opportunities for both groups and moves the culture of safety in an institution forward.

The philosophy of a gemba walk has been described as “go see, ask why, show respect,” and this form of real-time assessment is used to evaluate several domains and processes (57,58). The technical functions of equipment can be assessed with inspections of engineering and local ventilation components, including suction devices, fire detectors, radioactive shielding, and disposal containers. A gemba walk can also be used to confirm the presence of adequate signage on equipment for warning (eg, regarding radiation safety and MRI risks on radiofrequency generators and other electronic equipment) and/or showing maintenance schedules (eg, on portable radiography machines).

The main purpose of a safety walkabout is to evaluate the staff’s work practices in terms of hand washing, handling needles, disposal of sharp instruments and biohazardous waste, and adherence to fall risk warnings. Additional work practices that are assessed during gemba walks include compliance with infection control standards; correct use of patient positioning and dosimetry devices; correct storage of gas cylinders; correct use of personal protective clothing such as gloves, masks, gowns, eye wear, and lead aprons; and cleanliness of the work environment.

Gemba walks are performed by teams consisting, at a minimum, of the supervisor of and an employee who works in the surveyed work area, a QA expert, and a technical expert (in cases in which equipment is being evaluated). The frequency of the walks can vary between monthly and weekly, depending on whether routine surveillance (monthly) or performance improvement (weekly) is the objective. Routine topics are addressed on a monthly rotating schedule, with problem areas added as needed. The data gleaned from walkabouts can be summarized and discussed during staff and QA meetings or displayed on audit dashboards or departmental web pages.

This raises awareness of vulnerabilities and focuses attention on solutions to identified problems. Sharing data with frontline staff increases staff engagement by allowing employees to follow their own progress in reaching safety goals.

Safety Huddles.—Daily safety huddles allow staff members to prepare for the day’s activities and identify potential problems. These brief meetings are standardized and held in or near the workplace. Frontline employees discuss scheduled examinations and identify any safety and quality concerns. Those problems that can be solved by the frontline staff within 24 hours are assigned to the staff present at the meeting. Problems that cannot be solved by the assembled group within this time frame or that require the participation of staff from multiple services are assigned to staff of a higher organizational level. A helpful tool in this process is a visibility board that shows all identified issues, the persons assigned to each issue, and a date for following up to check the status of the problem, regardless of whether it has been resolved.

Readiness assessment is the main goal of daily huddles (59). During the daily huddle, the staff review that day’s case mix and volume and attempt to confirm that all necessary supplies, equipment, and personnel are available and functioning. For interventional procedures, supplies include contrast media and procedural devices such as biopsy needles. Equipment-related issues,
such as scheduled maintenance and downtime of nonfunctioning equipment, should be discussed to permit adjustments in operations, such as assigning patients to a different scanner. Other aspects of the daily huddle include a review of staffing needs, matching staff skills to scheduled patients, and discussion of any questions regarding protocols for imaging studies.

While the frontline staff can resolve minor equipment issues and/or clarify protocols and policies, more complex issues such as process redesign and those that involve coordination with other departments require that staff of a higher organizational level work together to identify solutions. To ensure reliable follow-up and eventual solutions, a competent person should be assigned to each task and responsible for regularly reporting on the progress. Use of this process ultimately enables an organization to establish a culture of continuous improvement, which is an important initiative in achieving institutional safety goals, including decreased safety hazards.

A periodic goal and/or metrics review is best accomplished by displaying goals and metrics on the visibility board. While visibility boards can be electronic, dry erase boards can be just as effective. The most important functions of the visibility board are to provide meaningful information, raise awareness of potential problems, and allow staff to take ownership of problems, all of which increase engagement in safety.

