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Value of Preoperative Clinic Visits in Identifying Issues with Potential Impact on Operating Room Efficiency

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Background: **Preoperative clinics have been shown to decrease operating room delays and cancellations. One mechanism for this positive economic impact is that medical issues are appropriately identified and necessary information is obtained, so that knowledge of the patients' status is complete before the day of surgery. In this study, the authors describe the identification and management of medical issues in the preoperative clinic.**

Methods: **All patients coming to the Preoperative Clinic during a 3-month period from November 1, 2003, through January 31, 2004, at the Brigham and Women's Hospital, Boston, Massachusetts, were studied. Data were collected as to the type of issue, information needed to resolve the issue, time to retrieve the information, cancellation and delay rates, and the effect on management.**

Results: **A total of 5,083 patients were seen in the preoperative clinic over the three-month period. A total of 647 patients had a total of 680 medical issues requiring further information or management. Of these issues, 565 were thought to require further information regarding known medical problems, and 115 were new medical problems first identified in the clinic. Most of the new problems required that a new test or consultation be done, whereas most of the old problems required retrieval of information existing from outside medical centers. New problems had a far greater probability of delay (10.7%) or cancellation (6.8%) than old problems (0.6% and 1.8%, respectively).**

Conclusions: **The preoperative evaluation can identify and resolve a number of medical issues that can impact efficient operating room resource use.**

EFFECTIVE patient evaluation in a preoperative clinic has been shown to increase efficient utilization of operating room resources. Preoperative clinic visits have been shown to improve patient satisfaction,[1] reduce unnecessary testing and consultation,[2,3] and decrease duration of hospital stay.[4] Preoperative risk factors are effective predictors of hospital costs; therefore, preoperative intervention to reduce risk could lead to significant cost savings.[5] Optimization of a patient's medical condition before surgery has also been shown to decrease operating room cancellations and delays.[6] Cancellations can have significant negative financial implications, with one estimate suggesting that a minimum of approximately $1,500 per hour of revenues is lost.[7] Delays can also have significant financial impact; the cost of lost operating room time was estimated in 1999 to be approximately $10 per minute.[7,8]

Proper risk assessment and optimization of medical conditions in the preoperative clinic may be a major factor contributing to the reduction in cancellations and delays on the day of surgery. Optimization may occur for preexisting medical conditions or those diagnosed for the first time during the preoperative assessment. Even if patients with preexisting conditions do not require changes in management, proper risk assessment can only be accomplished if adequate knowledge of these conditions is available. This may require obtaining old medical records, test results, and office notes from nonaffiliated hospitals, clinics, and/or institutions not readily available at the time of the preoperative evaluation.

We have noted that while a significant percentage of patients evaluated in our preoperative clinic have at least one known coexisting disease, a smaller percentage of patients will present with a change in their existing medical condition or a previously undiagnosed disease process. In addition, many of our patients come from outside institutions or are having their first visit to our hospital. Proper risk assessment and optimization of these patients often requires obtaining old medical records and test results, as well as new diagnostic testing and/or consultation in some cases. We are not aware of any studies that have looked at causes and impact of missing information on medical management, delays, and/or cancellations ahead of the time of the surgical procedure. It is our hypothesis that some of this information will be new and apply to different medical and surgical fields, and that obtaining previous diagnostic test results will modify the medical management of patients in the perioperative period. Furthermore, we expect that new problems will account for the bulk of the changes in the medical management. We therefore conducted a study of all patients receiving a preoperative evaluation during a 3-month period.

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Materials and Methods

We conducted a retrospective study on the charts of all patients evaluated in the Weiner Center for Preoperative

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Evaluation at the Brigham and Women's Hospital, Boston, Massachusetts, during the 3-month period from November 1, 2003, through January 31, 2004. The Partners Health Care Institutional Review Board, Boston, Massachusetts, granted approval for the project with a waiver of informed consent given that no identifiable patient information was collected. Patient evaluations for the majority of surgical cases performed at our institution (> 85%) are done in this clinic, with the exception of patients admitted through the emergency room or those already admitted to the hospital (*e.g.*, intensive care unit patients). Approximately 10% of those referred to the clinic are triaged to be screened by phone based on their overall health status and hospital-based guidelines for preoperative laboratory workup. The visit is scheduled several days to weeks in advance to allow time to locate all necessary records or do additional testing; on occasion, the urgent nature of the surgery or travel requirements of the patient preclude this timing buffer. Potential cancellations and delays in advance of the surgery are discussed with the surgical attending.

