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Surgical Research

Profiles in Error: A Template for Quality Improvement

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ABSTRACT

Introduction: *It has been alleged that human error is impossible to eliminate in surgery because of the complex, multifactorial nature of clinical care. However, the level of detail that describes error types is limited and studies analyzing large numbers of cases are few. We developed a standardized error template and gathered data over five years to profile patterns of error in surgical cases with complications.*

Methods: *Data was collected at an accredited general surgery residency program utilizing a previously described complication reporting system. The system allows for click-based, electronic entry of complications, case summaries, and a standardized critique algorithm across multiple domains including diagnostic, technical, judgment, therapy/prophylaxis, communication, professionalism and system error. Data was collected on cases with complications and reviewed at weekly validation meetings by a committee of attendings (including the site Chief of Surgery, Program Director, divisional leadership, senior and junior residents, nursing and quality). The process was prospective and comprehensive; presented by residents responsible for care; designed to validate complications and identify error. Data was analyzed for the incidence of error across the seven domains, thirty-seven subtypes, and for specific procedures including bariatrics, cholecystectomy, colectomy, hepatic procedures, hiatal hernia, ileostomy closure, pancreatectomy and ventral hernia/component cases.*

Results: *The study population included 25,857 general surgery/vascular cases, 4,005 complications, 1,473 cases with complications, and 3,268 errors or 2.2 errors per complication case. The number and incidence of error by domain category was technical (831, 25.4%), therapy/prophylaxis (598, 18.3%), judgment (509, 15.6%), diagnosis (378, 11.6%), system issues (379, 11.3%), communication (356, 10.9%), and professionalism (226, 6.9%). The most common subtypes for each domain were 'error technical performance'(54.2%), 'post procedure care MD Team'(79.4%), 'error medical judgment'(50.5%), 'delay diagnosis'(11.6%), 'pre/post procedure care Nursing Team'(59.7%), 'error in handoff team members'(10.9%), and 'identified/accepted responsibility'(62%), respectively. All of the operative procedures evaluated mimicked the error profile of the domain and subtype categories with some differences in emphasis. We calculated the proportion of operations with complications that had errors. The median sub-specialty had a rate of .83, with a range of only .77 to .89. Thus, a large proportion of operations with complications had at least one error, and this did not vary much across sub-specialty.*

Conclusion: *These data suggest that patterns of error can be accurately described utilizing a standardized error profile template to analyze post-operative complications. Operation types with more errors had more complications. By understanding the distribution of error types, providers and colleagues may be informed of their individual propensity for error, and systems can be more focused in quality improvement initiatives based on patterns specific to procedure type.*

Keywords
Quality Improvement (QI), Error, Harm.

Introduction

Medical error is reported to be the third leading cause of death in the United States, with estimates suggesting it accounts for a significant portion of preventable morbidity and mortality [1,2]. Despite prominence of this statistic, the definition of "error" remains a widely debated topic in the healthcare community. Probably the most famous definition of error was set out in the landmark publication "To Err is Human" 1999 which asserts that error is "either a failure of a planned action to be completed as intended, or the use of a wrong plan to achieve an aim."[3]. In other words, error is a result of the human condition and inevitable in any field wherein human reason and decision-making impact outcomes. Based on this definition, it has been accepted that there will always be some component of human error in medicine.