Huddles can be held at all staff member levels, from frontline personnel (“first-tier huddles”) to those high in the organizational structure. They can also be held in areas that are not primarily dedicated to patient care. For example, reading room huddles (60) can be held at the beginning of a shift, with all physician staff, attending physicians, and trainees. These huddles are held to ensure that adequate staff are available to supervise residents and technologists in all diagnostic and interventional procedures throughout the shift and provide appropriate coverage for all activities outside of the reading room, such as meetings and interdisciplinary clinical and teaching conferences. The skill level of trainees is assessed to guarantee that there is appropriate coverage of examinations. If needed, additional personnel can be requested or changes in conference coverage can be made.

Safety Audits.—A safety audit is defined as “any summary of clinical performance of health care over a specified period of time aimed at providing information to health professionals to allow them to assess and adjust their performance” (61). Safety audits provide an accurate picture of the state of the practice or organization and are valuable for collecting baseline data and as a monitoring technique for continuous improvement.

Performing audits and giving feedback to health care professionals have been shown to have a small to moderate effect on performance when they are used in isolation. However, the effect is increased when these activities are coupled with educational activities and/or other multifaceted interventions, such as discussion and planning of initiatives in quality meetings or as part of a plan-do-study-act cycle. Not surprisingly, the initial effect is higher when the state of the existing practice is farthest away from the desired state (62).

High-intensity feedback is thought to have a positive impact. Factors that contribute to high, low, or intermediate feedback are listed in Table 1. The highest intensity of feedback involves a direct supervisor giving feedback related to patients to one individual in written and verbal form on a weekly or daily basis, over a long period. Other important aspects of feedback that can make it beneficial are that it is timely with regard to the performance, nonpunitive, and actionable in that it is used to relay how employees can improve their practice (63–65). Feedback is less effective when it is focused on the recipient rather than provides specific suggestions for improvement that allow health care professionals to assess and adjust their performance. It is unclear whether peer-to-peer comparisons introduce a motivational component to an employee’s performance.

The costs of audits and feedback are variable, depending on the ready availability of audit data. Data obtained electronically from routine sources, such as picture archiving and communication systems (PACS) and electronic medical record systems, are much more cost-effective than are data that need to be collected ad hoc and individually by specific health care personnel. An example of the former is the documentation of compliance by means of critical result communication guidelines, which can be obtained automatically from some PACS systems. Conversely, hand hygiene compliance, which needs to be observed in individual cases, requires higher personnel costs.

While a large quantity of safety data must be collected owing to regulatory requirements, for any local safety project it is important to consider which audit data are worth pursuing. Based on the results of the studies just described, audits are most effective in areas where (a) the reality of the practice is farthest from the desired state, (b) the costs of an audit are low, and (c) it is believed that a moderate improvement will have a major effect on patient care.
Safety Reporting Systems.—Reporting systems for collecting and analyzing safety events (8, 66) should be accessible by all staff so that each employee can enter an event and as many events as possible can be recorded. Although safety reporting systems for patient-related events are usually structured for adverse event reporting, they should also be able to capture staff-related safety events such as needlestick and ergonomic injuries.

Physical and cultural barriers to safety event reporting need to be addressed. Physical barriers include limited or no access to computers in work areas where the events occur. In addition, computer software should be easy to use because having to enter cumbersome or an exorbitant amount of data is a disincentive to data submission. Cultural barriers include human factors such as authority gradients and fear of retribution, which must be addressed through cultural change.

Peer review and peer review learning systems to evaluate the accuracy of a radiology report are a form of safety reporting system in which data can be analyzed (67) to avoid future errors. When these types of reviews are performed in a timely fashion, they offer the opportunity to correct potential errors before adverse events occur and thus improve outcomes.

Data Visualization: The Scorecard
Tracking quality metrics is a Joint Commission requirement. However, monitoring quality metrics can quickly become daunting because of the large volumes of data that are generated. Scorecards can be helpful for collecting regulatory data, monitoring performance, identifying problem areas, and tracking compliance with quality improvement initiatives. Graphic displays provide an at-a-glance view of progress and an early warning system for detecting practice drift. In addition, scorecards enable goal setting and give users the ability to assess and track the effects of any corrective action.

