



Brief Communication

Developing surgical and anesthesia resident patient safety competencies through systems-based event analysis. Guide to curricular development and evaluation of longer-term resident perceptions

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ABSTRACT

Previous studies have demonstrated that residents participating in patient safety event investigations become more engaged in future patient safety activities. Currently, there is a gap in resident participation in patient safety event analyses. The objective was to develop and implement a sustainable, faculty-led curriculum for resident participation in patient safety event investigations and to evaluate resident perceptions of the training at least one year following completion of the training. One hundred sixty-five residents from three specialties participated in a formal RCA² training curriculum from 2013 to 2019. In November 2019, the same residents were asked to complete a survey which examined their perception of the training including the tools and techniques such as event mapping, cause-and-effect diagramming, and developing action plans for solving problems and unsafe conditions. The survey response rate was 36 % (60/165). Sixty-three percent (38/60) of the residents responding to the survey believed that RCA² training should be provided to all residents. Former residents rated the RCA² training tools and skills favorably, 3.6 median score (3.5–3.7, 95 % C.I.). Forty-eight percent of responding residents (29/60) believed that the previous RCA² training improved the way they identify and solve problems. The curriculum and faculty development program provides an effective intervention to address the current, identified gaps in patient safety in graduate medical education.

Introduction

In 2012 the Accreditation Council for Graduate Medical Education (ACGME) implemented the Clinical Learning Environment Review (CLER) program. The CLER program was designed to address patient safety and quality improvement as essential and foundational attributes for successful life-long practice [1]. For graduate medical education (GME) to properly prepare trainees for independent practice, the clinical environment must demonstrate the manifestations of these qualities in everyday practice [2].

Patient safety was identified by CLER as an area where the level of knowledge of faculty and trainees were rudimentary or non-existent across the entire learning environment [3]. One of the CLER “Pathways to Excellence” is “experience in patient safety investigations.” [1] Previous studies have demonstrated that participants in patient safety

event investigations are more likely to engage in future patient safety activities [4], CLER national findings have demonstrated a gap in resident participation in patient safety event investigations [5].

In 2013 the University of Michigan Center for Healthcare Engineering and Patient Safety (CHEPS) started a program using the Root Cause Analysis and Action (RCA²) process to train residents. This training utilized analysis techniques and tools that were subsequently included in the 2015 National Patient Safety Foundation (NPSF) paper “RCA² Improving Root Cause Analyses and Actions to Prevent Harm” [6] that has been endorsed by multiple organizations including The Joint Commission, Institute for Healthcare Improvement, and ECRI. The purpose of this study was to evaluate the perception of RCA² training by residents who had participated in RCA² during their residency.

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The University of Michigan has an electronic training site that is accessible to all faculty and residents. Six interactive training modules were developed covering the RCA² process which are assigned as prework and completed before attending the face-to-face sessions. Each training module includes an interactive quiz that serves as a comprehension check for the user and documents completion when successfully completed. The modules are:

- Module 1.** Human Factors Engineering: The Basic Science of Patient Safety
- Module 2.** RCA²: The Process
- Module 3.** RCA²: Event Story Map
- Module 4.** RCA²: Cause and Effect Diagramming
- Module 5.** RCA²: 5 Rules of Causation
- Module 6.** RCA²: Actions and Outcome Measures

Fig. 1. RCA² training curriculum for residents, University of Michigan, 2013–2019.

Methods

Setting and participants

One-hundred and sixty-five residents at the University of Michigan, in the Departments of Anesthesiology, Orthopedic Surgery, and Ophthalmology participated in RCA² training between 2013 and 2019.

Interventions

The content of the resident RCA² training program covered close call and adverse event investigation processes, tools, and techniques. RCA² requires that the investigative team develop an understanding “What happened?”, “Why it happened?”, and “What could be done to prevent it from happening again?”, questions based on a system-approach to patient safety described in earlier publications [7]. Tools to complete the process are provided in the appendices of the NPSF RCA² publication [6]. Departmental faculty leaders were required to participate in the training led by CHEPS with the knowledge they would co-teach the 2nd year and assume full teaching duties the 3rd year.

