

## Basic Original Report

# Missing the Near Miss: Recognizing Valuable Learning Opportunities in Radiation Oncology



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### Abstract

**Purpose:** “Near miss” events are valuable low-cost learning opportunities in radiation oncology as they do not result in patient harm and are more pervasive than adverse events that do. Near misses vary depending on the presence of a latent error of behavior or process, and the presence of an enabling condition predisposing the patient to harm. These nuanced distinctions across near miss types can elicit different cognitive biases affecting the recognition of near misses as learning opportunities. We define near miss types in radiation oncology and explore the differential perceptions among radiation oncology staff.

**Methods and Materials:** Six event types were defined based on attributes of latent error and enabling conditions: “hit,” “potential hit,” “almost happened,” “fortuitous catch,” “could have happened,” and “process-based catch.” These events were illustrated with an example of a patient receiving pacemaker cardiac clearance before radiation treatment. A survey assessing (1) success versus failure of an event and (2) willingness to report the event was administered to a radiation oncology department using the pacemaker example. Mean scores for each near miss type were compared.

**Results:** Ninety-five staff members (74%) completed the survey. Perceived success scores and willing-to-report scores significantly differed by near miss type ( $P = .042$  for success ratings;  $P < .0001$  for willingness to report). “Could have happened” events were viewed as less successful and were more likely to be reported than “almost happened” events ( $P < .0001$ ).

**Conclusions:** Cognitive biases appear to influence whether and how near miss types are recognized as report-worthy. Education of near miss types and engaging staff for quality improvement may improve recognition.

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## Introduction

Radiation oncology involves the delivery of complex care, which is vulnerable to adverse and near miss

events. The Agency for Healthcare Research and Quality (AHRQ) defines an adverse event as a medical error that results in patient harm. On the other hand, a near miss event is defined as an event that could have resulted in an accident, injury, or illness but did not by chance, which may be due to robustness of the patient or a fortuitous, timely intervention (Fig. 1). A near miss event may alternatively be referred to as a “close call,” “near hit,” “good catch,” or even “near-error,” semantically highlighting how these events may be variably framed. In radiation oncology, adverse events resulting

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in patient harm are rare compared with near miss events. Ford et al<sup>1</sup> comment extensively on these findings in a literature review of incident learning within radiology oncology. Departmental studies including near miss events report an average of 466 events per year, while studies that only include incidents, that is, events that reach the patient, report an average of 53 events per year. One study reports 14 near miss events for every actual incident.<sup>2</sup> Even with the inclusion of near miss events, data from hospital surveys suggest that only a minority of incidents being experienced are reported<sup>3</sup> (Cooke et al, BMJ Quality and Safety 2007). Despite the overall underreporting, near miss events present frequent, low-cost learning opportunities to improve processes and prevent future adverse events to ensure patient safety.

Greater reporting of near miss events is correlated with lower rates of patient safety events, and increased reporting can lead to resolution of processes contributing to errors.<sup>4</sup> Accordingly, the American Society for Radiation Oncology recommends that “near misses should be addressed with a similar vigor as that applied to (incidents)” in its 2012 “Safety is No Accident” report<sup>5</sup>. Unfortunately, many barriers exist to incident reporting, including confusion regarding incident importance, reputation of the reporter, effects of reporting on a colleague, workflow interruption, and possible punitive action.<sup>6</sup>

