Is Unplanned Return to the Operating Room a Useful Quality Indicator in General Surgery?

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Hypothesis: To test our hypothesis that unplanned return to the operating room (OR) is a useful quality indicator, we examined how often and for what reasons patients go back to the OR in a broad-based general surgery practice.

Design and Setting: Prospective cohort study at a rural tertiary care center.

Patients: Consecutive series of 3044 patients undergoing general surgery procedures in the OR between September 1, 1998, and March 31, 2000. Information about all postoperative adverse events occurring before discharge or within 30 days (whichever was longer) was collected prospectively. Unplanned return to the OR was defined as any secondary procedure required for a complication resulting directly or indirectly from the index operation.

Main Outcome Measures: Unplanned return to the OR, mortality, and hospital charges.

Results: Overall, 107 (3.5%) had an unplanned return to the OR. A relatively small number of inpatient procedures accounted for a disproportionate share of unplanned reoperations, including colon resection (18% of total reoperations), renal transplant (9%), gastric bypass (6%), and pancreatic resection (6%). As expected, hospital charges were markedly higher for patients with unplanned returns to the OR. Reoperation was also associated with higher mortality rates; statistically significant increases were noted for pancreatic resection (33% vs 3.7%; P=.04), esophagogastrectomy (100% vs 4.2%; P=.002), and laparoscopic Nissen fundoplication (50% vs 0%; P=.01). Overall, 91 reoperations (85%) were for complications occurring at the original surgical site, including those related to an anastomosis (n=16), surgical wound (n=21), infection (n=16), bleeding (n=12), and other (n=26).

Conclusions: Unplanned returns to the OR occur across a broad spectrum of general surgical procedures and carry significant implications. Because they most often reflect problems related to the procedure itself, reoperation rates may be useful for monitoring quality across hospitals and for identifying opportunities for quality improvement locally.

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AFTER the release of an Institute of Medicine report on medical errors,1 there has been considerable focus on the large number of hospitalized patients experiencing preventable adverse events.2 A large proportion of such events occur in surgical patients. For example, in large studies of hospitalized patients in New York State, Utah, and Colorado, 48% to 66% of all adverse events were related to surgery and of these, more than half were “preventable.”3,4 There is general consensus that quality improvement efforts aimed at reducing the incidence of adverse events require that such events be measured systematically and tracked prospectively. Unfortunately, appropriate measures in general surgery practice are lacking; mortality is rare for most procedures, and nonfatal complications are often too procedure specific to be useful across the heterogeneous range of general surgical procedures.

See Invited Critique at end of article

One potentially useful quality indicator may be rates of unplanned return to the operating room (OR). This event is more common than mortality for most general surgery procedures. It may occur (for different reasons) after almost any procedure and thus is broadly applicable. Compared with other potential broad-based quality measures (eg, wound infection), unplanned reoperations are relatively nondiscretionary (patients generally go back to the OR only if they really need to) and relatively discrete events. Similarly, they are easily tracked with administrative data. For all these reasons, unplanned return to the OR has been sug-
SUBJECTS AND METHODS

OVERVIEW AND STUDY POPULATION

Since September 1, 1998, the general surgery section at Dartmouth-Hitchcock Medical Center in Lebanon, NH, has maintained a prospective registry of all adverse events occurring after general surgical procedures performed in the OR (excluding minor surgery). All patients are followed up postoperatively until hospital discharge or 30 days (whichever is later). Information about adverse events is collected by nurse clinicians, generally in the process of clinical care. Complications are recorded according to preset definitions, modified slightly from those used by the VA National Surgical Quality Improvement Program. Coding controversies are arbitrated by a clinical end-points committee, consisting of 2 attending surgeons and 2 nurses blind to patient and surgeon identifiers. Data from the registry are compiled on a regular basis and used in multiple contexts: practice management and quality improvement (eg, confidential feedback regarding performance to attending surgeons); education (eg, part of a weekly morbidity and mortality conference); and clinical research.

