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ORIGINAL RESEARCH

Injury Prevention

Using a rule-based system to define error in the emergency department

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Abstract

Introduction: The evaluation of peer-reviewed cases for error is key to quality assurance (QA) in emergency medicine, but defining error to ensure reviewer agreement and reproducibility remains elusive. The objective of this study was to create a consensus-based set of rules to systematically identify medical errors.

Methods: This is a prospective, observational study of all cases presented for peer review at an urban, tertiary care, academic medical center emergency department (ED) quality assurance (QA) committee between October 13, 2015, and September 14, 2016. Our hospital uses an electronic system enabling staff to self-identify QA issues for subsequent review. In addition, physician or patient complaints, 72-hour returns with admission, death within 24 hours, floor transfers to ICU < 24 hours, and morbidity and mortality conference cases are automatic triggers for review. Trained reviewers not involved in the patient's care use a structured 8-point Likert scale to assess for error and preventable or non-preventable adverse events. Cases where reviewers perceived a need for additional treatment, or that caused patient harm, are referred to a 20-member committee of emergency department leadership, attendings, residents, and nurses for consensus review. For this study, "rules" were proposed by the reviewers identifying the error and validated by consensus during each meeting. The committee then decided if a rule had been broken (error) or not broken (judgment call). If an error could not be phrased in terms of a rule broken, then it would not be considered an error. The rules were then evaluated by 2 reviewers and organized by theme into categories to determine common errors in emergency medicine.

Results: We identified 108 episodes of rules broken in 103 cases within a database of 920 QA reviewed cases. In cases where a rule was broken and therefore an error was scored, the following 5 major themes emerged: (1) not acquiring necessary information

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(eg, not completing a relevant physical exam), N = 33 (31%); (2) not acting on data that were acquired (eg, abnormal vital signs or labs), N = 25 (23%); (3) knowledge gaps by clinicians (eg, not knowing to reduce a hernia), N = 16 (15%); (4) communication gaps (eg, discharge instructions), N = 17 (16%); and (5) systems issues (eg, improper patient registration), N = 17 (16%).

Conclusion: The development of consensus-based rules may result in a more standardized and practical definition of error in emergency medicine to be used as a QA tool and a basis for research. The most common type of rule broken was not acquiring necessary information. A rule-based definition of medical error in emergency medicine may identify key areas for risk reduction strategies, help standardize medical QA, and improve patient care and physician education.

KEYWORDS
adverse events, emergency medicine education, medical error, quality assurance, quality improvement, risk reduction

1 | INTRODUCTION

Medical error is a major cause of avoidable morbidity and mortality. Although we do not have *International Classification of Diseases Tenth Revision* codes as a potential cause of death, medical error has been reported as the third leading cause of death in the United States or ≈9.5% of all deaths.[1] Of patients in the United States, 34% report medical, medication, or test errors, which is the highest reported rate of any nation.[2] In 1991, the Harvard Medical Practice Study found that ≈3.7% of admitted patients suffered complications from treatment; two-thirds of these were attributed to errors in care, and a significant portion were preventable.[3,4] This landmark study prompted intense national scrutiny of medical errors, which continues to be a significant issue.[5,6] Recent data indicate that the incidence of adverse events attributable to medical error among hospitalized patients may be increasing.[7]

Medical error has been identified as a significant problem in our health care system, but determining what constitutes a medical error has proven difficult. It is often hard to distinguish between a true error or a legitimate judgment call that happened to coincide with an adverse event. Hospitals use different systems to screen for error and undertake a quality assurance (QA) process, and in turn there is variability in the rigor of their mechanisms and ability to disseminate their findings to the health care organization and physicians involved.

What is an error? An error according to the Institute of Medicine report is the failure of a planned action to be completed as intended (ie, error of execution) or the use of a wrong plan to achieve an aim (ie, error of planning).[3,8] An error in management is the failure to follow accepted practice at an individual or system level; this includes acts of omission (inaction) and commission (actions) and violation of accepted practice (current level of expected performance for the average practitioner or system that manages the condition in question).[3,8] Medical error can then be defined as deviation from an accepted course of action in a case that may or may not cause harm to the patient.