The Center conducts an average of 1,600 patient visits per month. For most patients seen in the clinic (approximately 80%), the visit consists of having necessary laboratory work collected, an electrocardiogram performed if indicated, as well as a history and physical, anesthesia assessment, and nursing assessment conducted by a nurse practitioner. For insurance reasons, approximately 20% of the patients seen in the clinic have the history and physical done by a physician, with the anesthesia assessment and nursing assessment done by an anesthesia resident and a registered nurse, respectively. An attending anesthesiologist reviews all cases, regardless of who performs the initial assessments, to ensure that each patient is ready for surgery and to determine whether further information is required; this is done before the patient leaves the clinic. An extensive preoperative clinic educational program, as previously described,[3] ensures alignment among the anesthesia staff regarding the use of guidelines and risk assessment algorithms.

It is our current practice that any patient considered not to be adequately assessed at the time of the visit has his or her chart identified and labeled with the information needed. A clerical assistant aids the attending anesthesiologist in resolving these issues. If information is required from nonaffiliated institutions, charts are filed by the date of their surgery, with a notation of the information needed to be obtained placed on a cover sheet within the chart. The clerical assistant is also responsible for scheduling additional testing if ordered by the attending anesthesiologist. When all information and results are obtained, the information is filed in the chart and given to the attending anesthesiologist for review. Based on the information obtained, the attending anesthesiologist decides whether the patient is ready for surgery. This decision is based on having all of the patient's data complete and available for surgery. Furthermore, it takes into account the significance of having any missing information. For the purposes of this article, delays were defined as cases that were eventually placed in the operating room schedule at a later date than originally planned, and cancellations were cases that were removed from the operating room schedule, and not rebooked onto the operating room schedule for a 3-month period.

Table 1. Patient Demographics and Risk Data

	Old Problems (n = 565)	New Problems (n = 115)
Age, mean ± SD, yr	60.4 ± 13.7	60.6 ± 14.3
Sex, n (%)		
Male	277 (51)	48 (47)
Female	267 (49)	55 (53)
ASA physical status, n (%)		
I	11 (2)	4 (4)
II	321 (59)	52 (50)
III	207 (38)	47 (46)
IV	5 (1)	0 (0)
Surgical risk classification, n (%)		
Low	174 (32)	21 (20)
Intermediate	343 (63)	65 (63)
High	27 (5)	17 (17)

ASA = American Society of Anesthesiologists.

In addition, problems were classified as either preexisting or newly diagnosed at the time of the clinic visit. Data recorded included patient demographics as well as the type of issue, information needed to resolve the issue, time to retrieve the information, cancellation and delay rates, and the effect on management. The recorded items were reviewed by the investigators to check for clarity and comprehensibility before tabulation. Results were tabulated and analyzed using appropriate descriptive statistics.

Results

During the 3-month study period, 5,083 patients were seen in the preoperative clinic. A total of 647 patients (12.7%) had 680 medical issues requiring further information or management. Of these identified issues, 565 (83%) were thought to require further information regarding known medical problems ("old problems"), and 115 (17%) were medical problems first identified in the clinic ("new problems"). We were able to identify all outstanding medical issues and obtain the necessary information in 93% and 96.1% of patients with old and new medical problems, respectively. The attending anesthesiologist did not deem any of the missing information necessary to assess the readiness of the patient for surgery. Demographics, American Society of Anesthesiologists physical status, and surgical risk are described in table 1. The medical conditions requiring further investigation were divided into several general categories as

Table 2. Description of Identified Issues

Type of Issue	Patients with Old Problems, n (%)	Patients with New Problems, n (%)
Cardiac	491 (87)	73 (63.5)
Anesthesia	21 (3.7)	4 (3.5)
Pulmonary	19 (3.4)	12 (10.4)
Hematologic	17 (3)	11 (9.6)
Vascular	5 (0.9)	3 (2.6)
Endocrine	3 (0.5)	3 (2.6)
Other*	9 (1.6)	9 (12.3)

* Most were significant laboratory abnormalities including positive human chorionic gonadotropin.

described in table 2. The majority of issues identified were cardiac in origin (87% of old problems and 63.5% of new problems).

The specific problems identified in each category are shown in table 3. Obtaining existing information (*e.g.*, stress test, echocardiogram, or electrocardiogram) about known symptomatic coronary artery disease was the most frequently identified source of incomplete information among the preexisting problems. Significant new abnormalities on electrocardiogram or the presence of new cardiac symptoms were the most common source of newly identified issues.