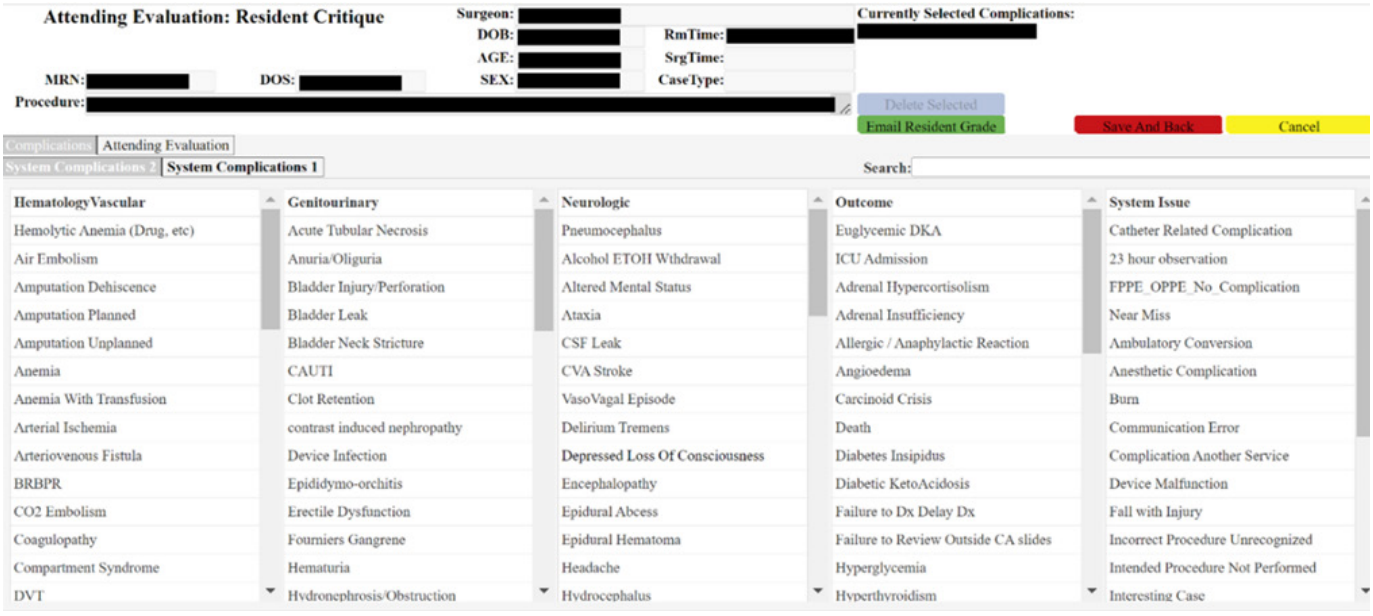
Further studies have worked to define error into more quantifiable measures, creating classification and categorization systems to stratify and study different types of error with the aim of accurately describing and minimizing error, thereby reducing patient complications. Some systems are intention based while others remain more objective. However, error reporting remains inconsistent, and few large-scale trials exist. In addition, while it should be evaluated, not all errors lead to harm. Unlike medical error, which encompasses all mistakes made in the field, harm is defined as the error that reaches the patient and results in a negative or adverse outcome.

More recently, researchers have been interested in determining the root causes of medical error. In many studies, error has been classified by pre-determined categories. For instance, Marsh et al performed a systematic review of the literature related to medical mistakes, finding a myriad of disparate definitions of medical error. At the conclusion of the review, the authors proposed five standardized categories of error including: medication errors, errors in diagnosis, technical errors, system errors, and judgment errors [4]. Moreover, studies of error have sought to relate errors to specific procedures, recognizing that different surgeries are prone to particular errors and may not be easily compared. Using both the aforementioned categorization system and surgical subgroup stratification, subsequent research efforts by Marsh focused on role of judgement errors in harmful surgical outcomes from medical mistakes [5].

In this paper, we present a set standardized error template and evaluate data gathered over five years to profile patterns of error in surgical cases with complications. We hypothesized that errors leading to harm are not typically attributable to a single source but rather arise from complex, multifactorial sources including human, systemic and procedural elements.

Methods

Data was collected at an accredited general surgery residency program utilizing a complication reporting system previously described [6-11]. The system allows for web-based electronic data entry system and collects complication data via clinical case summaries and a 90% click-based data entry system. This allows for standardized identification of over 300 surgical complications (Figure 1). The system requires attending, team and patient identifiers. It begins with a detailed case summary of the case events followed by a series of click-based inputs which includes a standardized critique algorithm for error. The error domains included: diagnostic, technical, judgment, therapy/prophylaxis, communication, professionalism and system error (Figure 2).



