

COMPLICATIONS ON A GENERAL SURGERY SERVICE: INCIDENCE AND REPORTING

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OBJECTIVES: To determine the incidence and nature of complications on a general surgery service and to compare these results with pre-existing institutional recording and reporting methods.

DESIGN: A single observer prospectively monitored the presence and documentation of complications for all patients admitted to the general surgery service at the Wellesley Central Hospital over a 2-month period, through daily chart reviews, attendance at rounds and surgical operating rooms, frequent patient visits on the ward and interviews with the health care team.

SETTING: The general surgery service of an urban, university-affiliated teaching hospital.

PATIENTS: One hundred and ninety-two general surgery inpatients over 1277 patient-days from June 16, 1996, until Aug. 15, 1996. Same-day surgery patients were not included.

RESULTS: Seventy-five (39%) of the 192 patients suffered a total of 144 complications. Two complications (1%) were fatal, 10 (7%) were life threatening, 90 (63%) were of moderate severity and 42 (29%) were trivial. Of these 144 complications, 26 (18%) were deemed potentially attributable to error. One hundred and twelve (78%) of the complications occurred during or after a surgical operation and were related directly or indirectly to it. Only 9 (6%) complications were not documented in the progress notes of the patients' charts. However, 115 (80%) were not presented at weekly morbidity and mortality rounds, and 95 (66%) were not documented on the face sheet of the patients' final medical records.

CONCLUSIONS: Complications are common and are underreported by traditional methods. Since hospital funding and quality improvement efforts depend on accurate identification and recording of adverse events, strategies to improve the recording and reporting of complications must be developed.

OBJECTIFS : Déterminer l'incidence et la nature des complications dans un service de chirurgie générale et comparer ces résultats aux méthodes antérieures de consignation et de production de rapports de l'établissement.

CONCEPTION : Un seul observateur a suivi de façon prospective la présence et la documentation des complications chez tous les patients admis au service de chirurgie générale de l'Hôpital Wellesley Central pendant deux mois en étudiant les dossiers quotidiens, en participant aux visites, en assistant aux interventions chirurgicales, en visitant fréquemment les patients en salle et en interviewant les membres de l'équipe de soins.

CONTEXTE : Service de chirurgie générale d'un hôpital d'enseignement urbain affilié à une université.

PATIENTS : Cent quatre-vingt-douze patients hospitalisés en chirurgie générale pendant 1277 jours-patients, du 16 juin au 15 août 1996. On n'a pas inclus les patients en chirurgie de jour.

RÉSULTATS : Soixante-quinze (39 %) des 192 patients ont subi 144 complications au total, dont deux (1 %) ont été mortelles, 10 (7 %) ont menacé la vie, 90 (63 %) ont été de gravité moyenne et 42 (29 %) ont été bénignes. De ces 144 complications, 26 (18 %) auraient pu être attribuées à une erreur. Cent douze (78 %) des complications se sont produites pendant ou après une intervention chirurgicale et étaient liées directement ou indirectement à celle-ci. Seulement 9 (6 %) des complications n'ont pas été documentées dans les notes sur les progrès des patients consignées dans le dossier de ceux-ci. Cependant, 115 (80 %) n'ont pas été présentées au cours des consultations hebdomadaires sur la morbidité et la mortalité et 95 (66 %) n'étaient pas documentées sur la première feuille du dossier médical final des patients.

CONCLUSIONS : Les complications sont fréquentes et sont insuffisamment signalées au moyen des méthodes traditionnelles. Comme le financement des hôpitaux et les efforts d'amélioration de la qualité dépendent de la description exacte et de la consignation des événements indésirables, il faut élaborer des stratégies afin d'améliorer la consignation des complications et la production de rapports à ce sujet.

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Complications of hospitalization and surgery are potentially controllable factors that contribute to the high cost of medical care, and patient morbidity and mortality.¹⁻¹³ Although complications may reflect the risk associated with modern medical care,³ errors are not inevitable.¹⁴ An important task in improving the quality of health care is to identify, monitor and record the incidence and nature of complications, to develop methods for prevention.^{12,13} In addition, audits, research and hospital reimbursement depend on accurate identification and coding of clinical diagnoses, complications and procedures.¹⁵

We undertook a prospective study to determine the incidence and nature of complications on a general surgery service. We also determined the reliability with which these findings were reported by traditional methods already functioning at our hospital: documentation in the progress notes of the patient's chart, presentation at weekly morbidity and mortality rounds and documentation on the face sheet of the patient's permanent medical record.

