Global Quality Imaging: Emerging Issues

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Quality imaging may be described as "a timely access to and delivery of integrated and appropriate procedures, in a safe and responsive practice, and a prompt delivery of an accurately interpreted report by capable personnel in an efficient, effective, and sustainable manner." For this article, radiation safety is considered as one of the key quality elements. The stakeholders are the drivers of quality imaging. These include those that directly provide or use imaging procedures and others indirectly supporting the system. Imaging is indispensable in health care, and its use has greatly expanded worldwide. Globalization, consumer sophistication, communication and technological advances, corporatization, rationalization, service outsourcing, teleradiology, workflow modularization, and commoditization are reshaping practice. This article defines the emerging issues; an earlier article in the May 2011 issue described possible improvement actions. The issues that could threaten the quality use of imaging for all countries include workforce shortage; increased utilization, population radiation exposure, and cost; practice changes; and efficiency drive and budget constraints. In response to these issues, a range of quality improvement measures, strategies, and actions are used to maximize the benefits and minimize the risks. The 3 measures are procedure justification, optimization of image quality and radiation protection, and error prevention. The development and successful implementation of such improvement actions require leadership, collaboration, and the active participation of all stakeholders to achieve the best outcomes that we all advocate.

Key Words: Quality and safety, quality improvement, radiation protection, radiation safety, procedure justification, optimization of protection, radiology errors, adverse events, referral guidelines

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QUALITY IMAGING

The key elements for quality in imaging (Figure 1) include the following:

- accessibility: to provide access to procedures at the right place and at the right time;
- integration: to provide coordinated care across practices (eg, previous records can influence procedure choice, interpretation, and follow-up);
- responsiveness: to recognize the primacy of a patient and that the practice is patient and family oriented;
- appropriateness: to provide care that is relevant to a patient's needs and is based on established standards;
- safety: to minimize unavoidable risks, prevent avoidable harm, and manage radiation exposures;
- capability: to ensure that the procedures are undertaken with skill, competency, and knowledge;
- timely communication and accurate interpretation: to deliver timely results, especially for urgent or unexpected findings;
- efficiency: to ensure the cost-effective use of resources;
- effectiveness: to achieve the desired outcome; and
- sustainability: to provide infrastructure that is responsive to changes and emerging needs.

Radiation safety is considered as one of the key quality elements. These elements are consistent with the quality dimensions under the National Health Performance Framework [1].

Quality Control, Assurance, and Improvement

Using a chest x-ray as an example, quality control can be defined as the repeat of a poorly exposed or positioned image to ensure that it is diagnostic. Quality assurance requires a more comprehensive approach (eg, procedure manual, exposure chart, processor quality control, imaging processing) to reduce poor-quality images. Quality

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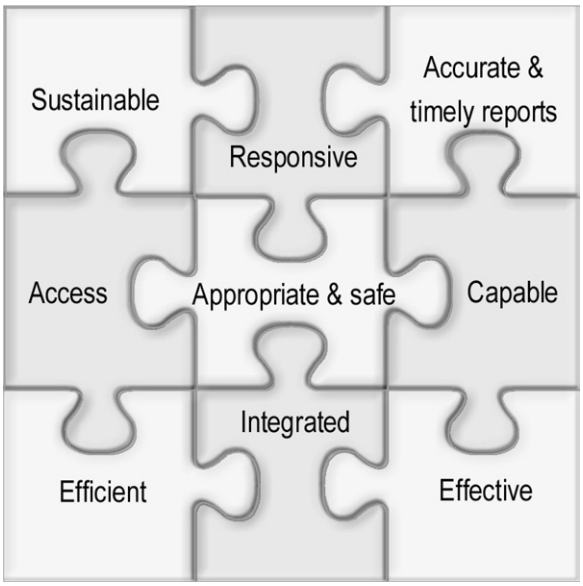

Fig 1. The quality elements include timely access, integrated care, responsiveness, appropriateness, capability, safety, accuracy, efficiency, effectiveness, and sustainability.

improvement is a proactive process, such as by audit, training, analysis, development, and implementation of improvement for each step to achieve diagnostic images while using minimal radiation [2].