In this study, we examined rates of unplanned reoperation in 3044 patients undergoing index general surgical procedures (defined by the presence of an attending general surgeon) between September 1, 1998, and March 31, 2000. For subgroup analysis, patients were sorted according to their primary general surgery procedure using clinically appropriate groupings of Current Procedural Terminology codes. Data pertaining to patient age, sex, and acuity are obtained from our hospital information systems. Our system allows for 4 procedure acuity levels (scheduled, urgent, emergent, and trauma), which are coded at the time surgery is booked into the OR system. Because few procedures were coded as urgent or trauma-related (only 2%), we collapsed the last 3 acuity levels as “nonelective.” To link postoperative outcomes with a primary general surgical procedure, we excluded 63 patients undergoing immediate free flap breast reconstruction after mastectomy.

OUTCOME DEFINITIONS AND ANALYSIS

We defined unplanned return to the OR, our primary outcome measure, as any secondary procedure required for a complication occurring directly or indirectly from the index operation. Thus, we did not count reoperations intended at the time of the index procedure (eg, planned “second look” operation for mesenteric ischemia) or follow-up procedures not related to a clinical complication (eg, placement of indwelling venous access catheter for adjuvant chemotherapy after uneventful colectomy for cancer). We excluded reoperations not felt to represent deviations from standard care (ie, breast lumpectomy following excisional biopsy with positive margins). Patients with multiple returns to the OR (eg, wound debridements) were counted only once.

The causes of unplanned reoperations were categorized retrospectively by one attending surgeon into 5 exclusive groups: (1) bleeding, (2) infection, (3) wound-related, (4) anastomosis-related, and (5) other. For ambiguous cases (eg, more than 1 potential indication for reoperation), the primary cause was decided by a clinical end-points committee.

Information regarding hospital charges was obtained from our accounting office. Mortality data were collected prospectively as part of the registry but confirmed by data from hospital information systems. We used simple proportions to describe the incidence of unplanned return to the OR, the primary goal of our analysis. For between-group comparisons (eg, patients with and without reoperation), we used t tests to assess statistical significance for continuous measures and χ^2 tests for categorical data.

Table 1. Characteristics of Patients With and Without Unplanned Returns to the Operating Room

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patients With Unplanned Reoperations (n = 107)</th>
<th>Patients Without Unplanned Reoperations (n = 2937)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age, y</td>
<td>53.9</td>
<td>53.1</td>
<td>.62</td>
</tr>
<tr>
<td>Male, %</td>
<td>54</td>
<td>44</td>
<td>.97</td>
</tr>
<tr>
<td>Admission acuity, %</td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Elective</td>
<td>52</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Nonelective</td>
<td>48</td>
<td>26</td>
<td></td>
</tr>
</tbody>
</table>

Of 3044 patients undergoing general surgical procedures, 107 (3.5%) experienced an unplanned return to the OR. Patients with and without unplanned reoperations did not differ with respect to age or sex (Table 1). Patients undergoing nonelective index procedures were more likely to go back to the OR than patients undergoing elective surgery, primarily because they were more likely to have undergone abdominal procedures. However, acuity was not an independent risk factor: reoperation rates with colectomy, small bowel resection, and renal transplant (the only 3 procedures with sufficient numbers for analysis) did not differ significantly after elective and nonelective surgery (Table 2).

