Characteristics and contributing factors of diagnostic error in surgery: analysis of closed medico-legal cases and complaints in Canada

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Background: Diagnostic errors lead to patient harm; however, most research has been conducted in nonsurgical disciplines. We sought to characterize diagnostic error in the pre-, intra-, and postoperative surgical phases, describe their contributing factors, and quantify their impact related to patient harm.

Methods: We performed a retrospective analysis of closed medico-legal cases and complaints using a database representing more than 95% of all Canadian physicians. We included cases if they involved a legal action or complaint that closed between 2014 and 2018 and involved a diagnostic error assigned by peer expert review to a surgeon.

Results: We identified 387 surgical cases that involved a diagnostic error. The surgical specialties most often associated with diagnostic error were general surgery (*n* = 151, 39.0%), gynecology (*n* = 71, 18.3%), and orthopedic surgery (*n* = 48, 12.4%), but most surgical specialties were represented. Errors occurred more often in the postoperative phase (*n* = 171, 44.2%) than in the pre- (*n* = 127, 32.8%) or intra-operative (*n* = 120, 31.0%) phases of surgical care. More than 80% of the contributing factors for diagnostic errors were related to providers, with clinical decision-making being the principal contributing factor. Half of the contributing factors were related to the health care team (*n* = 194, 50.1%), the most common of which was communication breakdown. More than half of patients involved in a surgical diagnostic error experienced at least moderate harm, with 1 in 7 cases resulting in death.

Conclusion: In our cohort, diagnostic errors occurred in most surgical disciplines and across all surgical phases of care; contributing factors were commonly attributed to provider clinical decision-making and communication breakdown. Surgical patient safety efforts should include diagnostic errors with a focus on understanding and reducing errors in surgical clinical decision-making and improving communication.

Contexte : Les erreurs de diagnostic causent des préjudices à la patientèle; par contre, la majeure partie de la recherche a porté sur d'autres disciplines que la chirurgie. Nous avons voulu caractériser les erreurs de diagnostic susceptibles de survenir lors des périodes pré-, per-, et postopératoires, en décrire les facteurs contributifs, et mesurer leur impact sur le plan des préjudices causés à la patientèle.

Méthodes : À partir d'une base de données représentant plus de 95 % de tous les médecins canadiens, nous avons procédé à une analyse rétrospective des dossiers et des plaintes de nature médico-légale réglés. Nous avons inclus tous les dossiers ayant donné lieu à une poursuite judiciaire ou à une plainte officielle qui ont été réglés entre 2014 et 2018 et qui, après expertise, mettaient en cause une erreur de diagnostic imputée à un chirurgien ou une chirurgienne.

Résultats : Nous avons recensé 387 cas chirurgicaux associés à une erreur de diagnostic. Les spécialités chirurgicales les plus souvent impliquées dans une erreur diagnostique étaient la chirurgie générale (*n* = 151, 39,0 %), la gynécologie (*n* = 71, 18,3 %), et la chirurgie orthopédique (*n* = 48, 12,4 %), mais la plupart des spécialités chirurgicales étaient représentées. Les erreurs se sont produites plus fréquemment durant la période postopératoire (*n* = 171, 44,2 %) que durant les périodes pré- (*n* = 127, 32,8 %) ou peropératoires (*n* = 120, 31,0 %). Plus de 80 % des facteurs contributifs impliquaient le personnel soignant, la prise de décision clinique en étant le principal. La moitié des facteurs contributifs avaient à voir avec l'équipe soignante (*n* = 194, 50,1 %), et le plus fréquent concernait un quelconque bris de communication. Plus de la moitié des cas ayant fait l'objet d'une erreur de diagnostic ont subi des préjudices au moins modérés, et 1 fois sur 7, l'issue en a été fatale.

Conclusion : Dans notre cohorte, les erreurs de diagnostic ont touché la plupart des disciplines chirurgicales et toutes les périodes opératoires; les facteurs contributifs ont souvent été liés à la prise de décision clinique et à un bris de communication. Les efforts déployés pour assurer la sécurité de la patientèle devraient aussi tenir compte des erreurs de diagnostic et mettre l'accent sur l'analyse et la prévention des erreurs associées à la prise de décision clinique et sur l'amélioration de la communication.