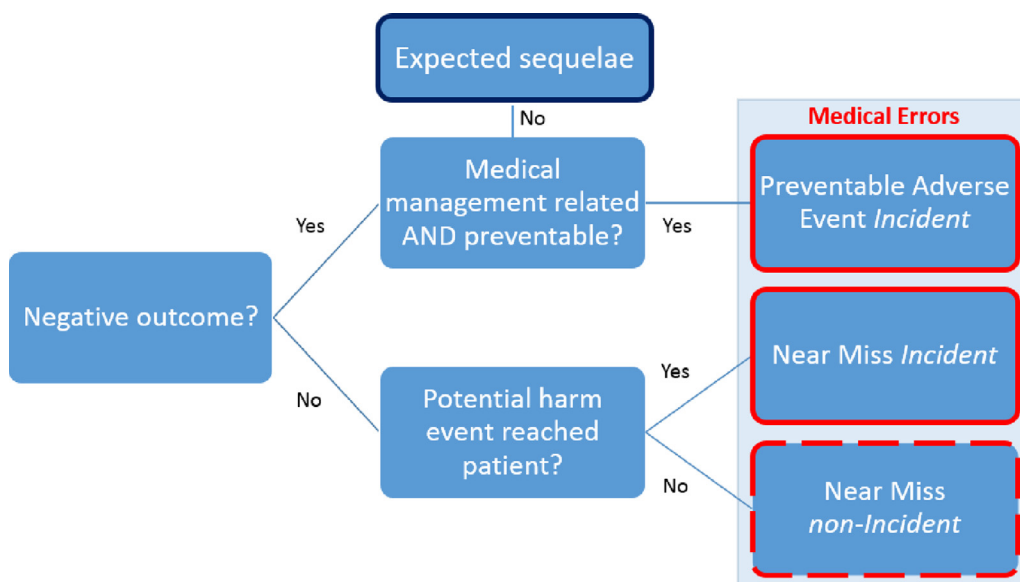
Beyond barriers of which we are aware, health care staff must be able to recognize near miss events as system vulnerabilities worthy of reporting. The systems risk management literature discusses significant cognitive biases impeding recognition and perceived risk of

different types of near miss events.<sup>7</sup> Specifically, near miss events that “could have happened” are distinguished from those that “almost happened,” with the former eliciting cues of system resilience (event perceived as “success”) and the latter eliciting cues of system vulnerability (event perceived as “failure”). The distinction may be due to varying presences of a latent error of behavior or process and the enabling condition that predisposes the patient to harm. Specifically, “could have happened” events feature only the underlying latent error of behavior or process. On the other hand, “almost happened” events feature the latent error as well as the enabling conditioning signaling predisposition to harm. These distinctions are further illustrated in the Methods and Materials section of this study.

To evaluate differences in near miss recognition based on near miss types specific to the process of care in radiation oncology, we apply nuanced definitions of near miss types to patient cardiac pacemaker clearance before radiation treatment, which is understandable, comprehensible, and familiar to a broad range of health care staff. We then empirically explore the presence of biases in near miss type interpretations among staff in a high volume, academic radiation oncology department.

### Methods and Materials

We developed the example of a patient with a cardiac pacemaker receiving radiation to define near miss types, which was then incorporated into an institutional survey to assess perceptions of success versus failure and willingness to report the event to an incident learning system.



**Figure 1** Negative outcomes that result from disease or intended medical management are expected sequelae. Medical errors include preventable negative outcomes from medical management and near miss events without the presence harm. Incidents include medical errors, adverse events, or near misses, which reach the patient.

## Motivating example

Radiation treatment of a patient with a pacemaker can result in malfunction of the pacemaker, depending on its make and model. As a result, cardiologist clearance is often required and dose is appropriately limited.<sup>8</sup> This example was drawn from several reports in an incident learning system describing patients with pacemakers who were nearly treated in fashions described in the following sections. Moreover, this example can be easily illustrated and explained to multidisciplinary health care staff involved in the process of care.

## Event definitions

### Hit

“Hits” are adverse events resulting in patient harm. An example of a hit event may involve a patient with a pacemaker that malfunctions, resulting in an arrhythmia after receiving radiation. The combination of a latent error (not checking pacemaker status), enabling condition (presence of pacemaker), and ultimate result of harm (arrhythmia) characterize the hit event.

### Potential hit

“Potential hits” are events that reach the patient, but harm does not immediately manifest. For example, a patient with a pacemaker receives radiation without cardiac clearance, but whether the pacemaker will malfunction later on as a result is unknown. These events feature the latent error and enabling condition, though with uncertainty regarding harm. This situation is somewhat specific and salient to radiation oncology and more so related to known normal tissue complication probability, as incidental radiation at clinical doses is generally undesirable even if not resulting in immediate harm. In contrast, the onetime ingestion of a systemic medical drug that is safely metabolized and excreted is not thought to cause long-term sequelae, for example, aspirin in the absence of any acute complication, such as bleeding.