IMAGING STAKEHOLDERS AND QUALITY DRIVERS

Consumers of imaging include patients and referrers who are today better informed and expect quality services. Equipment manufacturers and vendors use quality and safety as a marketing tool (eg, 50%-80% lesser dose and better image quality in new CT scanners).

Imaging provider teams include radiologists, radiographers, other eligible providers, medical physicists, and nurses. They support professionalism and their professional responsibilities [3-5] and are the advocates for improvement actions toward better quality and safer and more appropriate and sustainable use of imaging by doing the right procedure on the right patient, using the right technique, at the right time, and at the right cost.

Governments, competent authorities, radiation safety agencies, and policymakers promote quality care and ensure radiation safety by regulations and policies. Payers expect value for their reimbursements. Evidence-based utilization is being assessed as a means to promote appropriate use and to manage demand and rising cost. Some organizations champion quality by rewarding outstanding providers (ie, pay for performance).

Professional organizations, academic institutions, scientific societies, national, regional, international organizations, and United Nations agencies advocate for quality and safety systems and provide important links between the stakeholders.

Medical defense organizations and malpractice insurers recognize the connection between quality and risk management. Some insurers offer premium reduction for participation in quality improvement activities.

GLOBAL ISSUES

Over the past 3 decades, the use of imaging has greatly expanded worldwide. By applying new techniques and technologies, radiologists, radiographers, medical physicists, and other eligible providers have improved patient safety and the quality of care. Patients benefit from earlier diagnoses and less invasive treatments. However, workload, workforce, workplace, and budget issues are emerging.

Increased Utilization

About 3.6 billion radiology procedures are performed worldwide each year [6], and this figure is rising. In the United States, 500 million procedures are performed annually. With an estimated 70 million procedures, CT is the major source of radiation exposure [7]. In this country, medical to total population exposure from ionizing radiation increased from 15% in 1980 to 50% in 2006 [8], and health care expenditure increased from 13.9% of the gross national product in 2001 to 15.3% in 2003 [9]. Increases in utilization lead to increases in radiation exposure and health care costs.

Expanded applications and aging populations are appropriate reasons for increased demand. Self-referral, defensive medicine [10], and wellness screening could lead to inappropriate use; unnecessary, unintended, or accidental exposures; and waste of resources. Studies have consistently demonstrated higher utilization, increased charges, and unnecessary exposures in self-referred practices [11,12].

In the United States, up to 20 million adults and 1 million children may undergo unnecessary CT each year [13]. A Finnish review of 2,367 CT procedures in patients aged $<$ 35 years showed that 77% of lumbar spine, 36% of head, and 37% of abdominal procedures were not justified [14]. Users need guidance on the appropriate use of procedures, radiation safety, and ethical issues [15].

Nevertheless, from a global perspective, the health sectors of many countries are underresourced, with considerable inequalities. For example, the health care expenditure per capita in 2007 ranged from $7 to $7,439, with a median cost of $248 [16]. This means limited to no access to imaging in many low-income countries.

Changing Practice

Globalization, consumer sophistication, communication advances, workflow modularization, and commoditization are reshaping imaging practice. For example, sched-

uling, imaging, and reporting are potential candidates for commoditization [17].

Applications of digital radiology, PACS, and secure virtual private networks together with workforce shortages are propelling the use of teleradiology. The globalization of health care, skyrocketing costs, and the corporatization of some imaging practices are accelerating the outsourcing of imaging by teleradiology [18]. There are technical, organizational, and quality issues with outsourcing [19,20]; for example, clinical-radiologic consultation, referrer and radiographer education, and quality assurance actions will likely be reduced [21].