RESULTS

INCIDENCE

Of 3044 patients undergoing general surgical procedures, 107 (3.5%) experienced an unplanned return to the OR. Patients with and without unplanned reoperations did not differ with respect to age or sex (Table 1). Patients undergoing nonelective index procedures were more likely to go back to the OR than patients undergoing elective surgery, primarily because they were more likely to have undergone abdominal procedures. However, acuity was not an independent risk factor: reoperation rates with colectomy, small bowel resection, and renal transplant (the only 3 procedures with sufficient numbers for analysis) did not differ significantly after elective and nonelective surgery (Table 2).
Unplanned reoperations occurred following 32 different types of index operations. However, 7 procedures accounted for almost half (47%) of unplanned returns to the OR (Figure 1). The single procedure accounting for the largest proportion (18%) of reoperations was colectomy, of which most were elective. In terms of incidence rates, however, renal transplant and pancreatic resection procedures were most likely to result in unplanned returns to the OR (26% and 18%, respectively) (Table 3). In contrast, laparoscopic fundoplication was associated with unplanned reoperation in only 2.4% of cases (Table 3).

**IMPACT OF REOPERATIONS ON MORTALITY AND CHARGES**

Overall, mortality rates in patients experiencing unplanned reoperations were significantly higher than in patients who did not return to the OR (15.9% vs 2.3%; P<.001) (Table 3). Because sample sizes were relatively low for individual procedures, however, statistically significant increases were noted only for pancreatic resection (33% vs 3.7%; P=.04), esophagogastrectomy (100% vs 4.2%; P=.001), and laparoscopic Nissen fundoplication (50% vs 0%; P=.01). As expected, total hospital charges were markedly higher for patients with unplanned returns to the OR ($82300 vs $17700 without reoperation, P<.001). Unplanned reoperation was associated with increased charges for most individual procedures (Figure 2).

**REASONS FOR REOPERATION**

Of 107 total unplanned reoperations, 91 (85%) resulted from problems at the original surgical site (Table 4). Of these, 16 (18%) were performed for problems related to an anastomosis, and 21 (23%) were for wound complications (including deep wound infection and dehiscence). As given in Table 4, however, indications for unplanned reoperation were highly procedure specific. Infection and abscess were most likely to cause return to the OR for pancreatic resection, while wound complications were the most common indication for reoperation after gastric bypass. The remaining 16 unplanned reoperations were attributable to clinical complications related only indirectly to the index procedure (tracheostomy, 3; gastrostomy tubes, 1; pressure sores, 4; and other, 8).
In this prospective cohort study, we found that unplanned returns to the OR are relatively common in general surgery practice, occurring after more than 3% of procedures. Previous estimates of the incidence of unplanned reoperations vary markedly. One population-based study in Australia reported an incidence of only 0.6% for all surgical procedures. However, this study was not restricted to general surgery and relied on voluntary reporting by hospitals, likely explanations for the low incidence of reoperations. In contrast, in the VA health system, 9.4% of patients returned to the OR within 30 days. Unlike ours, however, this VA study did not restrict their analysis to unplanned reoperations occurring as a result of a complication of the index procedure. Moreover, their study population was limited to patients undergoing major procedures and not restricted to general surgery.

Although a large proportion occurred in a relatively small number of inpatient procedures, reoperations occurred following a broad spectrum of general surgery procedures, with important implications for costs and, in some cases, mortality. These findings suggest that tracking rates of unplanned return to the OR may be useful in 2 ways: (1) at the local level, for identifying opportunities for quality improvement, and (2) at the policy level, as a broad-based indicator of surgical quality across hospitals.

As part of quality improvement efforts at our hospital, information from the clinical registry of adverse events is routinely incorporated into our weekly morbidity and mortality conference. We review procedure-specific complication rates (including unplanned reoperation) against external benchmarks (when available) and examine trends over time. This process frequently suggests problem areas and quality improvement opportunities. In our series, for example, reoperation rates for renal transplant (26%) and pancreatic resection (18%) were recognized as too high, and focused improvement efforts were initiated. Because several reoperations following renal transplants were related to problems of the cystoureterostomy, technical processes related to anastomoses were reviewed, revised, and standardized across surgeons performing the procedure. High reoperation rates following pancreatic resection prompted review of indications for portal vein reconstruction for patients with otherwise unresectable pancreatic cancer, standardization of operative and postoperative processes of care, and reduction in the number of surgeons performing Whipple procedures.