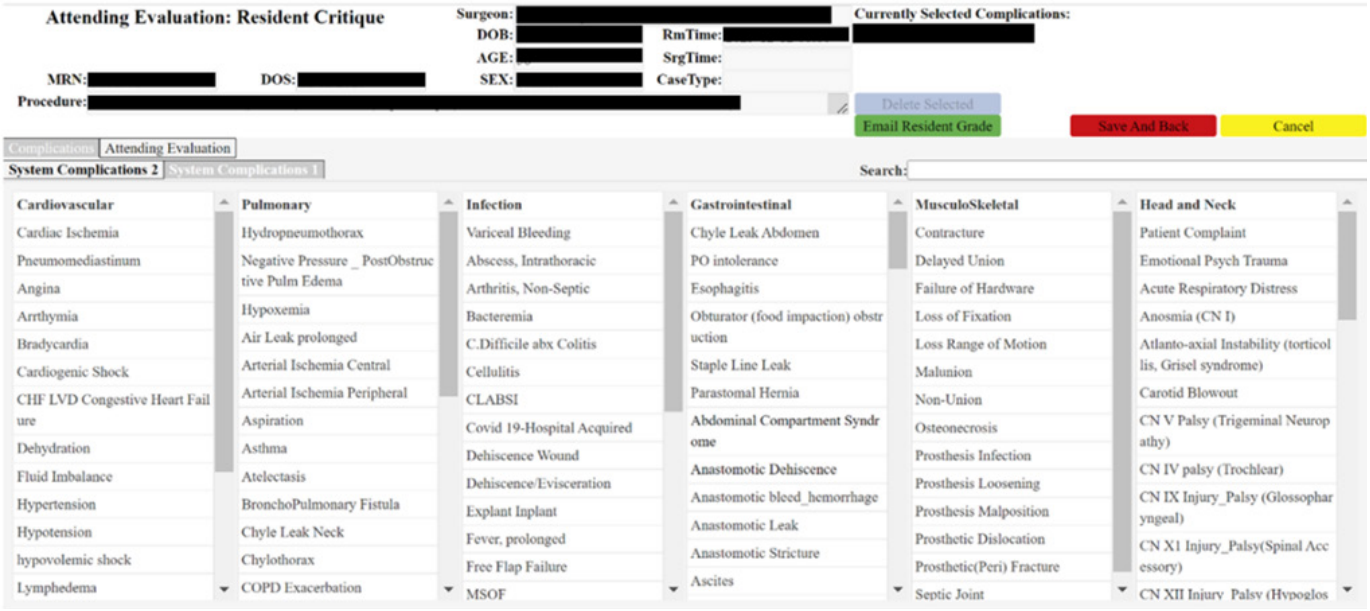
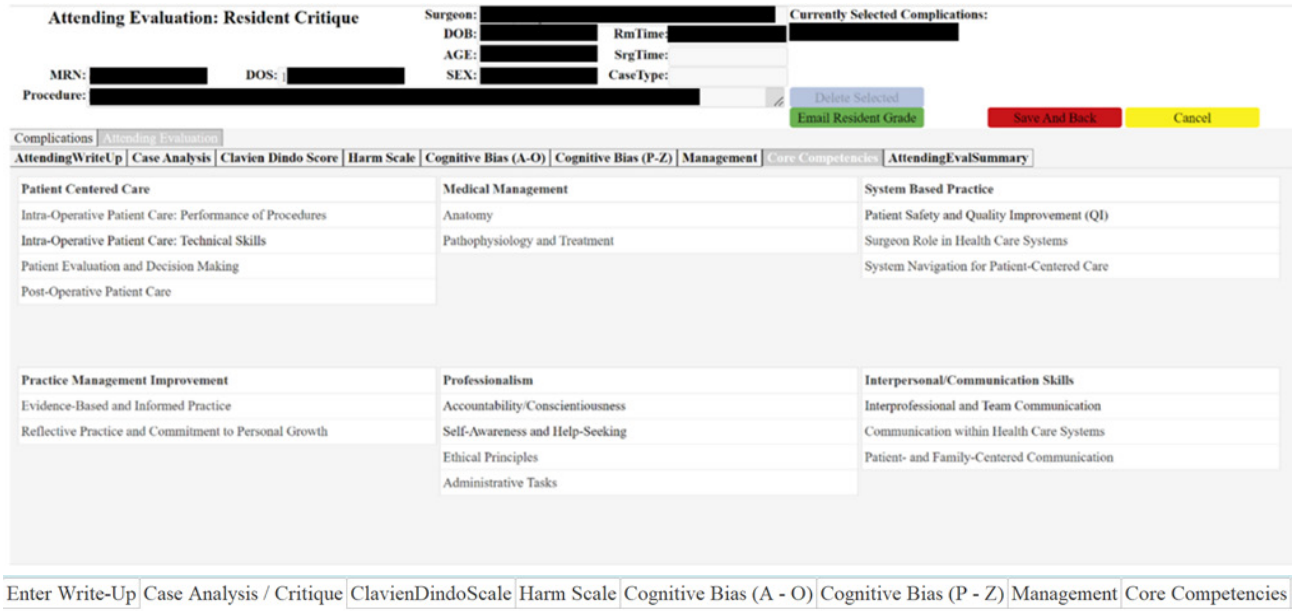


