Differences in Safety Report Event Types Submitted by Graduate Medical Education Trainees Compared With Other Healthcare Team Members

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Objectives: Graduate medical education (GME) trainees have a unique perspective from which to identify and report patient safety concerns. However, it is not known how safety reports submitted by GME trainees differ from those submitted by other clinical staff. We hypothesized that GME trainees were more likely to submit safety reports regarding transitions of care, delays in care, and lapses in communication, and reports of higher severity compared with other frontline staff such as nurses, pharmacists, and other providers.

Methods: Patient safety reports submitted by clinical staff for 1 year at an academic tertiary care children's hospital were retrospectively reviewed and categorized by reporter type. Severity level and event type were analyzed by reporter type, and repeat χ^2 tests were used to compare the percentage of reports at each severity level and in each event type submitted by GME trainees compared with each other reporter type.

Results: Graduate medical education trainees submitted reports of greater severity (level E/F/G) compared with nurses (10% versus 5%, $P = 0.021$) and pharmacists (10% versus 2%, $P = 0.001$). A greater percent of GME trainees' reports were categorized as errors in transitions of care, diagnosis, ordering, laboratory collection, and care delays compared with several other reporter types.

Conclusions: Graduate medical education trainees identify system vulnerabilities not detected by other personnel, supporting efforts to increase safety reporting by GME trainees.

Key Words: safety event reporting, graduate medical education

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Reporting adverse events is critical to identify health system safety concerns and promote a culture of safety. Patient safety reporting has been shown to correlate with safety culture and to contribute to improved patient outcomes in some clinical areas.[1–3]

Despite the importance of safety reporting, previous studies have demonstrated that physicians, including graduate medical education (GME) trainee physicians (residents and fellows), submit a minority of reports.[4,5] As members of the healthcare team who practice in various settings often at multiple institutions, GME trainees are uniquely positioned to recognize adverse events and flaws in systems of care. Recognizing their potential to identify errors and promote patient safety, several institutions have focused on increasing GME trainee involvement with patient safety efforts by encouraging use of the safety reporting system (SRS).[6–8] Higher GME trainee error reporting has been associated with a decline in reporting of serious harm events and likely leads to improvements in patient care.[7] However, no prior study has identified what additional information is obtained through GME trainee-generated safety reports as compared with that of other clinical staff, which might lead to these clinical improvements.

Our aim was to identify differences in the type of safety reports submitted by GME trainees compared with other members of the healthcare team (nurse, attending physician, pharmacist, etc), with a focus on GME trainee contribution as compared with that of other clinical staff. Given their experience in multiple settings throughout the health system, we hypothesized that GME trainees recognize flaws in transitions of care, delays in care, and lapses in communication. In addition, we hypothesized that reports submitted by GME trainees were of greater severity and less likely to include good catches or near misses consistent with prior studies of physician reporting behaviors.

METHODS

Setting/Data Source

We performed a single-center retrospective review of safety reports submitted at a 190-bed tertiary care children's hospital housed within a large university hospital. All reports submitted from inpatient pediatric units where residents often care for patients were included, excluding the newborn and neonatal units, bone marrow transplant unit, and cardiac intensive care unit. During the project period of July 1, 2016, and June 30, 2017, the children's hospital had approximately 7500 pediatric inpatient admissions. All staff, faculty, GME trainees, and students used a web-based SRS software program to report adverse events. All reporters across the hospital were trained to use the SRS program. Reporters selected the event type, identified themselves by name and role, provided a narrative description, and classified the initial event severity using the National Coordinating Council for Medication Error Reporting and Prevention classification system[9] for both medication and nonmedication events. Once the report was entered, it was viewed by the operational leaders of the location or service, as well as the patient safety officer and children's hospital quality and leadership team. All reports submitted by a resident were also reviewed by the two pediatric chief residents and members of the Pediatric Resident Safety Council.[10,11] The Pediatric Resident Safety Council conducted systematic reviews of selected trainee-reported events using a learning from defects tool during morbidity and mortality conferences, held approximately every 8 weeks. Additional event review and classification of the actual severity, defined as the final severity level, were determined first by the operational owner of the unit or service. Operational owners included personnel, such as nurse managers, pharmacy managers, and medical directors. Adverse drug events were reviewed and analyzed, and the actual score was determined by a

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children's medication safety pharmacist and interdisciplinary adverse drug event committee. In addition, nondrug events with reported harm (E and above using the National Coordinating Council for Medication Error Reporting and Prevention classification) were reviewed and analyzed, and the final score was determined by children's quality leadership team. The final scores for all harm events were determined by a consensus of the quality leadership team when there was disagreement. High risk or harm events were systematically reviewed using root cause analysis or learning from defects exercise depending on the severity of the harm event. Of the approximately 19,000 total hospital reports in fiscal year 2017, 1535 were attributed to the previously mentioned selected units in the children's hospital by location. This retrospective observational study was exempted by the institutional review board.