Table 3. Specific Identified Issues

Type of Issue	Number of Patients with Old Problem	Number of Patients with New Problem
Cardiac		
Abnormal electrocardiogram	25	26
Coronary artery disease	101	11
Congestive heart failure	6	0
Arrhythmia	40	1
Recent testing	97	12
Symptoms	133	16
Valve disease	41	3
Other*	48	4
Anesthesia		
Difficult airway	8	1
Malignant hyperthermia	2	0
Drug reaction	4	0
Other†	7	3
Pulmonary		
Sleep apnea	7	1
Asthma	3	0
Symptoms	4	2
Abnormal examination	0	6
Other‡	5	3
Hematologic		
Coagulopathy	5	9
Hemoglobinopathy	2	0
Pulmonary embolus	6	0
New antibodies	0	1
Other§	4	1
Vascular		
Carotid artery disease	0	2
Cerebrovascular accident	2	0
Deep vein thrombosis	3	1
Endocrine		
Hyperthyroid	2	2
Diabetes	0	1
Pituitary tumor	1	0

* Included general requests for cardiac risk assessment for patients followed chronically by a cardiologist. † Included risk for airway obstruction with the induction of general anesthesia. ‡ Included patients with upper respiratory infection. § Included idiopathic elevated laboratory abnormalities.

Table 4. Information Required to Proceed with Surgery

Type of Information	Old Problems (n = 591)	New Problems (n = 122)
Retrieve old information, n (%)	498 (84.3)	24 (19.6)
Office/medical record	88	14
Test result	395	10
Consult note	15	0
Obtain new information, n (%)	93 (15.7)	98 (80.3)
Test	77	88
Consult	16	10

As shown in table 4, most of the new problems required that a new test or consultation be performed (80.3%), whereas most of the old problems required retrieval of information from outside medical institutions (84.3%). Only 26 new consultations were requested from the total of 713 queries for additional information. The most common consultations obtained were with a cardiologist followed by a hematologist. Cardiology consultations were usually obtained to help optimize the status of patients with relatively complex cardiac comorbidities, whereas hematology consultations were usually to devise a perioperative anticoagulation scheme. Patients with newly identified problems were far more likely to require new testing or consultation (15.7% of patients with previously diagnosed problems *vs.* 80.3% of patients with newly diagnosed problems).

New problems were associated with a greater chance of delay (10.7%) or cancellation (6.8%) from the originally scheduled date than old problems (0.6% and 1.8%, respectively). Although the median times to obtain the desired data were 1 day for patients with both new and old problems, the range was wide (0–34 days for old problems and 0–60 days for new problems). Thirty-four percent of the data requested was obtained on the same day as the preoperative testing center visit (counted as day 0); 78% of the data obtained on the same day were medical records of office visits, hospital admissions, and laboratory and diagnostic testing. The time from the preoperative visit until the day of surgery was 6 days (range, 0–135 days) for patients with old problems and 7 days (range, 0–137 days) for patients with new problems. The prolonged duration in some cases between the time to identify and obtain the desired data and the surgical procedure was due to the need for new testing with eventual postponement of surgery.

Table 5 describes the management changes recommended by the preoperative clinic for patients with old and new problems. A total of 15.8% of patients with old problems and 27.2% of patients with newly diagnosed problems (17.6% overall) had alterations in perioperative

Table 5. Effect on Management

	Number of Patients with Old Problem	Number of Patients with New Problem
Coronary artery bypass	1	1
Carotid endarterectomy	0	1
Admitted to hospital	2	0
β Blocker started	43	17
Air filter use planned	1	0
Anticoagulation plan*	7	2
Awake fiberoptic intubation	2	1
Change in anesthetic plan†	28	4
Blood transfused preoperatively	1	1
Insulin started	0	1

* Preoperative platelet transfusion, preoperative fresh frozen plasma transfusion, warfarin (Coumadin) stopped preoperatively and enoxaparin (Lovenox) started. † Malignant hyperthermia precautions, specialized monitoring, alteration in routine drug management.

management implemented as a result of the preoperative evaluation. The most common change in management involved the institution of perioperative β blockade. Three patients were identified who were thought to require surgical intervention in the form of coronary artery bypass or carotid endarterectomy. In these three cases, the original surgery was delayed or cancelled.

Discussion

A preoperative clinic provides a valuable means of centralizing medical information and coordinating perioperative care. Many of the patients seen have known complex medical problems involving multiple organ systems; by contrast, some patients will have comorbid conditions, particularly if unrelated to their surgical pathology, not previously diagnosed. For these reasons, a careful and complete preoperative evaluation is imperative. This is the first study to demonstrate that a preoperative clinic can identify the common types of medical issues (*e.g.*, cardiac and hematologic) that account for most of the problems in the perioperative period and could potentially cause delay or cancellation of a case on the day of surgery because all of the information considered necessary by the anesthesiologist is not readily available. It also provides an opportunity to make changes in perioperative medical management such as the initiation of β blockade or alterations in anticoagulation regimens.