The use of surrogate markers of error such as 72-hour returns with admission, floor-to-ICU transfers, death within 24 hours of admission, and multiple repeat visits within a short period of time are often used as routine metrics in emergency medicine QA, and although they are often perceived as the gold standard, they remain largely unvalidated expert opinion.[9,10] The use of both patient and physician complaints has also been described as a useful tool to find cases of error in emergency medicine.[9,10] We have previously reported error rates for the previous metrics as being between 9.1% and 12.1% and a corresponding adverse event rate of 8.3%.[9,10]

The objective of this study was to delineate a consensus-based determination of rules to identify medical errors.

2 | METHODS

2.1 | Study design and setting

We conducted a prospective observational study of consecutive patients presenting to an urban, tertiary care, academic medical center emergency department (ED) with an annual volume of ≈57,000 patients between October 13, 2015, and September 14, 2016, to derive a set of rules for the practice of emergency medicine. This ED maintains a QA database linking all patient and physician complaints to all patients through a web-based integrated dashboard. The QA database also chooses certain preprogrammed cases for review including floor-to-ICU transfer within 24 hours, 72-hour returns, death within 24 hours of admission, weekly morbidity and mortality cases, and cases that fall within the various pathway systems the ED has developed. This electronic system maintains the data relating to each QA case, including individual reports from the reviewer, and

when arbitrated by a multidisciplinary ED QA committee, their final conclusion. The ED multidisciplinary QA committee is made up of physicians, residents, nurses, case managers, hospital-wide quality administration, ED leadership, and quality nursing staff. Available information includes laboratory results, physician notes, radiology reports, and team members, and their roles. This system was used to create a report of all cases that were found to have an error and to review the specifics of each case to derive a set of rules that had been broken and then to analyze and categorize the rules found. Each rule was then reviewed by at least 2 senior committee members individually to ensure the terminology used matched the committee's consensus decision. In cases where the rule broken could apply to >1 category, the most applicable category was chosen by committee consensus agreement. If an error could not be phrased in terms of a rule broken, then it would not be considered an error.

The Bottom Line

The development of a consensus-based rule system can help define error in the emergency department. A rule system may result in a more standardized and practical definition of error in emergency medicine to be used as a quality assurance tool and a basis for research. A rule-based definition of medical error in emergency medicine may identify key areas for risk-reduction strategies, help standardize medical quality assurance, and improve patient care and physician education.

2.2 | Definition of terms

The hospital's institution-wide definition of medical error is the failure of a planned action to be completed as intended or the use of a wrong plan to achieve an aim. An adverse event is defined as unintended physical injury or physiologic insult resulting from or contributed to by medical care (including the absence of indicated medical treatment) that requires or prolongs hospitalization, or results in permanent disability or death that cannot be solely and definitively attributed to the progression of the patient's underlying condition. Adverse events caused by medical error are termed *preventable adverse events*. Near miss events are medical errors that do not result in an adverse event.[11]

2.3 | Data collection and processing

The hospital system uses a web-based platform that provides a dashboard where cases can be flagged by physicians and nurses or any other person involved in a patient's care. The QA dashboard program performs automated nightly sweeps of the computerized ED patient log to identify patient cases that meet the criteria for QA review including deaths within 24 hours of ED arrival, return visits within 72 hours requiring hospitalization, and floor admissions transferred to ICU within 24 hours as well as cases involving high-risk procedures, such as endotracheal intubation or procedural sedation. There is a mechanism in place where any health care professional involved in a patient's care (from technicians to consulting physicians) can manually flag cases for review on the QA dashboard. Complaints and concerns received by the ED administration are also forwarded to the QA system. Patients may report complaints through the hospital's patient relations office, which are referred through the dashboard program for review. In addition, there is a hospital-wide error reporting system that refers additional cases for review. The multiple ways to flag cases both through the hospital-wide and ED-based system is meant to maximize the opportunities to flag cases and create a culture of reporting and inclusivity (Figure 1). The identified cases undergo random assignment to an emergency physician reviewer who did not provide care for the patient. To ensure that all reviewers receive similar numbers and a similar distribution of types of cases, cases are assigned with preprogrammed load balancing. Initial reviewers are randomly assigned cases and include all emergency attending physicians. They are provided with a case detail page containing key demographic and operational data elements as well as all relevant clinical data associated with the case. The electronic scanned copy of all paper documentation associated with each case is captured from our billing process and stored in the electronic dashboard database.