Definitions and Conceptual Framework

Reporter type (self-identified) was collected from the SRS system. We included reports submitted by GME trainees, nurses, pharmacists, other frontline staff, and other providers.

We adapted the Donabedian Model, a quality improvement tool to identify how structures and processes contribute to outcomes, to develop a conceptual model predicting unique system vulnerabilities that would be identified by trainees.[12] Based on our clinical experiences, we brainstormed structures and processes unique to trainees at our institution. We then used this framework to hypothesize safety event types that residents would be more likely to encounter than other frontline staff (Fig. 1).

Analysis

In fiscal year 2017, we analyzed 1535 children's hospital event reports that were entered by health care workers. Event location, actual severity level of adverse events, general event type, and specific event type were analyzed by each of the health care worker groups to determine reporting characteristics. Event category and subcategory definitions are included in the supplementary Appendix (http://links.lww.com/JPS/A242). Repeat χ^2 tests were used to compare the percent of reports categorized at each severity level submitted by GME trainees compared with each other reporter types. Repeat χ^2 tests were also used to compare the percent of reports categorized as each general and specific event type submitted by GME trainees compared with each other reporter types. In addition, we performed the previous analysis by GME trainee postgraduate year (PGY) to identify differences in reporting by year of training among reports submitted by categorical pediatric and medicine-pediatric residents. Analyses were performed in STATA SE 15 (College St, Tex). P values < 0.05 were considered statistically significant.

RESULTS

Of the 1535 event reports submitted, nurses submitted 752, other frontline staff submitted 290, pharmacists submitted 237, GME trainees submitted 161, and other providers submitted 43. The reporter category "other providers" included attending physicians (n = 14) and advance practice providers (n = 29). "Other frontline staff" included therapists (n = 57, of which n = 52 respiratory therapists), dieticians (n = 13), phlebotomists (n = 10), medical students (n = 4), radiology technologist (n = 4), hospital unit coordinators (n = 2), certified nursing assistants (n = 2), social workers (n = 2), child life specialists (n = 1), transporter (n = 1), and patient care technician (n = 1). Of note, compared with attending physicians, GME trainees submitted for ten times as many reports (161 versus 14) during this study period.

Graduate medical education trainees submitted reports of greater severity (level E/F/G) compared with nurses (10% versus 5%, P = 0.021) and pharmacists (10% versus 2%, P = 0.001) (Table 1). In contrast, a lower percentage of GME trainee reports were level E/F/G compared with other providers (attendings and advance practice providers) (10% versus 49%, P < 0.001). On further exploration, several of the level E or above events submitted by other providers were due to pressure injuries, which are by default categorized as a high severity level and submitted by the pediatric wound care advanced practice provider. In addition, GME trainees were more likely to submit a report on the general pediatric floor compared with nurses, pharmacists, other frontline staff, and other providers. We suspect that differences in team structures in the intensive care unit compared with floor, such as a rounding pharmacist on the intensive care unit teams and greater resident autonomy on floor, may contribute to differences in reporting by event location.

The three most common general event types submitted were medication/fluid errors (n = 572), provision of care errors (n = 281), and laboratory/specimen errors (n = 152). Pharmacists almost exclusively submitted medication/fluid reports and thus were statistically different compared with GME trainees on