Figure 1: Click-based surgical complication reporting platform.



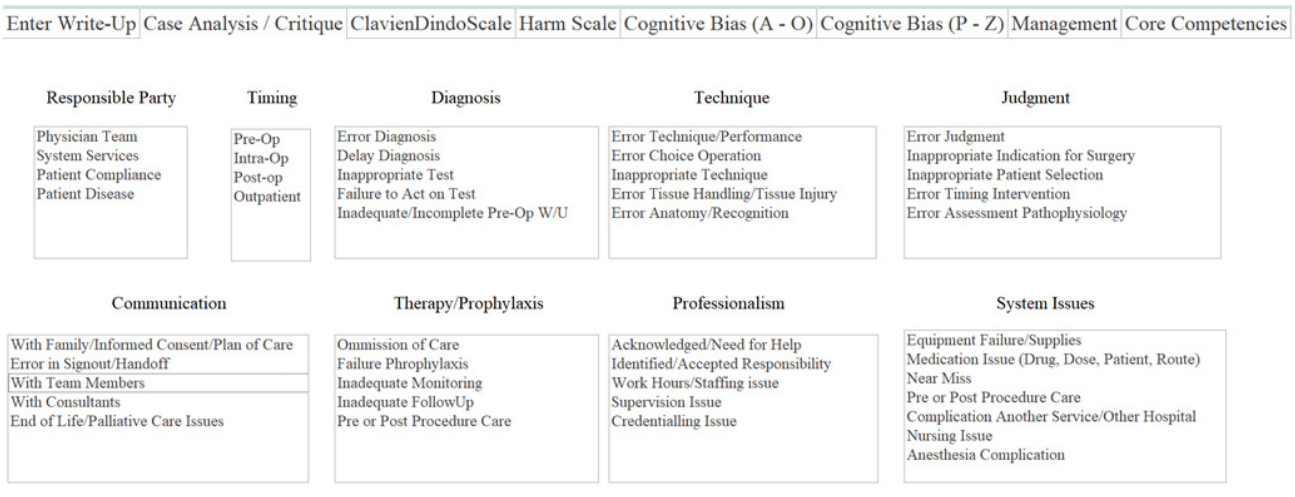


Figure 2: Click-based error reporting platform.

Thirty-seven subtypes of error are specified. Data was electronically collected on cases with complications and reviewed at weekly validation meetings by a committee of attendings (including the site Chief of Surgery, Program Director, divisional leadership, senior and junior residents, nursing and quality). The process was prospective and comprehensive. Cases were presented by residents responsible for care and data was validated by the above committee. Data was evaluated as the incidence of error across the seven domains, thirty-seven subtypes, and for specific procedures: bariatrics, cholecystectomy, colectomy, hepatic procedures, hiatal hernia, ileostomy closure, pancreatectomy and ventral hernia/component cases.

Results

The study population included 25,857 general surgery/vascular cases, 4,005 complications, 1,473 cases with complications, and 3,268 errors or 2.2 errors per complication case. The number and incidence of error by domain category was technical (831, 25.4%), therapy/prophylaxis (598, 18.3%), judgment (509, 15.6%), diagnosis (378, 11.6%), system issues (379, 11.3%), communication (356, 10.9%), and professionalism (226, 6.9%) (Table 1).

The most common subtypes for each domain were 'error technical performance' (54.2%), 'post procedure care MD Team' (79.4%), 'error medical judgment' (50.5%), 'delay diagnosis' (11.6%), 'pre/post procedure care Nursing Team' (59.7%), 'error in handoff team members' (10.9%), and 'identified/accepted responsibility' (62%), respectively.