Residents are trained through a combination of electronic interactive training modules, face-to-face training sessions, and group work, Figs. 1–2. The RCA² analysis includes flow diagramming the initial understanding of the event or close call to create an event story map; identifying information needed to understand what happened and why it happened; conducting interviews; accomplishing document, record, and literature reviews; and identifying root cause and contributing factors (RCCFs), actions and outcome measures. The RCCFs are written to meet the 5 “Rules of Causation and Actions” and action plans are based on the Action Hierarchy [7].

Outcomes and analysis

An email with a link to an anonymous, online survey was sent to residents in November of 2019 from their respective Departmental Chairs to evaluate resident perspectives of the RCA² training. In addition to demographic data (e.g., residency program, year RCA² training completed), the homegrown survey included 5-point Likert scale questions.

IRB statement

The University of Michigan Institutional Review Board exempted this survey from the approval process as a quality assurance activity.

Results

A total of 60 of the 165 (36 %) residents who participated in training completed the survey. The specialty distribution of respondents was Anesthesiology (52 %, 31/60), Ophthalmology (42 %, 25/60), and Orthopedics (6 %, 4/60). The mean (SD) interval between completion of RCA² training and survey response was 1.9 (0.9) years. All the survey respondents (100 %, 60/60) agreed or strongly agreed that they remembered participating in RCA² training while a resident. Former residents rated the RCA² training tools and skills favorably for survey questions, 3.6 median score (3.5–3.7, 95 % C.I.). Likert scale scores for all the 9 questions were positive (score > 3.0) and there was no statistical difference between responses for each of the nine questions, Table 1.

Twenty-nine of the former residents (29/60, 48 %) responded that they have served on an RCA team after completing the RCA² training. Twenty-two (22/60, 37 %) trainees responding to the survey entered comments into the survey's free text field. Positive comment themes included statements about using RCA² training skills and tools to solve current problems and preparation to serve on patient safety and quality improvement committees. Negative comments focused on the time that the training required.

Discussion

The current study demonstrates engagement of residents from a variety of specialties in patient safety event investigations. Most residents responding to a survey, on average two years following training, favorably viewed the problem-solving skills and tools they learned during RCA² training and recommended the training to other residents. Concurrent faculty development in RCA² knowledge and skills has promoted a sustainable initiative that is delivered by the participating residency programs.

Previous efforts to include residents in patient safety event investigations include mock RCAs and real patient safety event investigations within a program [8,9]. The current study builds on these efforts, expanding the resident patient safety event investigation experience to multiple, different specialty programs; training in previously validated RCA² tools and techniques; faculty development allowing for a sustainable curriculum within each participating department; and positive feedback from participating residents at an average of two years following training.

The current study has several limitations including a low survey response rate and the suboptimal composition of the RCA² teams. The

Pre-work: The residents and faculty are assigned six standardized training modules delivered via an electronic interactive learning interface (i.e., M-Learning) that are to be completed before the material is presented in the face-to-face meeting. Electronic Modules 1 through 4 are to be completed prior to the first face to face training session. Residents are assigned to a team and each team is assigned a faculty advisor/mentor. An actual adverse event or close call that occurred in the Department is identified for each team to investigate using the process and tools provided during the training.

First face to face session: The material from electronic training modules 1 through 4 is reviewed providing an opportunity for questions to be addressed. RCA² teams of approximately 4 residents and one department faculty mentor begin to work on their assigned case by creating an initial flow diagram, identifying questions that need to be answered, who may be able to answer the questions, and records, policies, procedures, and publications that need to be reviewed.

Resident homework: Residents complete electronic training Modules 5 & 6 prior to the next face to face meeting. Resident teams work on their assigned case by conducting interviews with pertinent staff and reviewing records, policies, procedures and publications.