Workforce Shortage

The volume and complexity of imaging procedures have increased, but the workforce is not keeping pace. There is pressure on imaging providers to do more for less [22], thus posing a threat to quality and safety. This workforce shortage particularly is worse in low-income and middle-income countries, where demand exceeds supply [23].

The convergence of imaging with other specialties has led to turf debates, with cardiac imaging added to the existing list where practitioners jostle for control. Workforce shortage is a dilemma confronting imaging providers worldwide, some more than others, and there are turf debates. Regardless of the specialty, providers must be adequately trained, experienced, and competent to perform such procedures.

Public Interest for Action

The public, regulatory authorities, and payers are increasingly interested in imaging issues: inappropriate use, radiation exposure, quality and safety, cost, and sustainability. Although imaging plays a pivotal role, system sustainability is becoming a concern. To meet these challenges, there is a need for imaging stakeholders to collaborate, identify the opportunities, strengthen the efforts, and develop and implement actions on cost-effective, better quality, safer, and more appropriate use of imaging.

QUALITY MEASURES

To tackle these challenges, a range of quality measures, strategies, and actions are used (Figure 2). The 3 quality measures are

- procedure justification,
- optimization of image quality and radiation protection, and
- error prevention.

Justification and optimization are well-recognized pillars of radiation protection. Error prevention will reduce errors along the patient journey, before, during, and after the procedures (Figure 3).

Fig 2. The 3 quality improvement measures underpinning quality imaging are justification, optimization, and error prevention. Specific actions are grouped under 5 strategies, supporting these 3 measures.

Procedure Justification

Justification is applied at 3 levels: society, procedure, and individual [24]. First, the use of medical radiation is acceptable if it will do more good than harm to society, with radiation, economic, and social issues being considered. Second, the objective for a procedure is defined and justified (ie, it will improve diagnosis, treatment, or patient management). Third, the procedure will do more good than harm to an individual.

For many conditions, imaging is not required. Before scheduling, it is important to verify if the information is not already available and if the relevant clinical, laboratory, imaging, and treatment details are provided in the referral. For high-dose (eg, CT) or complex procedures, individual justification by the imaging provider is particularly important and should take into account all the available information. When indicated, imaging that does not use ionizing radiation (eg, ultrasound, MRI) should be selected, especially in children [25,26]. Cost, expertise, and resources are other considerations.

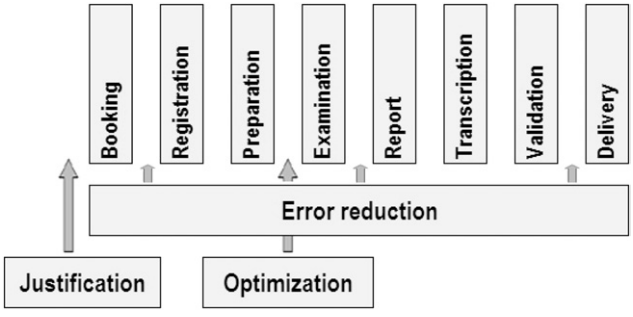

Fig 3. Procedure justification and optimization of image quality and radiation protection focus on the beginning of the patient journey (long arrows). Justification, situated at the start of the process, is an important "gatekeeper" to screen out unnecessary procedures. Error reduction measures (short arrows) are used to reduce human errors along the entire journey.