Based on our experiences, there are several limitations in using reoperation data for internal quality improvement efforts. First, even in a busy general surgery practice, the number of unplanned reoperations with any given procedure is relatively low. For example, with renal transplant and pancreatic resection (the 2 procedures with the highest rates in our series), only 10 and 6 patients, respectively, returned to the OR. When the total number of events is this low, it may be difficult to determine when high reoperation rates reflect real problems with quality of care or chance alone. Second, it is difficult to establish “acceptable” reoperation rates with most procedures. Published case series for individual procedures are no doubt influenced by publication bias (few centers publish results indicative of poor patient outcomes) and thus do not reflect true performance. In general, studies focusing on adverse events “across the board” almost invariably report higher rates than those from single institution case series focusing on a single procedure.

Third, it is difficult to establish when unplanned returns to the OR are “preventable” or even reflect quality of care. As in previous studies, we found that technical problems related to hemostasis, wound closure, and anastomoses were most commonly responsible for reoperation. In contrast to prior studies, however, we made no attempt to identify which unplanned returns to the OR were preventable. For some cases in our series, it is possible that focused review would have identified overt errors in either clinical judgment or technical processes leading directly to the complication necessitating return to the OR. However, we believe that determination of “preventability” would have been more ambiguous for most cases. Moreover, many unplanned reoperations seem to reflect bad luck as much as quality of care, eg, the patient experiencing cecal perforation from a colonic ileus after an otherwise unremarkable recovery from a renal transplant.

Would reoperation serve as a useful measure for tracking quality in general surgery? As documented in our series, unplanned reoperations occur relatively frequently across a wide range of procedures and most often indicate a complication directly related to the original operation. From a policy perspective, reoperation would be an attractive quality indicator because it is relatively easy and inexpensive to identify with administrative as well as clinical data.

### Table 4. Reasons for 107 Unplanned Returns to the Operating Room, by Procedure

<table>
<thead>
<tr>
<th>Procedures, No.</th>
<th>Bleeding</th>
<th>Infection</th>
<th>Anastomotic Problem</th>
<th>Wound Complication</th>
<th>All Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colectomy</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Pancreatic resection</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Renal transplant</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Gastric bypass</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Small-bowel resection</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Esophagogastrectomy</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Laparoscopic fundoplication</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Other procedure</td>
<td>5</td>
<td>11</td>
<td>4</td>
<td>11</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>16</td>
<td>16</td>
<td>21</td>
<td>42</td>
</tr>
</tbody>
</table>

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However, there are several downsides to using reoperation as a quality measure in general surgery. First, reoperation rates could be easily confounded by differences in patient case-mix across hospitals. As demonstrated in our analysis, reoperation rates are procedure specific, which underscores the importance of accounting for procedure mix when comparing performance across hospitals. Because our registry does not contain detailed clinical information about illness severity (beyond procedure acuity) or patient comorbidities, we could not determine the extent to which these variables are related to reoperation risk. However, analyses comparing hospital performance may need to adjust for patient characteristics as well as procedure mix. Second, all reoperations are not the same: reoperation rates may sometimes reflect local practice style as much as technical complications. In our series, for example, 2 of 4 reoperations after laparoscopic Nissen fundoplication were diagnostic laparoscopies in patients with unexplained tachycardia, both of which showed no evidence of complications.

Both risk adjustment and the ability to categorize indications for reoperation would be severely constrained in analyses relying exclusively on administrative data. Although monitoring reoperation rates with clinical data would be more precise, many hospitals (and surgeons) would not voluntarily participate in such efforts. Collecting prospective information about clinical outcomes is time-consuming and also expensive. Potential medicolegal implications associated with reporting complications rates would be another obstacle. Finally, some may worry that using reoperation as a quality indicator would inappropriately discourage surgeons from timely intervention in patients who need reexploration.