The diagnostic process is a foundational element of every medical specialty, both surgical and nonsurgical. In any clinical practice, the diagnostic process involves information gathering (via history taking, physical examination, expert consultation, and diagnostic testing using medical imaging, laboratory medicine, and anatomic pathology), information integration and interpretation, and the formulation of a working diagnosis.[1] For surgeons, this process occurs during the pre-, intra-, and postoperative phases.[2] Diagnostic decisions inform treatment decisions,[1] such as the decision to operate laparoscopically versus openly, to ligate 1 artery versus another when faced with intraoperative bleeding, or to initiate antibiotics for postoperative fever versus monitoring it clinically. As a result, the diagnostic process affects patient outcomes.[1]

Diagnostic errors lead to patient harm;[3,4] however, most current research has been conducted in nonsurgical disciplines, such as internal medicine,[5,6] emergency medicine,[7,8] and primary care.[9,10] In surgical practice, the failure points within the diagnostic process are not nearly as well understood. In this study, we sought to conduct a retrospective analysis of a national database of closed medicolegal cases and complaints to characterize diagnostic error in the pre-, intra-, and postoperative surgical phases, describe their contributing factors, and quantify their impact related to patient harm.

Methods

Study design

We conducted a retrospective analysis of closed medicolegal cases and complaints at the Canadian Medical Protective Association (CMPA), a national not-for-profit, mutual defence organization representing more than 95% of all physicians practising in Canada. The CMPA maintains a repository of medicolegal data about legal actions and complaints to regulatory authorities and hospitals. Each case represents a matter voluntarily brought to the CMPA by a physician seeking medicolegal advice.

Study cohort

We included cases if they met 2 criteria. Cases must have involved a threatened or realized legal action or complaint to a physician regulatory authority or hospital that closed between 2014 and 2018. Cases must have also involved a diagnostic error assigned to a physician practising in a surgical specialty who had performed a surgical intervention, as determined by peer expert review in each individual case. Expert nurse researchers (A.M. and C.D.) coded the data and 2 surgeons (L.H. and R.M.) conducted quality review. We excluded cases that involved obstetrical care or a class action lawsuit. We also excluded cases involving safety incidents that occurred before 2009 as criticisms of these cases may pertain to care practices that are outdated.

Data extraction and coding

Nurse analysts with clinical experience and extensive health information training coded information, as previously published.[11] They code around 4000 cases per year and participate in weekly quality assurance reviews to minimize misclassification.

To classify diagnoses and interventions, nurse analysts used the Canadian version of the *International Statistical Classification of Diseases and Related Health Problems, 10th Revision*, and the Canadian Classification of Health Interventions, respectively. To identify the clinical or technical factors that contributed to the patient safety incident, nurse analysts used a system to classify the criticisms of peer experts, regulatory authorities, or hospitals.[11] Peer experts were usually physicians with training or experience similar to the named physicians. They were retained by a party in the complaint to review case materials and attribute contributing factors to the patient safety incident. Within the framework, contributing factors were further categorized as related to the provider, the health care team, or the health care system.

In this analysis and in keeping with a patient-centric approach, we included the patient as a member of the health care team. Nurse analysts classified patient harm using a system modelled after the American Society for Healthcare Risk Management's Healthcare Associated Preventable Harm Classification.[12] This classification allowed us to differentiate harm related to health care from harm that is an inherent risk of care, near misses, and cases where no harm occurred.

Definitions

In this study, we applied the National Academy of Medicine's definition of diagnostic error as "the failure to establish an accurate and timely explanation of the patient's health problem(s) or to communicate that explanation to the patient".[1] We used a previously published definition of surgery as an act that "is performed for the purpose of structurally altering the human body by incision or destruction of tissues… [for] the diagnostic or therapeutic treatment of conditions or disease processes."[13]

Outcomes

Our primary outcomes were diagnosis by surgical phase of care; the contributing factors associated with the error coded at the level of the provider, team, and system; and level of patient harm. Secondary outcomes included clinical setting, physician characteristics, patient characteristics,

and type of medicolegal matter. Depending on clinical complexity, some cases were classified into more than 1 category (e.g., a given case may have had a diagnostic error attributed in the preoperative outpatient setting and an additional diagnostic error attributed later in the patient's clinical course in the postoperative inpatient setting).