Second face to face session: Residents, faculty mentors, and trainers work on completing the Event Story Map, Cause and Effect Diagram and discuss potential root cause contributing factors. Material from electronic training Modules 5 & 6 is reviewed.

Resident homework: Teams meet to continue work on the assigned event. The Event Story Map, Cause and Effect Diagrams are completed, and root cause contributing factors are identified.

Third face to face session: Each team presents their work to the other team(s) for their review and comment. Root cause contributing factors are written to meet the Five Rules of Causation and actions to address identified system vulnerabilities are identified along with a process and/or outcome measure. Work on the team presentation for the Department is started or continued.

Resident homework: Teams completed their work on their department presentation, consulting their advisor and trainers as needed.

Department presentation: Each team is given approximately 30 minutes during departmental grand rounds to present their RCA² analysis and answer questions from faculty and staff.

Department evaluation: Leadership evaluates and acts on RCA² team recommendation/actions.

Fig. 2. RCA² training agenda for residents, University of Michigan, 2013–2019.

low survey response rate could bias survey scores in a positive direction. The RCA² teams in this study consisted of patient safety facilitators, faculty, and residents but were not multi-disciplinary. The healthcare organization and departments were not required to implement the actions recommended by the trainees. Recent initiatives such as the ACGME Pursuing Excellence Initiative (PEI) have tried to address these shortcomings [10].

Conclusions

One-hundred sixty five residents from three different residency programs participated in RCA² training delivered by collaboration between patient safety leaders and trained departmental faculty. Residents, responding to a survey on average two years later, perceived the problem-solving skills and tools derived from the training favorably. The University of Michigan curriculum, as described, addresses the gap in patient safety investigative experience in GME as demonstrated by the

ACGME CLER national findings.

Funding sources

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Ethics approval

The University of Michigan School of Medicine Institutional Review Board exempted this study from the approval process as a QA activity.

CRedit authorship contribution statement

James P. Bagian: Conceptualization, Methodology, Investigation, Resources, Writing – original draft, Writing – review & editing, Supervision, Project administration. **Douglas E. Paull:** Formal analysis, Data curation, Writing – review & editing. **Joseph M. DeRosier:**

Table 1

Results of the 2019 survey of physicians who participated in RCA² training at the University of Michigan as residents during the years 2013–2019, (n = 60 respondents). Data presented as number of residents (%).

Question	Strongly disagreed or disagreed	Neutral	Agreed or strongly agreed
Residents should be provided with RCA ² training.	10 (16.7)	12 (20.0)	38 (63.3)
Faculty should be provided with RCA ² training.	7 (11.6)	13 (21.7)	40 (66.7)
Participation in the RCA2 training impacted the way I approach problem solving.	11 (18.3)	20 (33.3)	29 (48.3)
Event Story Mapping is a useful tool to describe what and why an event occurred.	8 (13.3)	13 (21.7)	39 (65.0)
Triggering Questions help identify questions that may not be otherwise considered when conducting an investigation.	10 (16.7)	24 (40.0)	26 (43.3)
The Five Rules of Causation help write root cause contributing factor statements that are focused on system issues.	9 (15.0)	19 (31.7)	32 (53.3)
Cause and Effect (C&E) Diagramming helps identify system vulnerabilities that contributed to the patient close call or adverse event occurring.	5 (8.3)	14 (23.3)	41 (68.3)
The Action Hierarchy (AH) helps to identify stronger or intermediate strength corrective actions.	8 (13.3)	23 (38.3)	29 (48.3)
Writing Process/Outcome Measures for each action helped determine if the action was effective after implementation.	9 (15.0)	13 (21.7)	38 (63.3)

Footnote. Likert scale 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree.

Conceptualization, Methodology, Formal analysis, Investigation,

Resources, Data curation, Writing – original draft, Project administration.

Declaration of competing interest

The authors have no conflicts of interest.

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