For all these reasons, tracking rates of unplanned returns to the OR may be more useful for improving quality at the local level. Although it has yet to be determined whether such efforts will ultimately reduce the rate of unplanned reoperations, they seem worthwhile given the substantial implications of this adverse event on patient outcomes and costs.

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REFERENCES


Andrew Warshaw, MD, Boston, Mass: In this study you have used reoperations as a surrogate for increased morbidity and cost. Like using death as an index, this is a relatively blunt tool. Other complications, which are much more frequent and which may summate differently, may be more costly and significant in the long run than the roughly 3% reoperation rate in these 3000 general surgical patients. To fully understand the study, we would have to factor in your criteria for reoperation as well as the non-operative alternatives that are now available. Some of your reoperations were apparently due to intra-abdominal abscesses, which conceivably could have been managed by percutaneous drainage. We also need to be cognizant that the number of events in each of your subgroups is very small, and they have had to be aggregated in order to come up with statistically analyzable data.

Nonetheless, your observations are really quite striking and show that reoperations are very costly, both in terms of dollars and human misery. You show that the costs in dollars are 4 times higher in those who require reoperation, and the mortality rate is more than 3 times higher. You used the terms cost and charges interchangeably. If I understand correctly, you are providing hospital charges rather than costs, and we need to be aware of the difference between the two. In the era of DRGs, many charges are wishful billing and are ultimately eaten by the institution rather than being paid by the insurer. It would also be useful to know in your analysis of charges how much was hospital global charge or operating room charge (which we generally do not get back) and whether professional fees for surgeons and anesthesiologists were factored in.

Seventy-five percent of the reoperations were related to problems at the surgical site. There was a potpourri of small numbers, and it was hard for me to analyze how many of those were potentially preventable, as you alluded to in your own analysis. It is interesting nonetheless that there was no significant difference between reoperation for anastomotic site problems after elective colectomy vs urgent colectomy. Does this imply that the reoperation is more related to surgical technique than to circumstances of the disease or its acuity? I also cannot refrain from pointing out that your reoperation rate of 18% for pancreatic operations seems to be an outlier off the end of the spectrum compared with the reported rates from many other institutions, including ours and Dr Cameron’s.

What are the potential lessons that can be learned here? As our CEO is fond of saying, “What’s the verb?” Can we identify weak spots in surgical practice that can point us to new solutions? For example, if you have a pancreatic leak, are there pharmacologic solutions that we should be using rather than...
reoperations? If wound dehiscence is one of your common wound problems, should you change your method of closure?

What does your study suggest regarding the potential benefits of regionalizing certain kinds of surgical treatment, a question of special interest to your group? You call your institution a rural tertiary hospital. Suppose we change that slightly and call it a rural hospital; might some reoperation rate be high enough to suggest that patients be transferred to a higher volume center? There is a burgeoning literature to which you have contributed that transfer is an important consideration for some complex procedures. There is also a nascent literature that common procedures—colotomy, pulmonary lobectomy, gastrectomy—have higher complication and mortality rates, which are related to both hospital and surgeon volume. A recent study from the American College of Surgeons showed that even breast lumpectomy has better outcomes related to higher volume. How are we going to use this kind of data?

You wisely point out that you are focusing on process, not on individual sentinel events or individual surgeon errors. A focus on process is much more likely to improve surgical practice and not meet resistance from surgeons. This is a powerful agent for change and improvement in patient care. I look forward to your next chapter as you will tell us how to do it.

Michael Zinner, MD, Boston: The Institute of Medicine about a year ago permanently changed the public's perception of quality in medicine, and it is going to be an important event for us in the future to pay a great deal of attention to. The Institute highlighted the need for focus on safer medication ordering, dispensing, and administration and highlighted that this and other events could impact survival.