Data analysis

We used SAS version 9.4 to calculate frequencies and proportions using deidentified and anonymized data. Given the sensitive nature of the data, we did not report absolute values for data points with fewer than 10 instances. To frame diagnostic error in surgery in a broader context, we also calculated the number of all surgical cases that closed during the same time frame.

Ethics approval

The study was approved by the Canadian panel of the Advarra Institution review board in accordance with Canada's Tri-Council policy regarding the ethical conduct of research involving humans.

Results

The study cohort included 387 cases of diagnostic error (Table 1), representing 16.4% of the 2362 total surgical medicolegal cases that closed over the study period. These cases involved 366 unique surgeons (median age 49 yr), 34 of whom were involved in more than 1 case (median 2, range 2–4). Surgical diagnostic errors most frequently occurred in the inpatient setting (n = 237, 61.2%); they occurred about half as often in the outpatient setting (n = 121, 31.3%). The surgical specialties most often associated with a diagnostic error were general surgery (n = 151, 39.0%), gynecology (n = 71, 18.3%), orthopedic surgery (n = 48, 12.4%), urology (n = 39, 10.1%), and plastic surgery (n = 28, 7.2%) (Table 1). Other surgical specialties that had diagnostic errors included neurosurgery, ophthalmology, otolaryngology, cardiac and thoracic surgery, and vascular surgery. Resident physicians were named in 20 (5.2%) cases; however, 80% were subsequently released from the claim upon further review. Most patients in this cohort (median age 52 yr) had good preoperative functional status (ASA class I and II, n = 224, 57.9%); patients were more often female (n = 239, 61.8%).

Diagnostic error by surgical phase of care

More diagnostic errors occurred in the postoperative phase of care (n = 171, 44.2%) than in the pre- (n = 127, 32.8%) or intraoperative (n = 120, 31.0%) phases of surgical care (Table 2). Diagnoses varied by surgical phase of care (Table 2). Cancer (mostly frequently lung and connective or soft-tissue primary cancer) was the most common diagnosis involving errors in the preoperative phase (n = 29, 22.8%). In the intraoperative phase, the diagnoses most often missed or delayed were injury during surgery (n = 25, 20.8%), misidentification of anatomy (n = 21, 17.5%), or a retained foreign body (n = 19, 15.8%). The most frequent diagnoses in the postoperative phase involved complications secondary to surgical injury, including failure to recognize subsequent clinical deterioration (e.g., failure to recognize hypotension as a symptom of septic shock), accounting for 62 (36.3%) postoperative cases. Postoperative gastrointestinal complications (e.g., bowel perforation, bowel obstruction) (n = 21, 12.3%) and progression or persistence of cancer (e.g., metastatic disease) (n = 18, 10.5%) were also common among postoperative missed or delayed diagnoses. Representative case examples for each of these diagnoses can be found in Table 2.

Table 1. Surgical diagnostic error cases by clinical setting, physician and patient

Characteristic	No. (%) of cases* n = 387
Clinical setting†	
Inpatient	237 (61.2)
Outpatient	121 (31.3)
Other	44 (11.4)
Physician‡	
Specialty	
General surgery	151 (39.0)
Gynecology	71 (18.3)
Orthopedic surgery	48 (12.4)
Urology	39 (10.1)
Plastic surgery	28 (7.2)
Other	69 (17.8)
Time since graduation, yr, median (IQR)	24 (15–35)
Age, yr, median (IQR)	49 (41–60)
Patient	
Age, yr, median (IQR)	52 (40–65)
Patient-reported gender§	
Woman	239 (61.8)
Man	147 (38.0)
ASA physical status	
ASA I	89 (23.0)
ASA II	135 (34.9)
ASA III	56 (14.5)
ASA IV or V	11 (2.9)
NA or not assignable	96 (24.8)

ASA = American Society of Anesthesiologists, IQR = interquartile range, NA = not applicable.