The reviewers are notified by email when a new case has been assigned to them with a prompt to log on to the QA dashboard and securely review the case documentation. Reviewers are also able to assess relevant records from the patients' online medical records through embedded links in the case detail page. After reviewing the case documentation, reviewers are then asked to respond to a series of 7 standardized questions with answers on a Likert scale (for examples, see Figures 2 and 3), adding additional text comments as needed. Based on the responses to the questions, only if the reviewer has concerns about possible errors, adverse events, or other quality issues, the case is referred for discussion by the full QA committee. In addition to those cases referred after initial review, additional preprogrammed cases, physician referrals, and patient complaints are reviewed at the committee level regardless of initial reviewer report.

At semimonthly meetings, the committee makes the final determination about whether errors or adverse events occurred based on committee consensus. The multidisciplinary QA committee consists of emergency physicians, nurses, residents, and ancillary staff. The cases are discussed by the committee members until a consensus has been reached on whether the case involved a medical error. Cases that are identified for presentation at a weekly emergency medicine morbidity and mortality conference are deferred until after they have been presented. If the QA committee determines that an error has occurred, the error is defined, and a rule is created and deemed to have been broken (examples of rules and their categories are provided in Table 1). The rule that is broken in a case found to have an error is entered into the QA dashboard (see Figure S1). Errors are only labeled as such

TABLE 1 Rule categories and their frequency with associated examples

Rule category	Broad rule	Rule examples
A. Errors in diagnosis: Not acquiring necessary information (eg, not obtaining an ECG on a dyspneic patient), n = 33	1. Review a patient's allergies before giving a medication	Do not give a patient a medication they are allergic to
	2. Perform a complete relevant physical exam	Patients require a skin exam, for example, anticoagulated with flank pain and at risk for RP bleed needs a skin exam to look for ecchymosis
		Perform a rectal exam on elderly patients with constipation as it may show blood or neurologic signs
		Do a pulmonary exam, that is, listen to the lungs, and look for JVD and lower extremity edema in patients with a history of CHF
		If a patient falls, they should have a complete physical exam do not miss occult rib/extremity fractures
		Check for tendon and ligamentous injury in patients with extremity lacerations
		If a patient has neurologic complaints, especially ataxia or dizziness, gait should be tested
		Altered patients with external evidence of trauma should have a complete trauma survey
		Do an oropharyngeal exam for patients with hemoptysis
	3. Review testing before ordering to ensure the correct test is ordered	Consider infection with elderly patients with altered mental status
		Evaluate for and recognize signs of sepsis and treat appropriately. Obtain lactate, cultures and related lab testing in patients with significant infections
		Draw appropriate cultures before antimicrobials in septic patients
		When considering multiple infections, obtain imaging to help differentiate and direct appropriate antimicrobials and care
		Do not assume a test will be done unless it is ordered
		Infectious workups are not complete until all ordered tests are done
		Draw appropriate cultures before initiating antimicrobials. Culture urine from patients with suspected pyelonephritis
		All ill immunocompromised patients need infectious workups
	4. Order and perform appropriate lab or imaging promptly (CTs take time)	Anticoagulated patients with confusion should have a CT head
		Perform indicated imaging in the ED, in a timely fashion. MRI needs to be expedient in patients with concern for spinal cord compression; endotracheal intubation should not be withheld if patient is uncooperative
		EKG should be performed on patients with unexplained tachycardia or dyspnea to evaluate for dysrhythmia
	5. If test results don't support suspected diagnoses, ensure appropriate further testing is ordered	Altered mental status exams should be addressed before admission and certainly before discharge from the ED, even if presenting for another diagnosis
	6. Review recommendations made by consulting services	Generally, implement recommendations by consults when appropriate but if one disagrees with consultant, ensure appropriate discussion and documentation
	7. Call indicated consults in the ED in a timely fashion (many consults can be initiated before testing results)	Promptly call a Code Stroke or Code STEMI if you diagnose acute stroke or STEMI or at least confer with the attending or consult service if you are not sure

(Continues)

TABLE 1 (Continued)