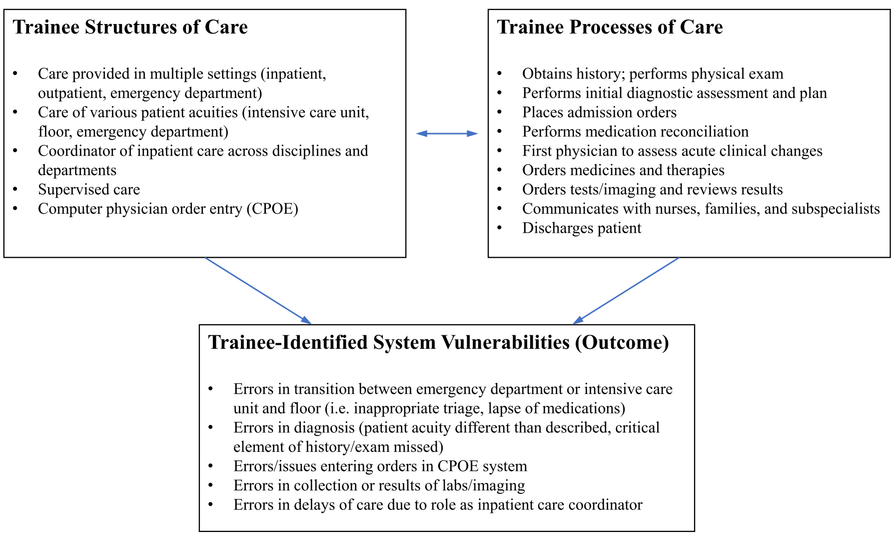

FIGURE 1. Conceptual model developed to predict system vulnerabilities that would be identified by trainees.

TABLE 1. Comparison of Event Severity by Reporter

		Trainee		Nurse		Pharmacist		Other Frontline Staff		Other Providers	
		n = 161		n = 752		n = 237		n = 97		n = 43	
		col% (n)	χ^2 *P*	col% (n)	χ^2 *P*	col% (n)	χ^2 *P*	col% (n)	χ^2 *P*	col% (n)	χ^2 *P*
Event location											
Floor		63% (101)	REF	48% (362)	0.001	40% (94)	<0.001	37% (36)	<0.001	42% (18)	0.01
Step-down		9% (15)	REF	15% (114)	0.05	5% (11)	0.06	20% (19)	0.02	21% (9)	0.04
Intensive care unit		28% (45)	REF	37% (276)	0.04	56% (132)	<0.001	43% (42)	0.01	37% (16)	0.24
Actual severity level	n										
A. Unsafe condition	369	32% (51)	REF	27% (200)	0.19	6% (15)	<0.001	25% (24)	0.24	14% (6)	0.021
B. Good catch	315	12% (20)	REF	14% (107)	0.55	46% (108)	<0.001	14% (14)	0.64	5% (2)	0.14
C. No harm, no monitoring required	415	20% (32)	REF	34% (257)	<0.001	28% (66)	0.07	29% (28)	0.09	16% (7)	0.59
D. No harm, monitoring required	347	26% (42)	REF	20% (149)	0.08	18% (43)	0.06	24% (23)	0.67	16% (7)	0.18
E/F/G. Harm, temporary or permanent	89	10% (16)	REF	5% (39)	0.021	2% (5)	0.001	8% (8)	0.65	49% (21)	<0.001

practically every event type except those with small numbers among both groups (surgery/procedure, infection, blood product, and falls).

Notably, almost half of GME trainee reports submitted were classified as a "provision of care" general event type (Table 2). This category includes errors the following: (*a*) access/transitions of care; (*b*) care not delivered per standard; (*c*) timely response to care needs; (*d*) delays in care; and (*e*) others (see Appendix Table 1 [http://links.lww.com/JPS/A242] for more information on event categories). A greater percentage of reports were classified as provision of care for GME trainees than nurses (45% versus 24%, $P < 0.001$), pharmacists (45% versus 0%, $P < 0.001$), other frontline staff (45% versus 18%, $P < 0.001$), and other providers (45% versus 16%, $P = 0.001$). In addition, we noted differences in the percent of GME trainee reports that were in the diagnosis/treatment, healthcare IT, and laboratory/specimen categories compared with nurses and pharmacists.