### Almost happened

“Almost happened” events are near misses that reach the patient, but no harm is produced. For example, a patient with the pacemaker receives radiation treatment without clearance, and it is known *ex post* the pacemaker will not malfunction, for example, because of its make and model (robustness of device). In retrospect, these events contain prior signaling of potential harm (eg, the presence of a pacemaker), that is, the enabling condition for harm, as well as a latent error by staff (eg, not checking the pacemaker status).

### Fortuitous catch

Also commonly known as “good catch,” “fortuitous catch” events do not reach the patients and are averted by

chance from human intervention. For example, a highly vigilant staff member incidentally notices the patient’s pacemaker on a prior chest radiograph and then halts the radiation treatment process until clearance is obtained.

### Could have happened

“Could have happened” events are near misses that do not reach the patient and furthermore do not contain prior signal of the enabling condition. For example, the pacemaker status was not checked, but incidentally, the patient did not have a pacemaker. They only feature the latent error by personnel (eg, not checking the pacemaker status at intake).

### Process-based catch

“Process-based catches” are averted by a systems-based process or check of the enabling condition (pacemaker status). For example, a staff member following an in-place quality procedure asks a patient about pacemaker status at intake and then is able to obtain cardiac clearance appropriately. If this occurs in the initial intake of the patient, this is standard care with a systems-based identification of the enabling condition. As a result, this scenario does not feature the latent error of staff of not checking the pacemaker status. However, if identification of the pacemaker status occurs later in the process of care at a redundant check, by human intervention or otherwise, after initial intake failed to do so, this may be regarded as a near miss event given the latent error present at initial intake.

The attributes of the various near miss types are summarized in Table 1. Note that “hit,” “potential hit,” and “almost happened” events are all considered to be “incidents” by AHRQ because the event reached the patient and would be further classified as “therapeutic incidents” in the Radiation Oncology ILS. “Almost happened” and “could have happened” events are near misses because of definitive lack of negative outcome. Although systems risk management literature does not classify “fortuitous catch” or “process-based catch” as near misses because of the element of human intervention, they may commonly be regarded as near misses in health care if associated with a lapse in standard safety procedures.

We use the previously discussed definitions to examine how professionally diverse staff of a high volume, academic radiation oncology department differentially assess various near miss types in terms of event success (vs failure) and willingness to report. In particular, we focus on “could have happened” and “almost happened” events given the evidence of relevant cognitive biases in other industries described in the systems risk management literature.<sup>1,7</sup>

## Institutional survey

We conducted our study in a radiation oncology department with an electronic incident learning system

**Table 1** Near miss attributes






	Latent error	Enabling condition	Event reached patient (incident)	Harm
Hit	+	+	+	+
Potential hit	+	+	+	+/-
Almost happened	+	+	+	-
Could have happened	+	-	-	-
Process-based catch	+/-	+	-	-

(ILS). The survey assessed (1) evaluation of hypothetical scenarios as success versus failure and (2) willingness to report the scenario using the ILS. We presented 5 scenarios about a patient with a cardiac pacemaker. The scenarios and survey questions were reviewed by the department’s quality committee leaders and piloted on committee members before administration. Given that the primary interest of this study was to distinguish

perceptions of “almost happened” near miss events from “could have happened” near miss events, as described in the systems risk management literature, the survey omitted “potential hit” and “process-based catch” for simplicity and to avoid ambiguity in definitions.

For each scenario, we included graphic displays to aid comprehension of the nuanced differences (Table 2). After the presentation of each scenario, respondents were