Rule category	Broad rule	Rule examples
		Consult appropriate services appropriate to clinical suspicion for example. Consult surgery for suspected bowel ischemia
	8. Do not hesitate in consulting multiple services in unstable patients	Unstable gastrointestinal bleeding generally requires GI, surgery, and interventional radiology consultation
B. Not acting on data that were acquired (eg, don't assume hemolyzed K is not an elevated K), n = 25	1. Address abnormal vital signs promptly during visit as well as before discharge	Hypotension should be addressed before admission or discharge. Often it is an indicator for ICU level of care
		Address unexplained hypoxia and notify PCP if discharging
		Patients with abnormal vitals and suspected cardiogenic syncope should have echo arranged
		If you do not think a negative inspiratory flow is accurate, obtain a blood gas before downgrading a patient's disposition. Obtain alternative testing if initial testing not diagnostic
	2. Address abnormal labs promptly during visit as well as before discharge	Ensure follow-up and PCP notification if blood sugar is concerning for a new diagnosis of diabetes
		Arrange for follow-up if creatinine is increased from baseline and you are discharging the patient
		Address an elevated INR in a patient that needs an invasive procedure
		Abnormal hematocrit should be addressed
		Positive blood cultures should be addressed
		Abnormal BNP should be addressed
		Treat abnormal phosphorus before discharge or document a plan why this should not be treated.
		Address hypokalemia, especially when a patient is on diuretics
		Abnormal Mg should be addressed and repleted
		Abnormal bicarbonate should be addressed
		Elevated potassium should be addressed
		Always repeat hemolyzed or potentially hemolyzed K
	3. Address abnormal imaging studies promptly during visit as well as before discharge	Emergency physicians should interpret their own plain films even if radiology will review in a timely fashion; radiologists can miss findings, too
		If a CXR shows pneumonia do not discharge without treatment or plan for treatment
	4. Always review out-of-hospital notification or other available data promptly	Patients referred for specific concerns should undergo evaluation for them, or document why this is not necessary
	5. Home medication list should be reviewed and given to patients in observation or prolonged ED stays	Patients need their essential meds when projected to be in the ED for a prolonged stay, especially insulin or rate control medications for patients in atrial fibrillation
C. Knowledge gaps by clinicians (eg, not attempting to reduce a hernia), n = 16	1. Ensure adequate supervision and oversight during procedures	Ensure correct anatomic location for procedures (chest tube) under attending supervision
		Attempt to reduce hernias in the ED and promptly consult surgery if unable or lack training to do so
		Obtain and stay to review post-procedural X-rays

(Continues)

TABLE 1 (Continued)

Rule category	Broad rule	Rule examples
		Ensure lines or chest tubes (pigtails) placed in the ED are placed and functioning properly
		Remove guide wire when placing a central line, always maintain proximal control
		Patients should be reevaluated before transfer and intubated if found to have unstable airways
	2. Ensure the procedure and or treatment regimen is the correct and or medication for the correct patient	Ensure a time out is performed before any invasive procedure
		Double check antibiotics or other medications are for the correct patient
	3. Ensure indicated procedures are performed in timely fashion (ie, chest tube for suspected tension pneumothorax before chest X-ray)	When meeting difficulty with a procedure, assess for complications—for example, intubated with tracheal injury
	4. If unsure of a dose or medication interaction, review the literature or call a pharmacist or specialist before administration	Initiate correct dose in a timely fashion for critical medications in the ED, such as N acetyl cysteine in acetaminophen overdoses or TPA in appropriate stoke patients
		Check dosing, allergies, efficacy and duration before prescribing medication
		Consider patients' home medications before prescribing a treatment regimen
		Do not pull medications from medication dispensing system without ensuring you are obtaining the correct medication requested
	5. Ensure a patient is safe for discharge before discharging the patient	Endocarditis suspicion requires admission and 3 sets of blood cultures and IV antibiotics until culture negative
		Do not send patients home who have required vasopressors during any part of their ED stay even if they are now hemodynamically stable
		Psychiatric patients must be appropriately medically treated before transfer to psychiatric care
	6. If you do not know the answer to a clinical finding or test result, seek prior information or ask a colleague or specialist for help	Given limited time in the ED, criteria for brain death determination and limited family input, this is more appropriately discussed and determined in the hospital ward
		Address abnormal EKG findings. Request consults to review equivocal or unclear data to prevent missing critical findings
		Compare new and old ECGs and repeat ECG when first one is equivocal
		For patients in shock, judicious use of IV contrast is needed (wait for creatinine only if time allows)
D. Communication gaps (ie, inadequate patient pass off or poor-quality discharge instructions), n = 17	1. Document in a timely fashion with clear medical decision making and plans	Document invasive procedures
		Include all important events
		Document when/why one is treating asymptomatic pyuria or similar lab abnormalities which do not necessarily warrant acute therapy
		Document in appropriate detail, including pertinent history physical exam findings and decision making
		Document in a timely fashion, procedures, critical care (such sedation and cardioversion) to include medications administered and effect