All of the operative procedures evaluated mimicked the error profile of the domain and subtype categories with some differences in emphasis. We calculated the proportion of operations with complications that had errors. The median sub-specialty procedures had a rate of 0.83, with a range of only 0.77 to 0.89. Thus, a large proportion of operations with complications had at least one error, and this did not vary much across sub-specialty procedure.

Table 1: Breakdown of errors by number and percent of cases.

Error Category	Number of Cases with Reported Error	Percent of Cases with Reported Error
Technique	**831**	**25.43%**
Error Technique/Performance	450	54.15%
Error Tissue Handling/Tissue Injury	189	22.74%
Error Anatomy/Recognition	67	8.06%
Inappropriate Technique	64	7.70%
Error Choice Operation	61	7.34%
Therapy/Prophylaxis	**598**	**18.30%**
Pre or Post Procedure Care (MD Team)	475	79.43%
Inadequate Monitoring	38	6.35%
Omission of Care	31	5.18%
Inadequate FollowUp	29	4.85%
Failure Prophylaxis/Failure to Follow Checklist	25	4.18%
Judgement	**509**	**15.58%**
Error Medical Judgment	257	50.49%
Error Timing Intervention	114	22.40%
Error Assessment Pathophysiology	83	16.31%
Inappropriate Patient Selection	43	8.45%
Inappropriate Indication for Surgery	12	2.36%
Diagnosis	**378**	**11.57%**
Delay Diagnosis	209	55.29%
Failure to Act on Test	64	16.93%
Error Diagnosis	50	13.23%
Inadequate/Incomplete Pre-Op W/U	41	10.85%
Inappropriate Test	14	3.70%
System Issues	**370**	**11.32%**
Pre or Post Procedure Care (Nursing Team)	221	59.73%
Complication Another Service/Other Hospital	66	17.84%
Medication Issue (Drug, Dose, Patient, Route)	32	8.65%
Anesthesia Complication	18	4.86%
Equipment Failure/Supplies	11	2.97%
Near Miss	10	2.70%
Nursing Error	10	2.70%
Operating Room Delay	2	0.54%

Communication	**356**	**10.89%**
Error Handoff Team Members	144	40.45%
With Family/Informed Consent/Plan of Care	105	29.49%
Error Handoff Signout with Consultants	63	17.70%
End of Life/Palliative Care Issues	30	8.43%
Error in Signout/Handoff	14	3.93%
Professionalism	**226**	**6.92%**
Identified/Accepted Responsibility	140	61.95%
Acknowledged/Need for Help	77	34.07%
Supervision Issue	6	2.65%
Work Hours/Staffing issue	2	0.88%
Credentialling Issue	1	0.44%

Discussion

Medical error, as an inherent part of healthcare, continues to be a significant challenge in clinical practice, with profound implications for patient safety, quality of care, and healthcare outcomes. Our study offers critical insights into the types and distribution of errors in surgical practice, supporting the idea that errors leading to patient harm are rarely the result of a single factor. Rather, they arise from a complex interplay of human, systemic, and procedural elements. In addition, system issues accounted for only 11% of errors, highlighting that provider-based technical and cognitive errors accounted for nearly 90% of errors. These findings expand upon existing literature, which has similarly emphasized the multifactorial nature of medical error and its relationship to various contributing factors, including clinical judgment, technical performance, communication breakdowns, and system-level issues.

The most common categories of errors observed in our study were technical and judgment errors, followed by errors in therapy, communication, and system failures. Specifically, technical performance and post-procedure care errors were the most frequently identified, which aligns with prior studies identifying the importance of technical proficiency and follow-up care in mitigating patient harm. Furthermore, the relationship between different surgical specialties and error profiles revealed that while specific error types may be more common in certain procedures (e.g., technical errors in complex surgeries such as pancreatectomy), the overall frequency of errors across different domains remained relatively consistent. This suggests that errors are a common feature across surgical disciplines, and strategies to mitigate them should be broadly applicable across various surgical specialties.