*Unless indicated otherwise.

†Some cases had more than 1 setting; therefore, the sum of frequencies does not equal 100%. Other settings included surgical day care units and emergency departments.

‡Some cases involved more than 1 physician; therefore, the number of physicians is greater than the number of cases. Other surgical specialties included neurosurgery, ophthalmology, otolaryngology, cardiac and thoracic surgery, and vascular surgery.

§Missing gender data for 1 case.

Table 2. Diagnosis by surgical phase of care with examples of diagnostic errors

Surgical phase of care and diagnosis	No. (%) of cases* *n* = 387
Preoperative	127 (32.8)
Cancer • Failure to review preoperative imaging leading to only partial removal of tumour and delayed diagnosis of invasive bladder cancer. • Failure to appreciate patient's changing symptoms between initial diagnosis of lipoma and surgery, resulting in failure to perform a biopsy preoperatively, leading to delayed diagnosis of leiomyosarcoma.	29 (22.8)
Gastrointestinal disease • Surgery performed for suspected cancer recurrence without awaiting preoperative pathology findings that identified scar tissue. This led to unnecessary surgery performed on a high-risk patient, ultimately resulting in their death.	17 (13.4)
Musculoskeletal and connective tissue disease • Wrong interpretation of imaging, thus incorrectly diagnosing patellofemoral pain syndrome as subluxation. • Failure to appreciate progressing symptoms of cauda equina syndrome while patient in hospital awaiting surgery, resulting in failure to expedite surgery. This left the patient with permanent neurologic deficits.	14 (11.0)
Genitourinary disease • Failure to perform imaging before surgery to confirm the absence of kidney stones, resulting in unnecessary surgery that was complicated by ureteric avulsion. • Wrong diagnosis of left-sided kidney stone due to failure to read radiology report that confirmed right-sided kidney stone, and instead relying on referral request, resulting in wrong-sided surgery.	12 (9.4)
Intraoperative	120 (31.0)
Injury during surgery • Failure to perform a rectal or vaginal exam after colposacropexy with mesh led to missed diagnosis of suture in rectum with subsequent suture erosion, resulting in rectovaginal fistula. • Failure to investigate source of bile contamination intraoperatively resulted in missed diagnosis of laceration to jejunum.	25 (20.8)
Misidentification of anatomy • Failure to obtain a laparoscopic critical view of safety led to the clipping and transection of the common bile duct rather than the cystic duct and cystic artery. This resulted in a missed diagnosis of intraoperative common bile duct injury. • Failure to identify the superior mesenteric artery resulted in a missed diagnosis of arterial injury and subsequent complete bowel ischemia.	21 (17.5)
Retained foreign body • Failure to perform a final sweep of the abdomen looking for sponges and ensure the count was correct before closing resulted in a missed diagnosis of retained surgical sponge.	19 (15.8)
Postoperative	171 (44.2)
Complications of surgical injury, including failure to recognize subsequent clinical deterioration • Failure to appreciate patient's ongoing hypotension and tachycardia postoperatively led to delayed imaging and delayed diagnosis of perforation of uterus and sigmoid colon, resulting in septic shock.	62 (36.3)
Gastrointestinal complications • Failure to appreciate persistence of tachycardia, increased leukocyte count, and abdominal pain on postoperative day 8 resulted in delayed diagnosis of bowel perforation. • Delayed diagnosis of gastric necrosis and subsequent failure to expedite surgery once diagnosis confirmed.	21 (12.3)
Progression or persistence of cancer • Surgeon failed to appreciate need for postoperative follow-up for patient with preoperative breast biopsy that showed high-grade ductal carcinoma in situ with one focus highly suspicious for microinvasion and a postoperative lumpectomy negative for cancer,despite pathologist recommending close follow-up. Patient subsequently developed ductal carcinoma. • Failure to order follow-up imaging 6–12 months after surgery resulted in delayed diagnosis of metastatic spread.	18 (10.5)
Genitourinary complications • Delay in diagnosis of ureteric injury when patient presented postoperatively with elevated creatinine, dilated ureter, and hydronephrosis, resulting in perforation of distal ureter and urinoma. • Failure to recognize priapism as an adverse effect of trazodone that was prescribed postoperatively and arrange a timely referral to a urologist.	17 (9.9)
Musculoskeletal and connective tissue complications • Failed to confirm on postoperative imaging that fracture was in good alignment, resulting in delayed diagnosis of fracture displacement. • Failed to obtain postoperative imaging before and after hardware removal to confirm healing, resulting in delayed diagnosis of fracture non-union and subsequent joint deformity.	15 (8.8)
Other postoperative complications • Delay in notifying final blood culture result for postoperative infection to patient or their family physician, resulting in treatment with the wrong antibiotics for 7 months and unnecessary surgeries and dressing changes.	16 (9.4)