(Continues)

TABLE 1 (Continued)

Rule category	Broad rule	Rule examples
		Use of chemical or physical restraints should have documentation as to the reason
	2. Ensure every patient receives discharge instructions with a clear and timely plan for each concern identified	Do not discharge with labs pending, unless this is communicated to patient and clear lab result follow-up is in place and documented
		Give specific discharge instructions and clear follow-up for addressing abnormal findings
		Part of discharge includes activities allowed and medications needed; when appropriate this may include specific documentation when transferring to nursing or rehabilitation facilities
	3. Time-sensitive interventions should be directly communicated to the care team	Communicate directly with nursing to ensure critical medications (eg, vasopressors) ordered are initiated
	4. Communicate with your patients frequently and always prior discharge	Communicate to families, when appropriate, and patients, pertinent positive and negative lab and imaging results before discharge
	5. Do not forget to communicate plans with entire care team to ensure unified care plan	Ensure entire care team is aware of the plan and stepwise evaluation for each patient
E. Systems issues/preventive safety measures (eg, improper registration of a patient), n = 17	1. Review elements of care system (just because something has always been done a certain way does not mean it is the best way)	Registration needs to ensure patients should be registered to the correct MRN; cross-check for spelling and prior visits
		Patients in the ED are not to eat unless a diet is ordered. Before providing food to patients, they should be identified with 2 identifiers to ensure the right patient is being fed
		When deviating from a treatment pathway, one should document reasons for deviation. Always consider resource use/HEART score or similar pathways when observing low-risk patients for cardiac evaluation
		Do not admit a patient to the ICU when not necessary; for example, a patient with need for only a 4-hour ICU stay for a reversible condition should be considered for ED observation (angioedema)
		Do not keep a patient in the ED longer than necessary; for example, a 2-day stress is only necessary if first-day testing is abnormal
	2. Do not allow delays in initiating care in critical patients	All critically ill patients should be placed in a treatment area quickly
		Do not obtain a test that would not alter management (D-dimer if you do not think patient is low risk and is unstable and you are obtaining a CTA)
	3. Patients at risk for falling should never be allowed to fall (create management pathways for patients presenting with high-risk diagnoses)	Identify and protect patients at risk for falls; use multiple identifiers and signage
		Communicate with admitting team if patient is at risk of falls
		Have low threshold to obtain imaging after fall in patients with head strike in the ED
		If a patient is a fall risk, do not allow them to use public bathroom; instead may offer a supervised commode or bedpan

BNP, B-Type natriuretic peptide; CHF, congestive heart failure; CRX, chest X ray; CT, computed tomography; CTA, computerized tomography with antiography; ED, emergency department; EKG, electrocardiogram; GI, gastrointestinal; HEART, an acronym including History, EKG, Age, Risk factors, and troponin; INR, international normalized ratio; IV, intravenous; JVD, jugular venous distension; MRI, magnetic resonance imaging; MRN, medical record number; PCP, primary care physician; RP, retroperitoneal; STEMI, ST-segment–elevation myocardial infarction; TPA, tissue plasminogen activator.