**Table 2** Spectrum of scenarios with increasing proximity to failure

	Graphic display	Scenario
Standard care		The pacemaker status of a patient <i>was checked</i> at initial consultation. The patient <b>did not have a pacemaker</b> and subsequently received radiation treatment <b>without any harm</b> afterwards.
Could have happened		The pacemaker status of a patient <i>was not checked</i> at initial consultation. <i>By chance</i> , the patient <b>did not have a pacemaker</b> and <b>received radiation without any harm</b> afterwards.
Fortuitous catch		The pacemaker status of a patient <i>was not checked</i> at initial consultation. The patient <b>did have a pacemaker</b> . However, <i>by chance</i> , <b>a team member noticed this</b> , and the patient’s <b>treatment was HELD for until clearance was obtained</b> .
Almost happened		The pacemaker status of a patient <i>was not checked</i> at initial consultation. The patient <b>did have a pacemaker</b> and <b>received radiation treatment</b> . However, <i>by chance</i> , the patient <b>did not experience any complication</b> afterwards.
Hit		The pacemaker status of a patient <i>was not checked</i> at initial consultation. The patient <b>did have a pacemaker</b> and <b>received radiation treatment</b> . The patient <b>experienced a pacemaker malfunction</b> afterwards.

**Table 3** Near miss success score pairwise differences

	Mean success	Standard care	Could	Fortuitous catch	Almost	Hit
		6.34	2.26	2.72	1.58	1.14
Standard Care	6.34	0				
Could	2.26	4.08	0			
Fortuitous Catch	2.72	3.62	0.46	0		
Almost	1.58	4.76	0.68	1.14	0	
Hit	1.14	5.2	1.12	1.58	0.44	0

Colored cells indicate absolute difference in mean success scores. Magnitude of difference highlighted from greatest (red) to least (green).

asked to evaluate the event as success or failure (1-7 Likert scale: 1 = failure, 7 = success) and to report the willingness of department staff to submit the event using the incident reporting system (1-7 Likert scale: 1 = very unlikely to submit, 7 = very likely to submit). We asked about the willingness of department staff to report rather than that of the respondent to minimize the effects of potential biases (eg, social desirability bias, acquiescing).

A Friedman test was used to assess presence of differences among mean success scores and mean willingness to report scores. This method tests the null hypothesis that ratings across all scenarios are equal. We used Wilcoxon rank-sum test for pairwise analysis. This approach seemed appropriate for our ordinal, non-normally distributed survey data.

## Results

The survey response rate was 75% (95/128). Of respondents, 21% were physicists and dosimetrists, 18% were attending physicians, 15% were therapists, 14% were administrative staff, 12% were resident or fellow physicians, and 12% were nurses or medical assistants.

Mean success scores (Table 3) and mean willingness to report scores (Table 4) differed significantly by near miss type ( $P = .042$  for success ratings;  $P < .0001$  for willingness to report), which was confirmed by pairwise analysis. On average, success scores for “almost happened” events were less than “could have happened” events ( $P < .0001$ ), and this difference exceeded that of

“almost happened” events compared with “hits” ( $P < .0001$ ). Similarly, willingness-to-report scores for “almost happened” events were greater than “could have happened” events ( $P < .0001$ ), and this difference exceeded that of “almost happened” events compared with “hits” ( $P < .0001$ ). Despite the presence of the enabling condition (pacemaker), “fortuitous catch” success scores were greater than those for “could have happened” events ( $P = .0005$ ). Yet subjects were more likely to report these events because they were deemed more successful ( $P < .0001$ ).

## Discussion

We demonstrate differences in perceptions of success versus failure and willingness to report based on near miss type. These differences correlate with tendencies and cognitive biases previously investigated in the systems risk management literature. Key to defining near miss types in radiation oncology, beyond whether an event reaches the patient or not, is the identification of the latent error (eg, not checking the pacemaker status in our example) and the enabling condition (eg, presence of the pacemaker). Enabling conditions cognitively signal greater proximity to the negative outcome than without such conditions. As a result, such an apparent predisposition to harm can elicit greater counterfactual learning, possibly due to negative outcome bias.<sup>7</sup> In this study, health care staff were more likely to perceive the “almost happened” events featuring the enabling

**Table 4** Near miss willingness to report score pairwise differences

	Mean reporting	Standard care	Could	Fortuitous catch	Almost	Hit
		1.74	4.64	5.66	6.06	6.79
Standard care	1.74	0				
Could	4.64	2.9	0			
Fortuitous catch	5.66	3.92	1.02	0		
Almost	6.06	4.32	1.42	0.4	0	
Hit	6.79	5.05	2.15	1.13	0.73	0