Consistent with our conceptual framework predicting unique system vulnerabilities that would be detected by GME trainees (Fig. 1), a greater percent of GME trainees' reports were categorized as specific event type errors in transitions of care, diagnosis, ordering, laboratory collection, and care delays compared with several other reporter types (Table 3). Examples based on real GME trainee–submitted safety reports within these categories at

TABLE 2. Comparison of General Event Type Submission by Reporter

		Trainee		Nurse		Pharmacist		Other Frontline Staff		Other Providers	
		n = 161		n = 752		n = 237		n = 97		n = 43	
		col% (n)	χ^2 *P*	col% (n)	χ^2 *P*	col% (n)	χ^2 *P*-value	col% (n)	χ^2 *P*-value	col% (n)	χ^2 *P*-value
General event type	n										
Airway management	40	4% (6)	REF	2% (13)	0.11	0% (0)	0.003	21% (20)	<0.001	2% (1)	0.65
Blood product	58	0% (0)	REF	2% (15)	0.07	0% (0)	n/a	0% (0)	n/a	0% (0)	n/a
Diagnosis/treatment	33	7% (11)	REF	1% (11)	<0.001	0% (0)	<0.001	9% (9)	0.48	5% (2)	0.6
Diagnostic imaging	13	2% (4)	REF	1% (6)	0.06	0% (0)	0.02	1% (1)	0.41	5% (2)	0.46
Equipment/medical device	62	1% (2)	REF	7% (50)	0.007	0% (0)	0.09	10% (10)	0.001	0% (0)	0.46
Fall	39	0% (0)	REF	5% (37)	0.004	0% (0)	n/a	1% (1)	0.2	0% (0)	n/a
Healthcare IT	25	4% (7)	REF	2% (13)	0.04	0% (1)	0.006	2% (2)	0.33	0% (0)	0.16
Infection	10	1% (1)	REF	1% (8)	0.61	0% (0)	0.22	2% (2)	0.83	0% (0)	0.6
IV/vascular access device	93	2% (4)	REF	11% (84)	0.001	0% (0)	0.02	1% (1)	0.72	2% (1)	0.95
Laboratory/specimen	152	11% (18)	REF	3% (26)	<0.001	1% (3)	<0.001	10% (10)	0.83	9% (4)	0.72
Line/tube	34	2% (4)	REF	4% (29)	0.4	0% (0)	0.02	1% (1)	0.41	0% (0)	0.3
Medication/fluid	572	12% (19)	REF	28% (209)	<0.001	98% (233)	<0.001	9% (9)	0.53	16% (7)	0.43
Patient ID/documentation/consent	40	3% (5)	REF	3% (22)	0.9	0% (0)	0.006	8% (8)	0.07	0% (0)	0.24
Professional conduct	33	3% (5)	REF	3% (24)	0.96	0% (0)	0.006	2% (2)	0.62	2% (1)	0.79
Provision of care	281	45% (72)	REF	24% (181)	<0.001	0% (0)	<0.001	18% (17)	<0.001	16% (7)	0.001
Safety/security	21	0% (0)	REF	2% (15)	0.07	0% (0)	n/a	3% (3)	0.03	5% (2)	0.006
Skin/tissue	25	1% (2)	REF	1% (7)	0.72	0% (0)	0.09	1% (1)	0.88	35% (15)	<0.001
Surgery/procedure	3	1% (1)	REF	0% (1)	0.23	0% (0)	0.22	0% (0)	0.44	2% (1)	0.31

TABLE 3. Comparison of Specific Event Type Submission by Reporter

		Trainee		Nurse		Pharmacist		Other Frontline Staff		Other Providers	
		n = 161		n = 752		n = 237		n = 97		n = 43	
		col% (n)	χ^2 *P*	col% (n)	χ^2 *P*	col% (n)	χ^2 *P*	col% (n)	χ^2 *P*	col% (n)	χ^2 *P*
Diagnosis/treatment:	n										
Diagnosis	8	3% (5)	REF	0% (2)	<0.001	0% (0)	0.006	1% (1)	0.28	0% (0)	0.24
Treatment	25	4% (6)	REF	1% (9)	0.02	0% (0)	0.003	8% (8)	0.12	5% (2)	0.78
Provision of care:											
Access/transition of care	62	17% (28)	REF	4% (32)	<0.001	0% (0)	<0.001	1% (1)	<0.001	2% (1)	0.01
Care not delivered per standard	63	9% (15)	REF	5% (40)	0.05	0% (0)	<0.001	6% (6)	0.37	5% (2)	0.33
Laboratory/specimen											
Collection issue	21	6% (9)	REF	1% (9)	<0.001	0% (1)	0.001	1% (1)	0.07	2% (1)	0.38
Medication/fluids											
Ordering or prescribing issue	162	7% (11)	REF	3% (24)	0.03	52% (122)	<0.001	1% (1)	0.03	9% (4)	0.58
Healthcare IT											
Electronic health record	16	1% (2)	REF	1% (11)	0.83	0% (1)	0.35	2% (2)	0.61	0% (0)	0.46
Paging system	4	2% (3)	REF	0% (1)	0.003	0% (0)	0.04	0% (0)	0.18	0% (0)	0.37
Delay in care											
Any delay	92	14% (23)	REF	9% (69)	0.05	5% (11)	0.001	9% (9)	0.24	19% (8)	0.48