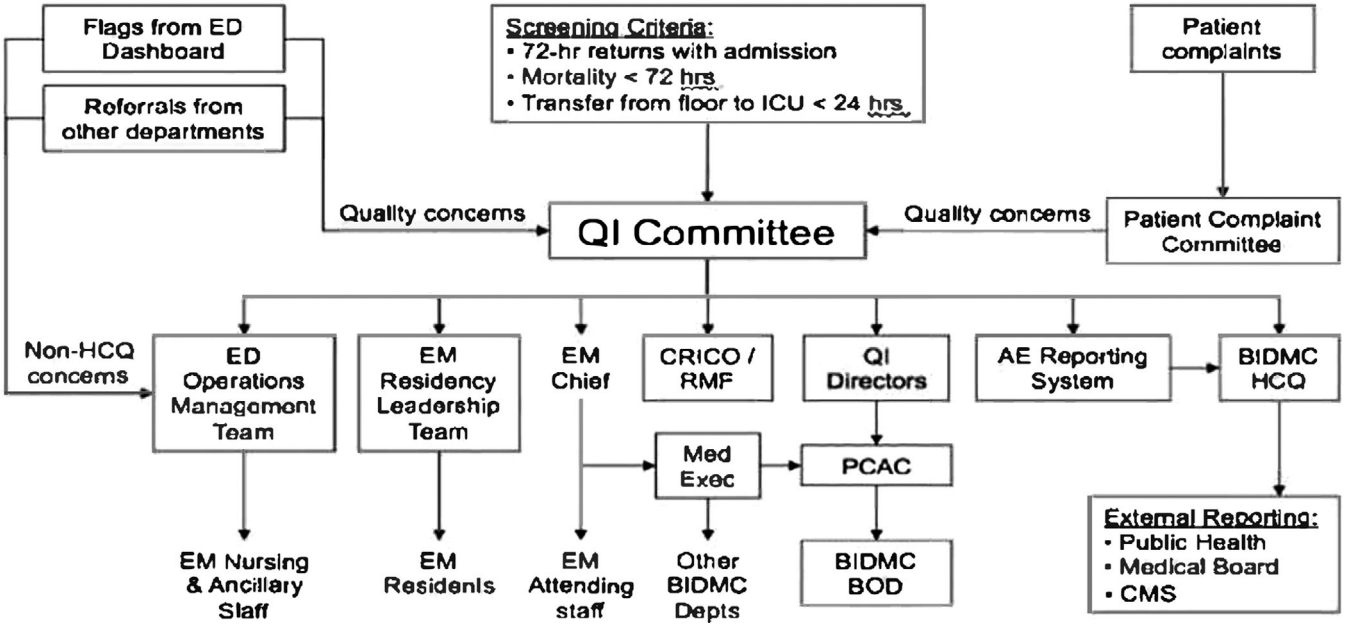
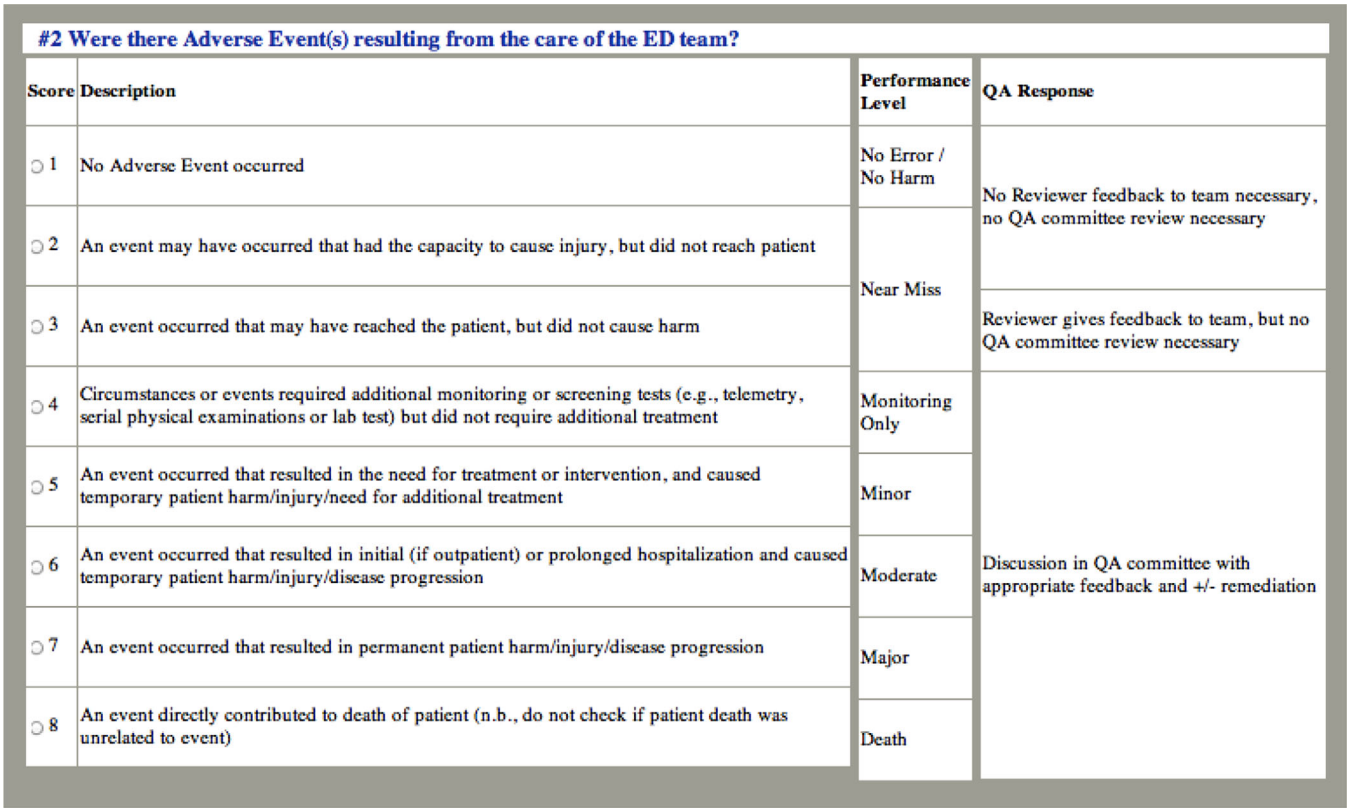