STUDY DESIGN

Patients

We identified all patients admitted or transferred to the Wellesley Central Hospital, general surgery service, from June 16, 1996, until Aug 15, 1996. At the time of this study, the general surgery service was divided between 2 hospital sites. Minor elective and short-stay procedures done at the smaller site were not included in this audit. We monitored prospectively all complications through daily chart reviews, attendance at rounds and surgical operating rooms, frequent patient visits and interviews with staff surgeons, residents, nurses and other health care staff.

Each patient admitted to the Wellesley Central Hospital general surgery service was followed up immediately on admission. Patients hospitalized before June 16 were followed up only from that date on. Complications that occurred before then or after Aug. 15 were excluded.

Data record and definition of terms

Our definitions depended to some extent on the judgement of the observer and, therefore, had a subjective component. We defined a complication as an unintended, adverse outcome that occurred after medical management or a surgical procedure, was not caused by the underlying disease and resulted in impaired health. Impaired health broadly included physical and mental well-being. A separate data record was completed for each complication. The record comprised the specific complication, demographic information, admission and discharge data, operative interventions (if any), and recording and reporting accuracy.

If a complication occurred during or after an operation, the procedure was defined as elective, urgent (i.e., at the earliest available time) or emergency (i.e., within 24 hours of surgical consultation). The American Society of Anesthesiologists (ASA) preoperative risk scores were recorded from the anesthesiologists' notes. Each adverse event was then classified as directly related to the operation (e.g., intraoperative hemorrhage), indirectly related to the operation (e.g., urinary infection due to catheterization) or unrelated (e.g., medication error).

Each complication was allocated to one of the following categories: death; surgical incision; infection; hemorrhage; related to a catheter or drain; a systemic disorder of respiratory, cardiovascular, gastrointestinal, genitourinary or central nervous system origin; medication error; or miscellaneous.

The severity of a complication was defined as "fatal" if no other cause of death could be ascertained; life threatening if life support (i.e., hemodialysis, mechanical ventilation, cardiac pacing, hemodynamic support) or emergency surgery was required to resuscitate the patient; moderate if other therapy was required (e.g., intravenous antibiotics); or trivial if it affected only physical or emotional comfort. Error was defined as an unintended act of omission or commission, or an act that did not achieve its intended immediate outcome.⁷ Each error was classified as an error in diagnosis, treatment, communication, or equipment/systems failure.

We anticipated that members of the surgical team might disagree in designating an adverse event as a complication. To avoid bias toward increasing our numbers by detecting more complications, we erred on the side of the responsible physician and did not ascribe a complication if there was disagreement among the investigators or clinicians. If disagreement among investigators arose, the final decision was made by the medical student in order to reduce potential bias on the part of the staff surgeon.

We recorded whether each complication was noted in the progress notes of the patient's chart, and if so by whom (physician or nurse, or both), whether it was reported at weekly morbidity and mortality rounds, and whether it was recorded on the face sheet of the final medical record. It is a requirement on our general surgery service that all deaths and complications be presented at morbidity and mortality rounds. The face sheet documents admission diagnoses, operative procedures and complications of illness and therapies that occur in hospital. Diagnoses and events are written on the face sheet by physicians and further completed and coded by health records personnel.

Statistical analysis

Complications were reported as incidences per patient-days in hospital and per patient. To compare the frequencies of complication recording by our database versus the those on the face sheet and at morbidity and mortality rounds, we used standard tests of comparisons of proportions, both parametric and nonparametric, depending on sample sizes.