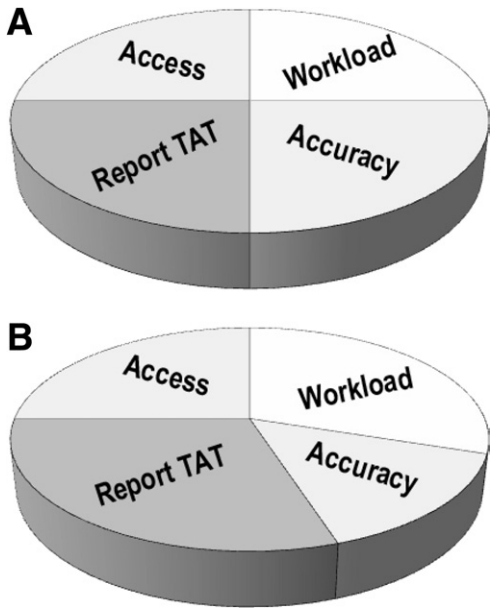

Fig 4. (A) The performance pie. Access, workload, turnaround time (TAT), and report accuracy are linked. Within the allocated resources and capacity, it is important to strike a balance among these metrics to ensure the quality and safety of care. (B) The performance pie under threat. Within the allocated resources, the output is finite. Attempts to set unrealistic performance expectation in one or more areas (eg, higher workload, shorter TAT) could adversely influence another (eg, report accuracy). However, building capacity and providing sufficient resources could achieve these aims without compromising the performance metrics.

Optimization of Image Quality and Radiation Protection

Optimization is applied at 2 levels: the design, selection, construction, and installation of appropriate equipment and the daily working procedure. The choice of measures will depend on the resources; will affect the exposure to patients, staff members, and sometimes the public; and will have financial implications.

In radiology, the aim is to keep doses as low as reasonably achievable, with economic and societal factors taken into account, while ensuring diagnostic image quality and maximizing the benefits (ie, to manage dose to be commensurate with the medical purpose). For example, when using CT to follow up a lung nodule, a low-dose technique will reduce the dose by 90%. In children, indication-based and weight-based protocols should be used.

Error Prevention

To err is human. However, errors will increase with workforce shortage, workload increase, workplace demands, and limited resources. For example, an increase in interpretation errors could be due to high workload, multitasking, distractions, knowledge, or experience gaps (Figure 4). An understanding of these causes by conducting audits followed by the implementation of corrective measures and quality improvement actions will prevent and minimize errors, risks, and the subsequent adverse events.

LEADERSHIP, COLLABORATION, AND PARTICIPATION

At a global level, system-based and multidimensional actions to improve quality care and radiation safety in imaging are usually initiated by leading organizations or agencies and supported by stakeholders under an inclusive framework. They require vision, leadership, partnership, collaboration, and participation [27,28]. Examples of stakeholder collaboration include the World Health Organization's Global Initiative on Radiation Safety in Health Care Settings [29] and the International Atomic Energy Agency's International Action Plan for the Radiological Protection of Patients. These actions require some initial investment but are indispensable in the long-term as an integral part of professionalism and risk prevention.

An organization's quality focus depends on its charter, constituency, expertise, and resources. The development and implementation of major actions are beyond the expertise and resources of a single organization. A team approach is required. Under a globalized environment, stakeholder collaboration will provide synergy, minimize duplication, and spearhead these actions [30]. Communication will prevent misunderstanding and identify common goals. Organizations could participate as partners and contribute to an integrated subaction. The sharing of resources and feedback between subactions and actions will add value and contribute to better outcome.

The biggest challenge for these long-term improvement actions is failure to deliver. This could be due to political considerations, a practice's financial burden, individual workload, organizational resources, and inevitable leadership changes. However, with a collaborative and inclusive framework, corporate memory will be shared and continuity ensured.

United Nations agencies, such as the International Atomic Energy Agency and the World Health Organization, with their independency, credibility, infrastructure, and links to other organizations and competent authorities, play a leading role by facilitating the member states in the strengthening of infrastructure and policies. Professional organizations, such as the International Radiology Quality Network, the International Society of Radiology, and International Society of Radiographers and Radiological Technologists, provide professional advice and advocacy at international level in the development of these global actions and facilitate their implementation at local level.

These quality actions will affect imaging users and imaging providers in their daily work. Therefore, it is important to engage imaging providers to ensure their

input and implementation of these actions to improve practice and patient care. The important roles imaging providers play by offering expert clinical advice, ensuring appropriate use by justification and optimization, and participating in technology innovations [17] should be stressed.

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