FIGURE 1 Structural schematic of how quality assurance issues are referred to different departments within the hospital. AE, adverse event; BOD, board of directors; CMS, center for medicaid and medicare services; CRICO, malpractice insurance program; ED, emergency department; EM, emergency medicine; HCQ, health care quality; PCAC, Department Chiefs Quality Assurance Committee; QI, quality improvement; RMF, risk management facility

#1 : Were Error(s) made by the ED team?

Score	Description	Performance Level	QA Response
○ 1	No Error	Perfect	No Reviewer feedback to team necessary, no QA committee review necessary
○ 2	Judgment calls that the reviewer may not have made but can accept; with no apparent consequences	Minor Flaws	
○ 3	Possible errors in care of little consequence that did not compromise care in any appreciable way		Reviewer gives feedback to team, but no QA committee review necessary
○ 4	Moderate errors with resulting consequences that had the potential to compromise care, but which did not appear to compromise care	Moderate Flaws	Discussion in QA committee with appropriate feedback and +/- remediation
○ 5	Moderate errors with resulting consequences that may have compromised care		
○ 6	Major errors that with consequences that compromised care but where the overall care was within the standard of care	Major Flaws	
○ 7	Major errors that resulted in compromised care and which violated the standard of care		
○ 8	Major errors that grossly violated the standard of care	Egregious	

FIGURE 2 Likert scale used by reviewers to determine presence of medical error in QA cases. QA, quality assurance



#2 Were there Adverse Event(s) resulting from the care of the ED team?

Score	Description	Performance Level	QA Response
○ 1	No Adverse Event occurred	No Error / No Harm	No Reviewer feedback to team necessary, no QA committee review necessary
○ 2	An event may have occurred that had the capacity to cause injury, but did not reach patient	Near Miss	
○ 3	An event occurred that may have reached the patient, but did not cause harm		Reviewer gives feedback to team, but no QA committee review necessary
○ 4	Circumstances or events required additional monitoring or screening tests (e.g., telemetry, serial physical examinations or lab test) but did not require additional treatment	Monitoring Only	Discussion in QA committee with appropriate feedback and +/- remediation
○ 5	An event occurred that resulted in the need for treatment or intervention, and caused temporary patient harm/injury/need for additional treatment	Minor	
○ 6	An event occurred that resulted in initial (if outpatient) or prolonged hospitalization and caused temporary patient harm/injury/disease progression	Moderate	
○ 7	An event occurred that resulted in permanent patient harm/injury/disease progression	Major	
○ 8	An event directly contributed to death of patient (n.b., do not check if patient death was unrelated to event)	Death	

FIGURE 3 Likert scale used by reviewers to determine the presence of adverse event(s) in QA cases. QA, quality assurance

if a corresponding rule is identified and can be defined. At the conclusion of each review and remediation process, all data elements are entered into the QA dashboard archive for reference, quality improvement, and research (see Figure S2). The use of team member identification as noted on the form is for educational purposes, is not punitive, and is confidential to all save for the administrative team and individual reviewer. The reviewer then provides the committee's feedback to the appropriate physicians involved in the case.[12]

3 | RESULTS

A total of 108 episodes of rules broken were identified in 103 cases within a database of 920 reviewed cases (see Table 1). In cases where a rule was broken and therefore an error was assigned, 5 major themes emerged. The first was not acquiring necessary information (N = 33; 31%). Common themes included not reviewing a patient's allergies and lack of a complete physical exam. For example, if a patient has a neurologic complaint, gait should be tested. There were multiple cases pertaining to a lack of indicated testing and subsequent data acquisition. There were also a number of cases where the appropriate consultation(s) were not obtained.