RESULTS

Frequency and nature of complications

One hundred and ninety-two patients were observed over 1277 patient-days. Seventy-five patients (39%) suffered a total of 144 complications. Table I illustrates the incidence, type, and severity of the recorded complications. Of the 75 patients, 47 (63%) suffered from a single complication, 26 (35%) suffered between 2 and 9 complications, and 2

patients had 10 complications each. Forty-one (44%) of 93 male patients suffered a total of 89 complications, whereas 34 (34%) of 99 female patients suffered 55 complications. Twenty-seven (37%) of 73 patients admitted electively or through clinic and office visits suffered a complication, as did 35 of 101 patients admitted through the emergency room and 13 (72%) of 18 patients transferred as emergencies from other hospitals ($p < 0.001$).

Of the 192 patients followed up during the study interval, 171 (89%) had operations during their hospitalization. Sixty-two (36%) patients suffered complications which made up 120 (83%) of the 144 complications overall. Thirty-six complications (30%) were directly related to the operation, 76 (63%) were indirectly related and 8 (7%) were not related to the surgical procedure. Of 137 patients who underwent an elective operation, 37 (27%) suffered a complication compared with 25 (74%) of 34 patients who had urgent or emer-

gency operations ($p < 0.001$). Twelve (21%) of 57 patients with a preoperative ASA score of 1 had a complication, whereas 50 (45%) of 112 patients with an ASA of 2 or greater had a complication ($p < 0.001$). ASA scores were not recorded on the operative records of 2 patients.

The most common complications were respiratory and those pertaining to the surgical incision (Table I). In total, 2 complications (1%) were fatal, 10 (7%) were life threatening, 90 (63%) were of moderate severity, and 42 (29%) were trivial. Twenty-six of the complications (18%) were judged to have resulted potentially from error. Twenty of them were considered to be the result of a single error type, the remaining 6 being caused by 2 simultaneous error types, for a total of 32 errors (Table II).

Reporting of complications

Of the 144 complications, 9 (6%) were not documented in patients' charts. The undocumented complica-

Table I

Incidence, Nature and Severity of Complications on a General Surgery Service

Type of complication	Complications (n = 144)	
	No. (and %)	No. of serious consequences*
Respiratory	23 (16.0)	3
Surgical wound	17 (11.8)	0
Genitourinary	16 (11.1)	1
Gastrointestinal	14 (9.7)	2
Catheter drain	14 (9.7)	0
Cardiovascular	9 (6.3)	4
Central nervous system	9 (6.3)	0
Sepsis	5 (3.5)	0
Medication error	3 (3.1)	0
Hemorrhage	2 (1.4)	0
Death†	2 (1.4)	2
Other/miscellaneous	30 (20.8)	0

*Refers to the number of life-threatening or fatal complications.
†Associated with multiple organ dysfunction syndrome secondary to infection.

Table II

Incidence Severity and Specific Types of Error*

Types of error	Errors No. (and %)	Degree of severity,† no. of patients			
		1	2	3	4
Diagnosis	9 (28)	3	6	0	0
Misdiagnosis	5 (16)	2	3	0	0
Late diagnosis	4 (13)	1	3	0	0
Treatment	23 (72)	9	11	3	0
Incorrect treatment plan	4 (13)	1	1	2	0
Delay in treatment	1 (3)	1	0	0	0
Medication error	5 (16)	3	2	0	0
Error in monitoring patient	2 (6)	1	1	0	0
Error in invasive procedure	3 (9)	0	3	0	0
Technical error in operation	8 (25)	2	4	1	0
Total	32 (100)	12	17	3	0

*There was no faulty communication and there were no equipment or systems failure errors.
†1 = trivial, 2 = moderate, 3 = life threatening, 4 = fatal.

tions were of no greater severity than moderate. Table III outlines the documentation of complications by physicians and nurses. In weekly morbidity and mortality rounds, only 29 (20%) of the 144 complications were presented. Five of 10 life-threatening and 1 of the 2 fatal complications were omitted (Table IV). Of the 26 complications that were attributed to error, 13 were discussed at the weekly rounds.

Ninety-five (66%) of 144 complications were not documented on the face sheet of the final medical record. Included in this number are 5 of 10 complications deemed life threatening (Table V). Health records personnel documented an additional 9 complications that we did not detect.