*Frequency of diagnosis presented as a proportion of surgical phase.

Table 3. Contributing factors of surgical diagnostic error cases by provider, team, and system

Contributing factor*	No. (%) of cases† *n* = 387
Provider	317 (81.9)
Clinical decision-making (e.g., deficient assessment, failure to perform test or intervention, misinterpretation of a test result, failure to refer)	150 (47.3)
Failure to follow up on a complication	85 (26.8)
Loss of situational awareness (e.g., inadequate monitoring or follow-up, insufficient knowledge or skill, failure to review medical record, premature discharge)	74 (23.3)
Inadequate evaluation of a presenting condition or comorbidity	53 (16.7)
Procedural violations (e.g., deviation from clinical practice guideline, deviation in use of equipment, deviation from administrative procedure)	32 (10.1)
Team	194 (50.1)
Communication breakdown with the patient (e.g., inadequate consent process, inadequate communication at discharge, inadequate disclosure of error)	117 (60.3)
Documentation issues	105 (54.1)
Communication breakdown between physicians (e.g., inadequate handover of care)	22/ (11.3)
Communication breakdown with nonphysician providers	17 (8.8)
Coordination of care issues between physicians (e.g., breakdown in consultation process)	12 (6.2)
System	46 (11.9)
Resource issues (e.g., malfunctioning equipment, insufficient or unavailable resource, wait time issue)	21 (45.7)
Protocol, policy and procedure issues (e.g., inadequate facility administrative procedure, test result mix-up)	18 (39.1)
Office issues (e.g., health information technology issue)	11 (23.9)

*Some cases had more than 1 contributing factor; therefore, the sum of frequencies does not equal 100%.

†Frequency of contributing factor presented as a proportion of factor domain (provider, team or system).

Table 4. Surgical diagnostic error cases by patient harm and type of medico-legal matter

Characteristic	No. (%) of cases *n* = 387
Level of patient harm experienced	
Asymptomatic*	< 10
Mild	148 (38.2)
Moderate	97 (25.1)
Severe	58 (15.0)
Death	56 (14.5)
None	20 (5.2)
Harm unrelated to health care*	< 10
Type of medico-legal matter	
Threatened or realized civil legal action	211 (54.5)
Complaint to a regulatory authority	156 (40.3)
Complaint to a hospital	20 (5.2)

*Cell counts of fewer than 10 cases were suppressed for privacy reasons.

Contributing factors of surgical diagnostic errors by provider, team, and system

More than 80% of the factors contributing to diagnostic errors in these surgical cases were attributed to providers (*n* = 317, 81.9%) (Table 3); in nearly half of these cases (*n* = 150, 47.3%), the provider's clinical decision-making (e.g., deficient assessment, failure to perform a necessary test or intervention, misinterpretation of a test, failure to refer) was the most prevalent contributing factor based on peer expert criticism. Failure to follow-up on a complication (*n* = 85, 26.8%), loss of situational awareness (e.g., inadequate monitoring or follow-up, insufficient knowledge or skill, failure to review medical record, premature discharge from hospital) (*n* = 74, 23.3%), and inadequate evaluation of a presenting condition or comorbidity (*n* = 53, 16.7%) were additional contributing factors attributed at the provider level.