Choosing the Right Metrics.—Metrics displayed on a radiology quality scorecard (Fig 2) highlight priorities and usually are linked to department, institution, and regulatory goals and requirements, with predetermined targets for performance and outcomes. Through the distribution of performance data on metrics, members of the radiology team are constantly reminded of safety goals, and the regulatory requirements of groups such as The Joint Commission are kept in focus. While some metrics, such as serious reportable events, falls, contrast medium–related events, compliance with universal protocols, and employee injury, are predetermined by regulatory agencies, departments and institutions are free to choose their own metrics to aid them in the quality improvement process.

Metrics that departments and institutions can use to define themselves should meet the SMART (specific, measurable, accurate, reliable, and timely) criteria. Metrics should also be limited to those that are meaningful and actionable, with target goals identified (68). Each measure should have an identified benchmark that is achievable and aimed at a level of excellence.

Component metrics should be reviewed annually to ensure relevancy, and new component metrics to monitor new goals and processes should be introduced. Group participation in the development of new metrics is highly encouraged. With a new focus on emotional harm resulting from a lack of respect and dignity (69) as an important part of the patient experience, our group started to monitor the number of patient complaints to the health care quality department. These complaints provide insight into aspects of the patient experience that can be improved, such as difficult access to systems for scheduling examinations, prolonged wait times, and communication issues during the radiologist-patient encounter.

Organization and Domains.—On the radiology quality scorecard, data are presented under the following broad perspective domains: patient safety,
employee safety, quality and safety, continuity of care, peer review, online QA submissions (70), and patient experience and satisfaction (Fig 2). Component metrics are placed below each heading, allowing viewers to see how each part contributes to the whole. A quarterly display of the data shows the performance of the radiology department or group over time. The graphic presentation of data in multiple formats permits rapid interpretation of current data, trends, and the group’s direction toward identified goals. The harm data presented as an actual number of incidents (number of serious reportable events, 3) rather than as the rate of occurrence (number of events expressed as a percentage of the number of examinations performed during the given period) (0.00234%) are more meaningful because they put a human face on data that might not otherwise be fully appreciated with traditional reporting.

A scorecard can consist of many layers. The front page of the scorecard (Fig 2) displays an aggregate score for each component metric, while the back pages provide a more granular view, with the decomposition of corresponding individual data points (Fig 3). Decomposing the data points allows analysis of contributing factors that can be tailored to individual practices and are built along many dimensions, such as office location, modality, and staff group.

Using Data to Foster Improvement

Red Flags.—Quantitative measures are paired with spotlight color indicators, such as red, yellow, and green, to visually demonstrate the relationship between data and the corresponding benchmark (Fig 2). This allows easier identification of problem areas.

Prioritizing Improvement Efforts.—Including a topic of improvement effort on the scorecard in the form of a metric intrinsically prioritizes the initiative. Discussion of the metric at the department QA meeting raises awareness of the issue, and the
display on the scorecard makes any progress visible to all employees. For example, to ensure compliance with a newly introduced postprocedural closeout process, we added a metric to document compliance. Data from random audits in all procedural areas are used to encourage discussion of the process and facilitate integration into daily practice.

**Monthly Meetings.**—Dedicated quality and safety meetings to analyze safety data and develop improvement projects should be held monthly and involve staff from all work areas. Participation from all staff groups improves the overall involvement of employees in the safety effort.

### Analyzing Safety Events

#### Root Cause Analysis

An RCA of all safety events must be performed to identify systemic vulnerabilities and develop effective corrective actions. RCA (71) is performed by repeatedly asking the question “Why?” (something happened) and thus peeling away multiple layers of contributing factors until the initial or root cause is discovered. This method is also referred to as “the five whys,” alluding to the number of rounds of questioning that it usually takes to determine the root cause.

As a method of error analysis, RCA is used to investigate system errors without assigning blame to individual staff members. The goal of RCA is to implement system solutions to latent errors, which reflect inherent faults in processes, equipment, or organizations that are contributing to failures (72). Therefore, the National Patient Safety Foundation has recommended renaming this process root cause analysis and action, or RCA2, to ensure that efforts will result in the implementation of sustainable systems–based improvements.