Colored cells indicate absolute difference in mean willingness to report scores. Magnitude of difference highlighted from greatest (red) to least (green).



condition as failure and more likely to report these events for organizational learning, demonstrating safety-promoting behavior. The counterfactual scenario of the patient (almost) having an arrhythmia due to the missed pacemaker check may be more cognitively accessible and result in greater perceived risk due to dominant associative information-processing, also known as System 1 thinking, which relies on heuristics connecting similarities between events.<sup>2,9</sup> On the other hand, because “could have happened” events only feature the latent error and not the enabling condition, the counterfactual scenario of patient harm may not have been as cognitively accessible. “Could have happened” events are less likely to elicit counterfactual learning as evinced in our results; study subjects were less likely to view these events as failure or report them. In fact, “could have happened” events are more likely to be viewed as a case of system resilience, and in the absence of salient information about the enabling condition that signals the predisposition to harm, these events have been shown to increase risk-taking behavior, that is, the normalization of deviance.

Although “almost happened” events are cognitively easier for individuals to learn from and self-modify behavior, “could have happened” events are likely to take place more frequently. Furthermore, latent errors resulting from individual safety behavior and processes are subject to intervention—process improvements, quality measures, and staff training—whereas enabling conditions is a feature of the patient outside the control of the health care staff. Current definitions of potential harm in health care anchor on the enabling condition and less so on the more pervasive but subtle latent errors in behavior and processes. We posit that health care organizations need not wait for the chance presence of an enabling condition to learn from near miss events and improve processes and that attention toward underappreciated near miss events due to latent errors offers a significant learning opportunity.

To address the challenge of recognizing and acting on cognitively elusive near misses, Dillon et al<sup>10</sup> demonstrated that organizational messaging on safety culture and project significance promotes both recognition and safety-promoting behavior. In the same vein, high reliability organizations tend to focus on failures, and near misses are evidence that a system should be improved as suggested by the AHRQ.<sup>11</sup> This preoccupation with failure should address latent errors.

Interestingly, “fortuitous catch” events were deemed as more successful in this study, despite the presence of the enabling condition signaling predisposition to harm, and these events were more likely to be reported. Staff may take responsibility and credit for a “good catch,” which is evidence of high vigilance and encouraged by the organization’s safety culture. The success of “good catch”

programs in radiation oncology points to the importance of staff engagement in directing attention to near misses with latent errors.<sup>12,13</sup>

How can organizations promote reflection of these behaviors associated with latent errors and encourage a continuous process improvement mindset? It is not enough for a safety process to exist if it is inefficient and not adhered to. Worse yet, it can instill false confidence and result in greater risk taking via normalization of deviance. Staff must be motivated to vigilantly identify counterproductive, deadweight processes and system vulnerabilities before the occurrence of cases with enabling conditions. For example, whether pacemaker status is being routinely checked at intake despite the known policy to do so may be unknown until the occurrence of an “almost happened” event. However, engaging frontline staff to proactively provide feedback and reflect on their own (non-)use of the process and soliciting ideas for improvement may better address ongoing “could have happened” events. Engaging frontline staff through such decentralized problem-solving mechanisms has been shown to improve process improvement and learning.<sup>3,6,14,15</sup>

The empirical survey results reflect the perceptions and attitudes of a single institution. Safety culture and education may influence these responses at other institutions. Although the presented cardiac pacemaker scenario was accessible and the presentation was carefully controlled, the differential perceptions may not apply to other scenarios. Despite these limitations, the precise definitions of near miss types are generalizable and likely to be useful in the review of submitted events at any health care organization. Differences identified in the perception of near miss types therein can highlight points of intervention to improve near miss recognition.

## Conclusions

Reporting near miss events is voluntary and requires appropriate recognition of events as an organizational learning opportunity. This recognition is affected by perception of success and risk moderated by near miss types. Near miss types with attributes cognitively distant from harm may be underappreciated despite being the most actionable to improve patient safety and care. Precise and accessible definitions of these events can facilitate better recognition and point to fruitful interventions in promoting safety culture, behaviors, and processes.

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