COMMENT

Early in the 20th century, Codman¹⁶ asserted that medical and surgical results should be monitored. Although a formidable task, it has been suggested that this objective can be met most economically by the concentration on complications, in which the most important lessons lie.¹

Incidence and severity

Over one-third of our patients suffered at least 1 complication. This incidence appears high but is difficult to compare meaningfully with reported

complication rates from different institutions because of a lack of uniform definitions and patient populations.¹⁷ For example, in one study of general medical patients, a 5% complication rate was found,¹⁸ in contrast to another study that reported a 36% complication rate in a similar patient population.⁶ Our finding of so many complications may be explained by the prospective nature of this study; our intense daily investigation for all types of complications; the exclusion of patients who underwent a same-day elective procedure who presumably suffer fewer complications; and underlying patient conditions. We do not believe that the incidence of complications implies substandard care. For example, although it might raise concern that 36% of patients suffered postoperative complications, two-thirds of those complications were related to the operation only indirectly, having occurred remote from the operative site after operation, such as postoperative pneumonia in a patient with chronic lung disease. The influence of underlying conditions was reflected by the higher incidence of postoperative complications occurring in patients with higher preoperative ASA scores.

Our results confirm previous observations that errors in patient care are not uncommon.^{7,14} Nearly one-fifth of our complications were attributed, at

least in part, to error. It has been shown previously that more errors occur than are actually detected since most errors do no harm.⁷ Thus, we may have underestimated the incidence of error in our study population. Studies in other areas of human endeavour, such as the generation of nuclear power, shipping and the airline industry, confirm that some degree of error is inherent in all human activity.² Given the complex nature of medical practice and paucity of systems designed to prevent error, a high error rate is disturbing but not surprising.

Prevention of error is an important link between clinical quality improvement and risk management, including prevention of legal actions. The 2 most common error types found in our study, diagnostic errors and technical errors during operation, have been found to be the 2 most common premises for medicolegal action against general surgeons.¹⁹ Documenting, understanding and reducing the incidence of errors should diminish the potential for legal action — a strong rationale for developing systems that will provide accurate recording and improvement with respect to clinical outcomes and complications.

Identifying the patients at high risk for complications should provide a focus for improvement efforts. We found that patients transferred as emergencies from other hospitals suf-

Table III

Documentation of Complications in Patients' Permanent Medical Record

Type of documentation	No. (and %)
Documented in chart	135 (94)
By physician and nurse	65 (45)
By physician only	53 (37)
By nurse only	17 (12)
Not documented in chart	9 (6)
Total	144 (100)

Table IV

Complication Severity and Reporting at Rounds

Complication severity	Total no.	Presented at rounds, no. (and %)
Fatal	2	1 (50)
Life threatening	10	5 (50)
Moderate	90	21 (23)
Trivial	42	2 (5)
Total	144	29 (20)

Table V

Complication Severity and Documentation on the Face Sheet of the Patient's Permanent Medical Record

Complication severity	Total no.	On face sheet, no. (and %)
Fatal	2	2 (100)
Life threatening	10	5 (50)
Moderate	90	37 (41)
Trivial	42	6 (14)
Total	144	95 (66)

ferred a significantly greater proportion of the complications, exemplified by 2 of our transfer patients, who suffered a total of 10 complications each. As reported by others, higher preoperative ASA scores, old age and nonelective operations were associated with a greater risk of complications.⁹

Reporting and documentation of complications

The documented incidence of complications is used to measure the quality of care.^{17,20,21} The reliability of such information is critical to its value for monitoring and improving the quality of health care. We determined the accuracy of documentation of complications in the progress notes, morbidity and mortality rounds and the hospital face sheets by comparing these methods with the records of our study observer. Our data revealed a high efficiency of documentation of complications in the patients' daily progress notes. However, at weekly morbidity and mortality rounds, 80% of complications were not presented, including half the complications that were life threatening or fatal and half the complications attributed to physician error. The reasons for these omissions were not determined, but we did not detect any reluctance of surgical staff or housestaff to discuss complications. We believe that the lack of an effective system to record and present complications explains the poor compliance with the requirement that all complications be presented.