our institution, and the action items that occurred as a result, are displayed in Table 4.

Interestingly, GME trainees submitted about half of the total reports around transitions of care, which included issues such as accepting provider concerns, admits/transfers to inappropriate level of care, insufficient handovers, and other transitions errors. They were also one of the top reporters of issues about laboratory and specimen collection errors, which is likely due to their central role ordering laboratories, coordinating collection, and following results. GME trainees were less likely to report falls, equipment/device, and vascular access errors compared with nurses.

Analysis of the 161 trainee-submitted reports revealed that they were entered by 69 unique trainees across training levels and specialties. Of these 161 reports, 111 were submitted by pediatric or medicine-pediatrics residents, 35 by pediatric subspecialty fellows, 8 by off-service residents rotating on pediatrics (6 anesthesia interns, 1 family medicine intern, and 1 second-year emergency medicine resident), and 7 surgical residents (4 neurosurgery and 3 general surgery residents). The subset of 111 reports submitted by pediatric or medicine-pediatric residents were reported by 41 unique residents, which corresponds to submission of at least one adverse event report by 55% of the total 74 residents in academic year 2017 (Table 5).

TABLE 4. Examples of Action Items that Were Generated by Resident-Submitted Safety Reports by Event Type

General Event Type	Specific Event Type	Case Example	Action Taken
Diagnosis/treatment	*Diagnosis*	Child admitted with "croup." Anchoring bias diagnostic error led to delay in treatment for bacterial tracheitis	M&M Conference of case. Education on cognitive errors and strategies to mitigate them.
Provision of care	*Access/transition of care*	Patient admitted from the cardiac catheterization laboratory. Postprocedure antibiotics were not given because of a lapse of communication.	New handoff template created for postcardiac catheterization admissions
	Care not delivered per standard	Delay in notifying resident of abnormal vital signs in a patient with febrile neutropenia.	Created a new process for nursing assistants to identify abnormal vital signs
Laboratory/specimen	*Collection issue*	Sodium level not collected at the desired time in patient with diabetes insipidus	Phlebotomy hours extended to late night hours
Medication/fluids	*Ordering or prescribing issue*	Home medications defaulted to a limited duration, causing the orders to "expire" during long hospitalizations	Institution-wide change in default duration of home medications
Healthcare IT	*Paging system*	Not all necessary personnel responded to the delivery of a preterm infant because the page did not include gestational age	Template designed for neonatal delivery pages
Delay in care	*Any delay in care*	Newborn developed a fever, but it took several hours to establish IV access for antibiotics	Establishment of an "urgent" option in the vascular access order

IV, intravenous; M&M, morbidity and mortality.

In analysis of the 111 reports by pediatric or medicine-pediatric residents, we found that upper level residents (PGY3/PGY4s) were more likely to submit unsafe conditions and first-year residents (PGY1s) were more likely to submit harm events. In addition, first-year residents, who perform most order entry for the team, were more likely to report errors involving ordering or prescribing.

DISCUSSION

This study supports the importance of engaging GME trainees in safety reporting as the content of GME trainee–submitted patient safety reports differs from those submitted by other frontline staff. Graduate medical education trainees have a unique position on the inpatient healthcare team, and they identify system vulnerabilities not detected by other personnel. Few prior studies have evaluated differences in safety reporting between members of the healthcare team. One qualitative study of enablers and barriers to reporting found that compared with physicians, nurses have a strong sense of professional duty to report and may be more likely to self-report errors. To our knowledge, this is the first study to look at differences *in content* between GME trainee physicians and other members of the healthcare team.[13]