From an HFE point of view, system errors can be addressed most effectively by redesigning processes or products, whereas corrective actions that consist merely of staff education and/or policy changes have been shown to have a weaker effect and are less likely to prevent recurrence of an event (73). However, staff education, in the form of didactic teaching, discussion at faculty and staff meetings, and/or in-service training, is still the most commonly suggested corrective action and is probably contributing to the ineffectiveness
Ascribed to RCA. Future efforts should be aimed at developing system improvements and finding ways to avoid slips and lapses.

**Failure Mode and Effect Analysis**

In 1988, the National Center for Patient Safety recognized that while RCA of serious adverse events enables the possibility to introduce system improvement, patient safety could be further improved with prospective analysis of health care processes. In 2002, The Joint Commission emphasized that institutional leaders should “ensure that an ongoing, proactive program for identifying risks to patient safety and reducing medical and health care errors is defined and implemented” (16,74). This guideline further specified that observed vulnerabilities should be evaluated with regard to their effect on patient safety, and their criticality should be ranked. For the most critical safety hazards, institutions should analyze the contributing factors, redesign processes and equipment, and test the proposed changes to confirm that the vulnerability has been addressed.

A proactive risk assessment of system vulnerabilities can be performed before errors occur by using FMEA. For FMEA, three variables are evaluated to calculate a risk priority number: severity, likelihood of occurring, and detectability. For health care–specific FMEA (HFMEA), the standard definitions need to be modified. HFMEA is performed by an interdisciplinary team with use of a six-step system (75) to evaluate the criticality of a health care process and develop a proposed action plan (7). The HFMEA process is summarized in Table 2. The applicability of this analysis to radiology has been previously reported on (75,76).

*Failure modes* are operationally defined as the different ways that a particular process or subprocess step can fail to accomplish its intended purpose. They can be identified by using comparisons with known failure modes from the literature, brainstorming, or cause-and-effect diagramming. It is helpful to include one team member who is unfamiliar with the process and can detect additional vulnerabilities. After the proposed actions are implemented, the system is tested to ensure that functionality is preserved and no new vulnerabilities were introduced elsewhere in the system.

**Joint Commission Ever-Readiness**

Currently, The Joint Commission informs an institution of a 3-month time window during which it can visit at any time without additional notice. Thus, the goal of every Joint Commission preparation is to achieve ever-readiness. To maintain this high level of preparedness is challenging and requires continuous staff engagement. The Joint Commission strives to evaluate patient care at the point of care to ensure that frontline personnel are delivering health care according to institutional policies and procedural guidelines. Joint Commission surveyors follow a number of individual tracer patients (77) through the organization’s entire health care delivery process, evaluating the patients’ experience of care, treatment, and/or other services. The aim of a Joint Commission visit is to identify performance

Table 2: Steps for Performing FMEA

<table>
<thead>
<tr>
<th>Step</th>
<th>Description*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1: define the process to be analyzed</td>
<td>High-risk process based on SREs, data published by The Joint Commission, department audits, patient complaints, and gemba walks</td>
</tr>
<tr>
<td>Step 2: assemble a team</td>
<td>Six to 10 staff members, including team leader, advisor (QA supervisor), subject matter experts (nurse, technologist, patient representative), and non–subject matter expert</td>
</tr>
<tr>
<td>Step 3: develop a process map</td>
<td>Flow diagram containing all processes and subprocesses</td>
</tr>
<tr>
<td>Step 4: conduct a risk analysis</td>
<td>List all potential failure modes; determine the probability and severity of the failure mode; assign a risk score; assess the criticality, absence of effective control measures, and lack of detectability</td>
</tr>
<tr>
<td>Step 5: define actions and outcome measures</td>
<td>List actions, outcome measure(s), and responsible person(s); engage leadership and management staff; test the system after actions are implemented</td>
</tr>
<tr>
<td>Step 6: follow-up</td>
<td>Monitor and sustain change</td>
</tr>
</tbody>
</table>

Source.—Reference 75.