Over the past 2 years, Health Records Department reports, derived from the face sheets of patients' charts, have recorded 14% to 17% complication rates for patients on the general surgery service. The discrepancy between these lower rates and our observed incidence of complications is explained in part by deficient recording of complications on the face sheets. If our results apply to other

health care institutions, the accuracy of information derived from health records data is questionable. Since documentation on the face sheet is used for clinical audits, outcomes research and hospital funding allocations, health care institutions must develop systems that improve on the performance of these functions by clinical and health records workers.

CONCLUSIONS

Hospitalization and medical care incur risks to patients. Despite the dictum: "first, do no harm," there is a high prevalence of complications. Preventing these complications is important to improve the quality of care and reduce costs. It has been estimated that preventable adverse events cost the United States over \$10 billion in a year.³ To improve our ability to monitor and prevent complications we must develop systems that identify and record them more efficiently.

References

1. Couch NP, Tilney NL, Rayner AA, Moore FD. The high cost of low-frequency events: the anatomy and economics of surgical mishaps. *N Engl J Med* 1981;304:634-7.
2. Leape LL, Brennan TA, Laird N, Lawthers AG, Localio AR, Barnes BA, et al. The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *N Engl J Med* 1991;324:377-84.
3. Leape LL, Lawthers AG, Brennan TA, Johnson WG. Preventing medical injury. *Qual Rev Bull* 1993;19:141-9.
4. Brennan TA, Leape LL, Laird NM, Herbert I, Localio AR, Lawthers AG, et al. Incidence of adverse events and negligence in hospitalized patients. Results of the Harvard Medical Study I. *N Engl J Med* 1991;324:370-6.
5. Bedell SE, Deitz DC, Leeman D, Delbanco TL. Incidence and characteristics of preventable iatrogenic cardiac arrests. *JAMA* 1991;265:2815-20.
6. Steel K, Gertman PM, Crescenzi C, Anderson J. Iatrogenic illness on a general medical service at a university hospital. *N Engl J Med* 1981;304:638-42.
7. Leape LL. Error in medicine. *JAMA* 1994;272:1851-7.
8. Couch NP, Tilney NL, Moore FD. The cost of misadventures in colonic surgery: a model for the analysis of adverse outcomes in standard procedures. *Am J Surg* 1978;135:641-6.
9. Dubois RW, Brook RH. Preventable deaths: Who, how often, and why? *Ann Intern Med* 1988;109:582-9.
10. Schimmel EM. Hazards of hospitalization. *Ann Intern Med* 1964;60:100-10.
11. McLamb JT, Huntley RR. The hazards of hospitalization. *South Med J* 1967;60:469-72.
12. Friedman M. Iatrogenic disease: addressing a growing epidemic. *Postgrad Med* 1982;71:128-9.
13. Barr DP. Hazards of modern diagnosis and therapy: the price we pay. *JAMA* 1965;159:1432-6.
14. Wu AW, Folkman S, McPhee SJ, Lo B. Do house officers learn from their mistakes? *JAMA* 1991;265:2089-94.
15. Hsia DC, Ahern CA, Ritchie BP, Moscoe LM, Krushat WM. Medicare reimbursement accuracy under the prospective payment system, 1985 to 1988. *JAMA* 1992;268:896-9.
16. Codman EA. The product of a hospital. *Surg Gynecol Obstet* 1914;18:491-6.
17. Fleming ST. Complications, adverse events, and iatrogenesis: classifications and quality of care measurement issues. *Clin Perform Qual Health Care* 1996;4:137-47.
18. Lakshmanan MC, Hershey CO, Breslau D. Hospital admissions caused by iatrogenic disease. *Arch Intern Med* 1998;158:431-7.
19. Kern KA. The anatomy of surgical malpractice claims. *Bull Am Coll Surg* 1995;80:34-49.
20. Hunter D, Bains N. Rates of adverse events among hospital admissions and day surgeries in Ontario from 1992 to 1997. *CMAJ* 1999;160:1585-6.
21. Iezzoni LI, Daley J, Heeren T, Foley SM, Hughes JS, Fisher ES, et al. Using administrative data to screen hospitals for high complication rates. *Inquiry* 1994;31:40-55.