The second major category was not acting on information that was acquired (N = 25; 23%). The most common error here was in not addressing abnormal laboratory values appropriately. There were also cases where necessary home medications were not ordered and where abnormal vital signs were not addressed as well as a case where the physician did not interpret radiographs independently (a standard in our institution) and a case where the referring physician's note was not read.

The third major category involved knowledge gaps by clinicians (N = 16; 15%). There were cases where hernia reduction was not attempted, cases where the appropriate supervision and instruction were not given in invasive procedures, cases with inadequate plans of care and misread ECGs as well as several cases with errors in medication use and stewardship.

The fourth major category pertained to communication gaps (N = 17; 16%). This category included cases of inadequate follow-up on discharge communications, documentation errors, delays in documentation, and errors in direct communication to staff and/or patients.

The final category involved systems issues (N = 17; 16%). These included incorrect patient identification and error in registration, improper resource use, lack of fall prevention, and incorrect triaging of patients. Certain cases broke >1 rule. Certain rules have >1 case assigned. Please see Table 1 for specific examples.

4 | DISCUSSION

There is an ongoing need to define more informative ED-based QA markers for clinical error, especially preventable errors resulting in harm.[1,4,5] In our study, we developed a rule-based definition of

medical error in emergency medicine. All cases where an error was found, whether it be a near miss or adverse event, were found to break an emergency medicine rule. As error can only be assigned if a corresponding broken rule of emergency medicine can be defined. We propose the rule-based identification as both a novel and evidence-based way to define error in emergency medicine. The development of this method aims to standardize the distinction between deviation from the standard of care, and hence error, from judgment calls where one physician may make different choices from another but is still acting within the standard of care. When looking at the individual rules that were broken in each case, 5 common themes emerged: not acquiring necessary information, not acting on data that was acquired, knowledge gaps, communication gaps, and systems issues. We propose that these are all areas that can be targeted for education via dissemination of the rules as a teaching tool and ultimately used as a tool in a risk-reduction strategy.

Medical error has received increased national attention during the past 20 years. Klasco et al[9] showed an overall incidence of error at 0.13% in ED care. Yet, overall, there is a dearth of high-quality evidence describing the incidence of error and adverse events in the ED.[13,14]

Prior investigations suggest that systematic evaluation of patient and physician complaints have been shown to have a high yield for detecting error.[7,8] There are other metrics described previously that are commonly used to look for cases to review. Peer review has long been thought to be a logical approach for discerning error and adverse events among physicians in medicine given the requisite specialized knowledge base and expertise, but in practice it is variable in quality and often not evidence based.[15,16] Therefore, we believe that a standardized set of rules validated by consensus from a trained multidisciplinary QA committee would be a superior method of objectively assigning adverse events and error in medicine. Further development over time of a standardized set of rules may be most useful in an objective evaluation to recognize and assign error.

The ultimate goal of such error detection is to implement system-based changes to decrease future error.

5 | LIMITATIONS

Although we employed multiple methods to obtain relevant cases, all cases undergo an initial review for possible error, therefore there may have been a component of selection bias and subsequent missed cases and subsequent rules that were missed because this initial review is an inherently subjective process performed by an initial single reviewer. We used a single institution for a test site and an institution-specific tailored QA database, which may both limit the generalizability of the conclusions of this study and introduce institution-specific bias as different institutions may have some inherent deviation in standard-of-care practices. In addition, although the rule broken and error was assigned after committee consensus review, the terminology was done with 2 senior reviewers with 6 years of experience. There was little overlap regarding agreement; however, this is also a limitation of the study. Lastly, the sample size of this study was small, and the creation of new rules is an ongoing process with the need for larger sample sizes as well as prospective implementation trials to validate its use. The practice patterns in individual institutions may vary, and certain rules may not apply equally to all institutions. Further research across multiple departments would be beneficial.

6 | CONCLUSION

Using an integrated, readily accessible electronic error reporting system, we studied the medical errors that have occurred at our institution and developed a consensus-based definition of medical error defined by a set of rules that can be categorized with the intent to use these rules both to teach avoidance of error in emergency medicine and ultimately identify clear targets for systems improvement. This may result in a more standardized and practical definition of error in emergency medicine. A rule-based definition of medical error in emergency medicine may identify key areas for risk-reduction strategies and help standardize QA while improving patient care and physician education.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Kiersten L. Gurley wrote the first draft. All authors reviewed and edited multiple revisions. Kiersten L. Gurley takes responsibility for the paper as a whole.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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