Graduate medical education trainee–submitted reports tend to be of higher severity, consistent with prior investigations of reporting behaviors of physicians compared with other providers.[5,14] Graduate medical education trainees were more likely than other clinical staff to identify errors in the categories of diagnosis/treatment, laboratory/specimen, healthcare IT, and provision of care. As we hypothesized, GME trainees were overrepresented in reports regarding transitions of care, which was expected given that GME trainees work in various settings across the health system while most other healthcare staff practice in just one area. Similarly, GME trainees more commonly reported delays in care, likely related to their central role in coordination of care of the hospitalized child. In addition, we found differences in type of error reports submitted by training year. Thus, it is important to engage residents across levels of training due to differences in team roles and responsibilities. Our analysis by training year was limited by a small sample size. Future studies could further explore this with a larger group of trainees, consolidating multiple years of data, or with qualitative interviews.

There is emerging evidence that GME trainee participation in health system safety initiatives can improve processes of care and patient outcomes.[8,15,16] In general, resident reports tend to be of high quality, meaning that they include a description of the event, are objective in the description, occur in a timely manner, do not blame individuals, and overall provide a clear description of the event.[17] Although it had been assumed that GME trainees identify system vulnerabilities unique from other healthcare professionals, this had not previously been studied. As such, this study supports institutions (such as our own) that are putting resources into increasing submission of patient safety reports from GME trainees.[18]

Graduate medical education trainees are frequently exposed to medical errors. In one survey study, 93% of first-year residents reported witnessing at least one medical error in the last 6 months.[19] Despite this, engaging physicians in error reporting can be challenging; barriers described by physicians include lack of knowledge about how to report, the time involved in reporting, and concerns about litigation and of damage to one's professional reputation. Recently, there have been efforts to more actively involve GME trainees in patient safety; one successful strategy has been the establishment of GME trainee safety councils.[11,20] Our institution's Pediatric Residency Safety Council reviews event reports submitted by residents and has used the unique information in those reports to effect system-wide changes (Table 4). Other successful interventions to increase reporting among GME trainees have included education about safety reporting, monthly

TABLE 5. Analysis of Adverse Report Severity and Type by Postgraduate Level Among Categorical Pediatric and Medicine-Pediatric Residents (n = 111 Reports)

	PGY			
	PGY1	PGY2	PGY3/PGY4	
	n = 25	n = 47	n = 39	
	col% (n)	col% (n)	col% (n)	χ^2 *P*
Actual severity level				
A. Unsafe condition	28% (7)	23% (11)	49% (19)	0.04
B. Good catch	8% (2)	21% (10)	10% (4)	0.21
C. No harm, no monitoring	20% (5)	21% (10)	18% (7)	0.93
D. no harm, monitoring	28% (7)	28% (13)	23% (9)	0.87
E/F/G. Harm, temporary or permanent	16% (4)	6% (3)	0% (0)	0.04
General event type*				
Provision of care	56% (14)	45% (21)	59% (23)	0.38
Medication/fluid	20% (5)	15% (7)	3% (1)	0.07
Laboratory/specimen	8% (2)	11% (5)	15% (6)	0.64
Diagnosis/treatment	8% (2)	13% (6)	5% (2)	0.46
Specific event type*				
Any delay in care	12% (3)	13% (6)	21% (8)	0.53
Access/transition of care	24% (6)	17% (8)	28% (11)	0.46
Care not delivered per standard	16% (4)	15% (7)	8% (3)	0.51
Ordering or prescribing issue	20% (5)	4% (2)	3% (1)	0.02

*Includes the top four general and specific event categories of resident-submitted reports.

event reviews of reports by GME trainees, and increased feedback to reporters after event submission.[8,21] Financial incentives and reporting quotas have had mixed impact on increasing trainee safety reporting.[22,23]

In this study, we were not able to evaluate the text of the submitted reports to identify themes that may not have been reflected in the category selected at the time of submission or review; future work could include thematic analysis of the text of safety reports. This study was based in a children's hospital in an institution that provides incentives for submission of safety reports by GME trainees and has a history of actively engaging GME trainees in patient safety. As such, these findings may not be generalizable to other teaching hospitals, so there may be value in replicating this study in other institutions.

CONCLUSIONS

This study provides initial evidence that GME trainees submit safety reports that identify unique system vulnerabilities that may not be recognized by other reporter types. Efforts to increase safety reporting by trainees may therefore benefit health systems in their efforts to reduce errors.

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