We as surgeons need to take the lead in first quantifying the impact of our actions on our patients and the surgical judgment and technical errors involved and then develop and implement improved processes to change these. We have a long and important history of doing this through our morbidity and mortality conferences, and I make reference to many publications in the area, including those by my predecessor, Francis D. Moore, Sr, on the importance of paying attention to those kinds of morbidity and mortality conferences. However, it is no longer sufficient to do only that. This abstract is a step in the right direction in broadening our horizons. However, I caution anyone making comparisons of quality of data. The comparisons must be made with some risk assessment.

In reviewing the abstract, I asked my department to pull similar data for our surgeons from our prospective quality data base, and they are very consistent with the data that you are seeing today. Our return to OR rate is in the range of 5% to 7%. That is return for all reasons for all cases in those services. We do not have it broken down by specific operation. What is very clear is what was highlighted in the manuscript, that the costs, both charges and cost, are significantly higher for any complications that arise in these patients as well as the mortality being about 5 times as high.

Both the aggregate level and specific procedures could be examined and the occurrence of potentially avoidable postoperative complications as well as increased lengths of stay reviewed by groupings, showing the increased importance of looking at this information. What is also critical to emphasize is that 10% to 20% of patients experience some form of postoperative complications, and this likely underestimates it, since this form of reporting is based on the medical record.

I would like to ask the authors the following questions. First, 25% of your unplanned returns to the operating room were for problems that you said were not at the original surgical site. Can you elaborate on what types of postoperative complications you are talking about? Secondly, the rates of return for colon at 7% and pancreas at 18% are high. Can you tell us a little bit more about what the reasons for that are and what changes you have made to affect the outcomes there? Third, have you begun to look at the incidence of reoperation by surgeon or tried to correlate reoperation rates to other patient-related or preoperative factors such as bowel preparations, timing or duration of the perioperative antibiotics, patient risk factors such as obesity or diabetes? And finally, and most importantly, have you been able to put together a strategy with your hospital's surgeons for reducing the incidence of reoperation and the related postoperative complications since showing them these compelling data?

Dr Birkmeyer: Dr Warshaw suggested that reoperation rates are a fairly blunt tool. I would agree with that particularly in the context that you would come across in report cards where there is no attempt to break things down by etiology, much less whether unplanned or planned. Ours is the first step toward a better tool, but clearly there is room to move.

Dr Warshaw's second point was that many reoperations seem to reflect practice style as much as simple quality problems, for example, the decision to reoperate vs use a percutaneous approach in pancreatic fistula or in intra-abdominal abscess. That clearly could epitomize some other variation that could be observed among hospitals.

Thirdly, I agree totally with his point about the distinction between hospital care and surgeon care, and there would be very little incentive for us to put as much effort as we do into tracking how we are doing as well as trying to make it better. Some of Dr Zinner's data underscored this also; surgeons would be surprised at some of their outcome rates if they looked at them as prospectively and carefully as we and others have been trying to do.

Dr Warshaw raised what I expected as a pointed question: should we at Dartmouth be sending all of our pancreatic surgery down to him? That is one arguable point when you review the excellent results that he has described at his institution and that we saw earlier from Dr Cameron. Taking that tack or assuming that focus is not warranted on a first pass at going through the data. If we felt that way, the end game at Dartmouth-Hitchcock would be to find operations that we should not be doing, and there would be very little incentive for us to put as much effort as we do into tracking how we are doing as well as trying to make it better. Some of Dr Zinner's data underscored this also; surgeons would be surprised at some of their outcome rates if they looked at them as prospectively and carefully as we and others have been trying to do.

Finally, let me address 2 of Dr Zinner's questions. Number one, what are the 25% of patients that went back to the operating room for other reasons? Some of the others are patients going back for complications only indirectly occurring from the first operation. The placement of a tracheostomy tube, the placement of a G-tube, repair of a pressure sore would all be among complications that would fit into that group.

Further work will be needed, Dr Zinner, to get to the issue of what is going on at the level of the individual surgeon or certainly in subgroups of patients undergoing an individual operation. We are already hampered somewhat by problems with small sample size, but over time, we hope to address many of the issues that you raised.