One of the most striking observations in this study is the high incidence of errors even in cases that did not result in harm. This highlights an important distinction in error research: not all errors lead to adverse outcomes, but the potential for harm remains ever-present. It underscores the need for a broader approach to error prevention, one that encompasses not just harm reduction but also efforts to minimize the frequency of error occurrence overall. While some errors may be benign, their presence signals opportunities for improvement in clinical practice, communication, and system design.

Our data also underscore the importance of standardized error reporting and classification systems. The template and error domains used in this study allowed for a systematic approach to error identification and analysis, facilitating the detection of recurring error patterns and trends. Although data is not specifically presented in this paper, the error data collected was automatically applied to individual procedure classes and to individual surgeons in the form of periodic reviewable report cards. Such a framework can serve as a valuable tool for quality improvement initiatives, enabling healthcare institutions to identify areas for targeted interventions and develop evidence-based strategies to reduce error rates.

Conclusion

These data suggest that patterns of error can be accurately described utilizing a standardized error profile template to analyze post-operative complications. Operation types with more errors had more complications. By understanding the distribution of error types, providers and colleagues may be informed of their individual propensity for error, and systems can be more focused in quality improvement initiatives based on patterns specific to the case type. In addition, system issues accounted for only 11% of errors, highlighting that provider-based technical and cognitive errors accounted for nearly 90% of errors.

The use of standardized frameworks, as demonstrated in this study, can aid in the development of targeted interventions and ultimately improve the safety and quality of care provided to patients. Moving forward, healthcare institutions should prioritize error reduction strategies, focusing on education, cognitive performance, prevention and the optimization of clinical workflows, communication, and team dynamics to reduce the frequency of errors and improve patient outcomes in surgical settings.

Furthermore, the study emphasizes the need for robust error reporting systems that can identify patterns of mistakes across different error domains, providing valuable data to inform continuous quality improvement efforts. By recognizing the prevalence of medical error, embracing a culture of transparency, and fostering collaborative approaches to patient care, healthcare providers can take important steps toward reducing preventable harm in surgical practice.

References

1. Xu J, Sherry ML, Kochaneck KD, et al. Deaths: final data for 2013. Natl Vital Stat Rep. 2016; 64: 1-119.
2. Makary MA, Daniel M. Medical error-the third leading cause of death in the US. BMJ. 2016; 353: i2139.
3. Institute of Medicine (US) Committee on Quality of Health Care in America. To Err is Human: Building a Safer Health System. Kohn LT, Corrigan JM, Donaldson MS, editors. Washington (DC): National Academies Press (US); 2000.
4. Marsh KM, Turrentine FE, Jin R, et al. Judgment Errors in Surgical Care. J Am Coll Surg. 2024; 238: 874-879.
5. Marsh KM, Turrentine FE, Knight K, et al. Defining and Studying Errors in Surgical Care: A Systematic Review. Ann Surg. 2022; 275: 1067-1073.
6. Antonacci AC, Lam S, Lavarias VA, et al. A Morbidity & Mortality Conference Based Classification System for Adverse Events (MARS): Surgical Outcomes. J Surg Res. 2008; 147: 172-177.
7. Antonacci AC, Lam S, Lavarias VA, et al. A Report Card System using Error Profile Analysis and Concurrent Morbidity and Mortality Review: Surgical Outcomes – Part II. J Surg Res. 2009; 153: 95-104.
8. Antonacci AC, Dechario S, Antonacci C. Cognitive Bias (CB) in Management of Post-op Complications: Incidence and Impact on Error and Care. J Surg Res. 2021; 258:47-53.
9. Antonacci AC, Dechario SP, Rindskopf D, et al. Cognitive bias and severity of harm following surgery: Plan for workflow debiasing strategy. The American Journal of Surgery. 2021;222(6): 1172-7.
10. Carsky K, Rindskopf D, Patel V, Ansari P, et al. AC Using Concurrent Complication Reporting to Evaluate Resident Critical Thinking and Enhance Adult Learning Journal of Surgical Education. 2024; 81:5. 702-712.
11. Antonacci AC, Ansari P, Andrews R, et al. Optimizing Complication Self-Reporting Methodologies Improves Standard of Care and Quality. J Surg Res. 2025. PMID: 40286590.