Half of the factors contributing to diagnostic errors were attributed to the health care team (*n* = 194, 50.1%). The most common contributing factors were communication breakdown with the patient (e.g., inadequate communication while obtaining informed consent, inadequate communication at discharge, inadequate disclosure of error) (*n* = 117, 60.3%) or between physicians (e.g., inadequate handover of care) (*n* = 22, 11.3%) and issues related to documentation (e.g., inadequate detail in documentation of care provided) (*n* = 105, 54.1%).

Finally, 46 (11.9%) of the factors contributing to diagnostic errors were attributed to the broader health care system, with resource issues (e.g., malfunctioning equipment, insufficient or unavailable resources, wait time issues) identified as the primary contributing factor in just under half of these cases (*n* = 21, 45.7%). The second most common contributing system factor in these cases was related to protocol, policy, and procedure issues (e.g., inadequate facility administrative procedure, test result mix-up).

Patient harm and type of medicolegal matter

In 368 (95.1%) cases, the harm experienced by the patient was associated with the diagnostic error; in only 12 (3.1%) cases was the patient harm deemed to be related to an inherent risk of health care provision (i.e., the underlying risk from undergoing a procedure in ideal conditions that is performed by qualified staff using evidence-based care). Just over 54% of patients (*n* = 211) experienced at least moderate harm, with 14.5% of cases (*n* = 56) resulting in death (Table 4). In nearly all (*n* = 362, 98.3%) of the 368 cases leading to patient harm associated with diagnostic error, peer experts were critical of the surgeon's care.

Slightly more than half of the 387 cases (*n* = 211, 54.5%) were threatened or realized legal civil actions, with the balance consisting of complaints to a regulatory authority (*n* = 156, 40.3%) and complaints to a hospital (*n* = 20, 5.2%) (Table 4); this distribution of medicolegal matters is similar for all surgical cases over the study period, for which the distribution was 48.6%, 45.3%, and 6.1%, respectively.

Discussion

In this study of medicolegal cases and complaints, we found that diagnostic error occurred in most surgical disciplines and across all 3 phases of surgical care (pre-, intra-, and postoperative care). More errors occurred in the postoperative phase of care than in the pre- or intraoperative phases. More than 80% of factors contributing to errors were attributed to providers, with clinical decision-making being the primary contributing factor. Half were attributed to health care team factors, the most common of which was communication breakdown. More than half of patients involved in a surgical diagnostic error experienced at least moderate harm, with 1 in 7 cases resulting in patient death. By using a national database of closed medicolegal cases and complaints representing nearly all Canadian physicians, our study provides insight into the characteristics of surgical diagnostic error at a national level.

To date, most research in diagnostic errors has focused on nonsurgical specialties such as internal medicine,[5,6] emergency medicine,[7,8] and primary care.[9,10] Although the provision of surgical care involves an essential technical component, comprehensive surgical care across the pre-, intra-, and postoperative settings includes several components of the diagnostic process described by the National Academy of Medicine.[1] For instance, the timely and accurate review of pathology results before surgery, diagnosis and treatment of intraoperative injury, and identification and management of postoperative sepsis all fall under the purview of the diagnostic process. Previous work in this area has focused on general surgery,[14] rather than all surgical disciplines, and has explored the relative incidence of diagnostic error in surgery compared with other disciplines. Malpractice claims data from the United States estimates that 13% of surgical claims are related to errors in diagnosis.[15] This is similar to our finding that 16.4% of the total surgical claims that closed over the study period involved a diagnostic error.