*SREs = serious reportable events. Probability (in step 4) refers to whether the given failure is likely to be frequent (several times within 1 year), occasional (several times within 2 years), uncommon (sometime within 2–5 years), or remote (within 5–30 years). Severity (in step 4) refers to whether the failure has minor, moderate, major, or catastrophic consequences.
issues in one or more steps of patient care and uncover issues at interfaces between different elements of the health care process.

There are also system tracers (data management, infection control, medication management, NPSGs, contracted services performance monitoring, incident or error reporting) and program-specific tracers (continuity of care, laboratory integration, patient flow, violence, suicide prevention). While system tracers are discussed during group discussions among responsible staff from all departments involved in the particular process, program-specific tracers are discussed during the time spent with individual tracers (78).

Much of a Joint Commission visit is spent with individual tracers while observing frontline staff, giving the staff the unique opportunity to showcase their excellent patient care, safety awareness, and active involvement in department QA activities. Having staff articulate how the department addresses and integrates NPSGs into daily practice underscores the high safety standard of the institution.

Tools and Processes
Mock surveys performed jointly by hospital and radiology department health care quality personnel by using the tracer methodology (79) are most helpful for uncovering specific vulnerabilities. The use of individual patient tracers is valuable for pinpointing critical areas and developing a specific action plan. A repeat survey performed after the action plan has been put in place can be used to determine whether the issue has been satisfactorily addressed or further work is needed. Additional interactions with a surveyor can be simulated in hallway discussions, during which questions are asked by the chief quality officer, nurse, or other managers when they encounter staff during the workday.

Daily e-mails that contain possible test questions can be sent to all members of the department or practice to reinforce material that is difficult to memorize (78). To provide immediate feedback and learning opportunity, the e-mail can be sent again, with the answers to the questions provided at the end of the communication. A jeopardy game for all staff (including technologists, nursing staff, transport staff, administrative staff, and attending and trainee physician staff) can be used to help memorize otherwise challenging material. The 60-minute game is played once, close to the time of the actual Joint Commission visit, during a period blocked specifically for the activity to ensure maximal participation. An audience response system is used to determine prizes for the most successful team. This game offers an opportunity to foster team building.

Common Vulnerabilities

Documentation of Staff Competency.—Mandatory staff training must be documented for fire and electrical safety, infection control, universal protocol compliance, familiarity with safety manuals, and training on the use of the local safety reporting tool. A centralized online staff training repository is helpful for keeping such data on each employee. An automated program sends all employees and their supervisors annual reminders that the yearly required testing needs to be completed (Fig 4). In addition, the department safety manual and the mass disaster policy and plan should be disseminated to all employees.

Areas of Overlapping Responsibilities.—One focus of the Joint Commission visit preparation process is to clarify or assign responsibility for all processes, particularly in areas of potential overlap. A known vulnerability is related to cleaning certain areas such as areas under sinks, regions above a certain height, cabinets, and hallways. While this may be considered part of the environmental staff’s responsibilities, this may not be the case technically. At our institution, environmental staff clean only to 6 feet above the floor, leaving the higher cabinets without responsible persons to clean them. The cleaning of radiology equipment, organization of cabinets, and discarding of expired supplies also fall into a group of tasks for which no specified group is responsible. To ensure consistent performance, these tasks have to be assigned to a responsible staff group or member, and schedules for performance have to be developed.

Conclusion
Safety programs designed to protect patients and employees are a critical mission of health care organizations. While safety programs require dedicated leadership, they can be successful only if all employees understand safety to be a responsibility shared by all and all safety events and potential safety hazards are reported in a dedicated database. Analysis of serious adverse events facilitates the implementation of effective preventative measures. Nevertheless, safety programs ultimately are most effective when error is identified and mitigated before it affects the patient.

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