Optimizing Radiation Use during Fluoroscopic Procedures: Proceedings from a Multidisciplinary Consensus Panel

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Diagnostic and interventional fluoroscopic procedures have dramatically improved patient care. They have helped minimize the need for more invasive surgical procedures and consequently reduced the morbidity and mortality of numerous diseases. However, in recent years, the rapid increase in the overall use of ionizing radiation has renewed concerns about the risks of radiation exposure in medical imaging (1–19) (Fig 1). The data indicate that diagnostic and interventional fluoroscopic procedures are major contributors to this increase in per capita exposure (18,19). Fluoroscopic procedures carry a risk of permanent skin injuries as well as possible risk future cancer induction (20–22). The heightened interest in the risks associated with ionizing radiation prompted the Society of Interventional Radiology (SIR) Foundation to convene a panel of experts who would investigate how to best balance the risks and benefits of fluoroscopic procedures. The meeting’s goal was to develop a comprehensive strategy for optimizing the use of ionizing radiation during fluoroscopic procedures. The premise is that ionizing radiation is a resource used during fluoroscopic procedures and optimal use satisfies the medical purpose but avoids excess or unproductive exposure.

MEETING ORGANIZATION

The SIR Foundation announced interest in developing a consensus panel for radiation use in March 2010. Interested parties were invited to develop and submit proposals for a national meeting. Proposals were reviewed in June 2010 and, based on previously specified criteria, an individual (J.R.D.) was selected to lead the panel. In consultation with the SIR Foundation leadership, the panel lead developed a list of experts in radiation dose optimization, medical physics, registry development, and health care policy. Fourteen of these experts were invited and agreed to serve on the panel and included interventional radiologists \( n = 8 \), diagnostic radiologists \( n = 2 \), medical physicists \( n = 2 \), a radiologic technologist, and an expert in registry development. In addition, officials from the Food and Drug Administration, Agency for Healthcare Research and Quality, National Council on Radiation Protection and Measurements, The Joint Commission, and Department of Defense were invited and agreed to participate in the panel discussions.
Before the meeting, the participants were given an agenda describing the structure and intent of the meeting. The structure of the meeting differed from earlier SIR Foundation Research Consensus Panels as the goal of this meeting was to select priorities for process improvement rather than to develop a research agenda. As illustrated in Figure 2, process improvement begins with an assessment of the current state, delineation of the desired future state, and assessment of the gaps between the two. The meeting, therefore, had three parts: (i) introductory presentations that described the current state, (ii) moderated roundtable discussion of desired future state, and (iii) discussion of the gaps between the two.

DATA COLLECTION: DESCRIPTION OF THE CURRENT STATE

The current state and ideas for the future state were described in a series of presentations to the panel (Table 1). The overarching need for improvement in health care was described and the current process drivers were discussed. As large-scale improvement efforts in computed tomography (CT) are already under way (10,23), these projects were reviewed with particular attention to learning what key strategies might prove beneficial when attempting to optimize radiation use during these procedures (19).

Figure 1. Trends in United States for per-capita exposure to ionizing radiation. Before 1970, the predominant source of ionizing radiation was from natural sources, but the rapid increase in medical imaging since then has doubled the per-capita exposure (18). Although this dose and the resultant risks are spread unevenly throughout the population, the increasing number and complexity of fluoroscopic procedures prompts evaluation of how to optimize radiation use during these procedures (19).

Table 1. Presentations to the Panel

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<th>Presentation to the Panel</th>
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<td>Improving health care: radiation use as a priority</td>
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<td>Adults as a priority (beginning with CT): Image Wisely campaign</td>
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<tr>
<td>Children as a priority: Image Gently campaign</td>
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<td>Data-driven improvement: American College of Radiology registries</td>
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<td>Improving tools for health care: role of the Food and Drug Administration</td>
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<td>Improving health care processes: role of Agency for Healthcare Research and Quality</td>
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<td>Data and system-based approaches to optimizing performance during fluoroscopic procedures</td>
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<td>DICOM-SR: new format for reporting radiation use during fluoroscopic procedures</td>
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<td>NCRP process for developing reference levels</td>
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Note.—DICOM-SR = Digital Imaging and Communications in Medicine structured reporting; NCRP = National Council on Radiation Protection and Measurements.

RESULTS: DESIRED ATTRIBUTES OF THE FUTURE STATE

The panel discussed the benefits of optimized doses and reduced variation. One of the fundamental goals of radiation protection is optimization (33,41). This means that the likelihood of incurring exposures, the number of people exposed, and the magnitude of their individual doses should all be kept as low as reasonably achievable, taking into account economic and societal factors. This strategy recognizes the need to optimally balance the risks versus the benefits of ionizing radiation. As highly variable but have been far more successful in producing results that exhibit minimal variation. Analysis of the current state found examples in which two- to eightfold reductions in radiation use were possible without sacrificing the diagnostic or therapeutic efficacy of fluoroscopic procedures (39,40). Finally, optimization efforts in radiology have been slow and sporadic rather rapid and continuous.
shown in Figure 4 (33,34,42), excessive reduction in radiation dose could result in a nondiagnostic study or a failed intervention. This analysis also illustrates the importance of reducing unnecessary variation and specifying values that trigger investigations into determining factors that might have led to the need to use more or less radiation to accomplish a specific task.

**DISCUSSION: GAP ANALYSIS**

The panel then discussed a data-driven strategy for continuous process improvement (Fig 5). The keys to this effort include the creation of a fluoroscopy registry in which dose metrics would be routinely collected from patient procedures. The observed values at an individual facility would be compared with national reference levels and the results used to plan and implement changes. The success or failure of those changes will become evident from continued data collection and analysis.

Creating such a feedback loop will require convincing key stakeholders that change is needed and developing the necessary change agents. The Image Gently and Step Lightly initiatives have enrolled numerous radiologists who
pledge to serve as change agents for pediatric imaging. The decrease in CT use in pediatric centers suggests that imaging behavior has changed (43). The Image Wisely campaign hopes to expand this successful model to adult imaging. As shown in Table 2 (9–12,23,25,26,33,41,44–51), the improvement process will also benefit from earlier work on the development of standardized radiation metrics such as Digital Imaging and Communications in Medicine structured reporting (50,51). As this loop is repeated, and knowledge gained, the results must be disseminated so that others may benefit from the process (52).

SUMMARY

Optimizing radiation use during fluoroscopic procedures is a key aspect of adding value to these procedures. The multidisciplinary panel acknowledged that patients are and will remain the key stakeholders in the improvement process. The panel recommended development of a multidisciplinary registry that will continually capture and analyze data from fluoroscopic procedures in an attempt to improve the safety of these procedures while maintaining their benefit. Although the SIR Foundation is well positioned to initiate this effort, long-term support will require working with a variety of patient advocacy groups and federal agencies.

REFERENCES