More than 80% of the factors contributing to diagnostic errors were attributed to providers, with clinical decision-making being the principal contributing factor. Although the importance of cognitive errors in diagnosis has been well studied — particularly cognitive errors associated with failures in perception, failed heuristics, and cognitive biases[16] — how these contribute to diagnostic error in surgery is not nearly as well described. A systematic review that defined and studied errors in surgical care found that there was inadequate literature on judgment errors, unlike, for example, medication errors or technical errors.[17] The authors of this review go on to propose that judgment errors should ideally be their own category of error in surgical care as they do not neatly fit into any other error category. Surgical care often requires the unique ability to make rapid, split-second decisions to save a patient's life, limbs, or vital organs. Although this skillset is essential for surgeons, it is also this type of decision-making that is most vulnerable to faulty heuristics and cognitive error.[18]

Other studies support the need for emphasis on decision-making errors in surgery. In a surgical quality improvement study involving more than 5000 operations, 56% of all adverse events were attributed to human error, of which cognitive error accounted for more than half of the human performance deficiencies.[19] Thus, patient safety efforts in surgery should also target improvements in surgical clinical decision-making. Additional research should identify what strategies could help to overcome cognitive errors in surgery. For example, it will be essential to determine what, if any, context-specific strategies are needed for the unique practice of surgical care, rather than the adoption of existing general strategies that have been suggested for other medical specialties.[20,21] Some such general strategies could include seeking feedback on diagnostic decisions, integrating brief diagnostic challenges into one's daily routine, considering cognitive biases, fostering critical thinking skills, and integrating the expertise of other health professionals, patients, and families.[22,23] Future work can inform a more comprehensive understanding of diagnostic error in surgery using well-established measurement approaches, such as electronic trigger tools that can identify patients at high-risk for diagnostic error so that their medical records can be selectively reviewed.[24–27]

We found that the most common factor contributing to diagnostic errors that was attributed to the broader health care team was breakdown in communication with the patient. In fact, communication breakdown is an integral component of the National Academy of Medicine's definition of diagnostic error.[1] Breakdowns in communication and information transfer are a common cause of surgical errors and adverse events.[28,29] In an analysis of communication breakdowns resulting in injury to surgical patients, the distribution of such breakdowns occurred fairly evenly across the pre-, intra-, and postoperative periods.[30] These authors found that ambiguity about responsibilities and communication between clinical team members of asymmetric status (e.g., between attending physician and medical student) was commonly associated with communication breakdowns resulting in surgical harm. Interventions intended to improve teamwork[29,31] or standardize communication using checklists, proformas, and information technology[28,32] have shown potential to improve surgical communication.

Limitations

As we analyzed closed medicolegal data, our data likely biased toward those errors that resulted in patient complaints and legal action, potentially leading to a higher degree of patient harm and an underestimate of system issues than that of the surgical population at-large. However, unlike most closed malpractice claims studies that

include only those cases resulting in paid claims, 45% of the cases included in our study were complaints to a regulatory authority or hospital, rather than legal action, thus providing a different lens through which to understand these errors. Given the retrospective nature of our analysis and the involvement of peer expert opinion in our coding, our results are susceptible to hindsight and outcome bias. In addition, we can report only on associations and not causal links between physicians, setting characteristics, and diagnostic errors.

Conclusion

We found that diagnostic error occurred in most surgical disciplines and across all 3 phases of surgical care (pre-, intra-, and postoperative care). More than half of patients involved in a diagnostic error in surgery experienced at least moderate harm, with 1 in 7 cases resulting in death. Given that a substantial proportion of these errors were unique to the care of surgical patients, additional research is needed to characterize epidemiology and explore potential solutions specific to surgical disciplines. The primary factors contributing to these errors were clinical decision-making and communication breakdown; identifying and evaluating novel interventions to reduce cognitive errors and improve communication in the surgical environment are important next steps in addressing diagnostic error in surgery.

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Competing interests: Lisa Calder, Cara Bowman, Anna MacIntyre, Richard Mimeault, Liisa Honey, Cynthia Dunn, and Gary Garber are employees of the Canadian Medical Protective Association. Lisa Calder is board chair with Salus Global and sits on the board of the Medical Professional Liability Association. Gary Garber reports funding from the Canadian Institutes of Health Research. Hardeep Singh reports funding from the Department of Veterans Affairs, the Veterans Affairs National Center for Patient Safety, and the Agency for Healthcare Research and Quality. Hardeep Singh serves as co-chair of the Leapfrog Diagnostic Excellence Advisory Group. The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs or the United States government. No other competing interests declared.

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