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Critical Review

# Promoting safety mindfulness: Recommendations for the design and use of simulation-based training in radiation therapy

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## Abstract

There is a need to better prepare radiation therapy (RT) providers to safely operate within the health information technology (IT) sociotechnical system. Simulation-based training has been preemptively used to yield meaningful improvements during providers' interactions with health IT, including RT settings. Therefore, on the basis of the available literature and our experience, we propose principles for the effective design and use of simulated scenarios and describe a conceptual framework for a debriefing approach to foster successful training that is focused on safety mindfulness during RT professionals' interactions with health IT.

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## Introduction

It is widely believed that health information technology (health IT) can help providers safely deliver the right care at the right time to the right patient and thus should be vigorously embraced.[1-3] However, imperfectly designed and misused health IT can create new hazards in the already complex delivery of health care.[4-6] Suboptimal health IT systems and interfaces can impose additional

(and unnecessary) cognitive effort and confusion on health care providers, which increases the potential for patient harm.[6-10] Indeed, there are reports that link patient harm to the suboptimal design and use of health IT,[11-15] including in radiation oncology.[16-19] In fact, information management in health IT has become one of the top patient safety concerns (based on 1.5 million events that were reported to patient safety organizations and a consensus of patient safety experts).[5] Errors in radiation therapy (RT), where most communications and care delivery are essentially completely driven through health IT, are estimated to occur in approximately 5% of the more than 600,000 patients receiving RT per year in the United States. Serious/lethal events occur in approximately 1 in 1000 to 10,000 patients, highlighting the need for improvement.[20,21]

Thus, the U.S. government; national associations, including the American Society for Radiation Oncology, American Association of Physics in Medicine, American Society of Radiologic Technologists, American Association of Medical Dosimetrists; and multiple businesses are supporting efforts to optimize the implementation and use of health IT systems (eg, improving interoperability, usability, workflows, and shared learning about safety issues).[4,5,20,21] They also emphasize the need to develop and assess innovative educational and training programs to prepare the current and future workforce to safely operate within the health IT sociotechnical system.[4,5,20,21]

Experts believe that simulation-based training can be preemptively used to yield meaningful improvements during providers' interactions with health IT (eg, procedural compliance, clinical skills, and patient safety)[22-26] including RT settings.[27-30] By allowing trainees to make, recognize, and learn from undesirable behaviors and failures in the simulated training environment, it should be possible to preempt similar unsafe situations and behaviors in clinical environments. Specifically, health care educators have recognized the pivotal role of debriefing in simulation-based training to support the transfer of learning from experiences in the training environment into practice.[31-40] In general, effective debriefing involves a 2-way conversation between the trainee and educators to highlight particularly favorable behaviors/actions and to identify and discuss areas where there is potential for the trainee to improve performance.

For this article, we refer to improvement in performance in terms of safety mindfulness. We define safety mindfulness during RT professionals' interactions with health IT systems (eg, treatment planning and delivery systems, and electronic medical records) as adherence to evidence-based medical procedures including documentation and communication standards while maintaining moment-by-moment appreciation of the potential for latent and active failure pathways (Fig 1).

We use the term *adherence* to emphasize the need for pragmatic improvement efforts, which must be standardized and sustained over time. We use the term *moment-by-moment* to emphasize the cognitive aspects of safety mindfulness that are involved in monitoring real-time performance, particularly in maintaining awareness of risks and being both willing and able to detect, interpret, and intervene in abnormal and potentially hazardous situations. The premise is that under more standardized systems for doing the work, which encompass the concept of safety mindfulness, failures should interact in a more predictable manner. Thus, a safety-mindful mindset offers the opportunity to operate proactively (eg, something seems wrong here, this seems too perfect to be true) as opposed to reactively (eg, I assumed it was correct, I forgot to communicate), mitigated by using validated cognitive quality assurance (QA) routines and improvement behaviors.[41-43]

However, despite the increase in simulation-based training in the medical domain, relatively little research has been carried out to understand how to incorporate, use, and evalu-
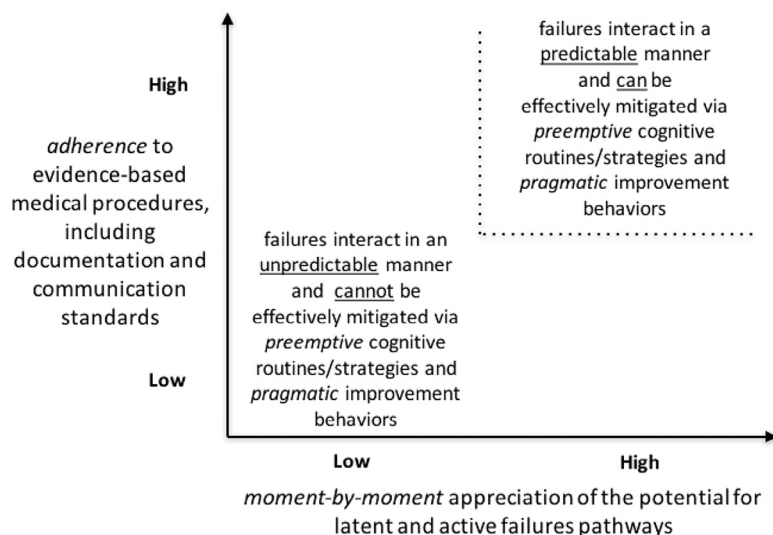


**Figure 1**    Consequences of suboptimal safety mindfulness during interactions with health information technology.[41,42]