Maintaining good preprocedure clinical practices, as well as maintaining compliance with regulatory agencies such as the Joint Commission on Accreditation of Healthcare Organizations, requires that a surgical history and physical, anesthesia assessment, nursing assessment, and necessary testing be done before surgery. Many institutions struggle with the issue of financial justification of resources for a preoperative clinic to perform and coordinate these preoperative functions. However, it is important to realize that the same standard of evaluation and assessments are required whether a complete evaluation is done in a preoperative clinic or done piecemeal with some of the assessments and final evaluation shifted to the day of surgery. Essentially, a preoperative clinic represents a resource shift, but with the added benefits of patient and hospital provider satisfaction and significant savings; delaying final assessment until the day of surgery results in overall increased operating room expenses as well as decreased operating room efficiency.[6,7]

Surgical case cancellations on the operative day can be estimated to result in a loss in revenue of the average contribution margin per case of $1,500.[7] During the 3-month period of this study, 647 patients were identified who required additional information or testing (either old or new) before being considered "optimized for surgery." Had these individuals presented to the preoperative clinic on their expected day of surgery, it is likely that their cases would have been delayed or cancelled, regardless of who was staffing the clinic. This is due to a small, select group of anesthesia attending physicians, all with a special interest and expertise in preoperative assessment, who staff our clinic. Moreover, the group has uniformly adopted preoperative algorithms for testing and consultations; required testing results must be in the chart before proceeding to surgery. In addition, all cancelled or delayed cases are collected and reviewed periodically by this group to evaluate why these outcomes were observed and how they can be prevented. Any alterations to algorithms are made and uniformly used. If multiple attempts have been made to retrieve missing information deemed to be necessary, or if no information exists on a certain characteristic of interest, a new workup is initiated and labeled as a "new" problem. It is possible that all of the 647 patients identified as requiring more information or testing may have been cancelled or delayed; although this may be an overstatement, at the minimum, the 191 patients (30%) who required new consultations or testing would have most likely resulted in delays or cancellations.

There is currently no system for documenting delays and cancellations or their reasons at our institution. By sharing the results of our investigation with operating room leaders, this system is currently in the process of being developed. As an example, a total of 80 charts out of 1,178 cases (6.8%) that came through our preoperative clinic came back because of a cancellation during the month of January 2006. None of these charts were cancelled due to inadequate workup or unresolved medical issues but rather for diverse reasons such as surgeon decided against the operation, patient changed his or her mind, or patient felt ill.

It is difficult to calculate the financial impact if the missing information results in a delay rather than a cancellation. However, should case delay result in the overall lengthening of the operating room day resulting in increased over-

time as well as shift differential payments, the variable costs of running the operating room would increase.

Typical costs of preoperative clinics vary with the extent of assessments performed and the level of professional staffing used. The primary cost is clinical and nonclinical personnel, with lesser costs contributed by paperwork and charting and the fixed expenses of the clinic's operation. Average costs in 2002 were estimated to range between $41.45 and $145 per patient.[9] The cost per patient of evaluation in the preoperative clinic at our institution is monitored on a monthly basis; during the time period of this study, the average cost per patient was $136.61. The majority of the costs in our clinic are fixed and consist largely of labor costs. The largest variable costs include printing, medical record forms, and office supplies, which only average approximately $14 per chart. Thus, the yearly operating costs of the preoperative clinic are $2,777,555 ($136.61 per patient × 5,083 patients every quarter × 4 quarters per year). If revenue can be collected from billing for the surgical history and physical part of the preoperative visit, more significant cost savings can be realized.

The unique opportunity provided by the preoperative testing center is the chance to intervene before the day of surgery and to facilitate the implementation of hospital-wide guidelines for perioperative management. A recent article by Davenport *et al.* [5] suggests that because preoperative risk factors are effective predictors of hospital costs, preoperative intervention to reduce risk could lead to significant cost savings. Because hospitalization before surgery is infrequent even in patients with significant comorbidities, processes to optimize comorbidities and reduce preoperative risk to decrease costs and minimize hospital stay will need to occur in the outpatient setting.

Many preoperative testing centers, including ours, have developed a number of protocols based on the existing literature that provide guidelines for appropriate testing and perioperative medical management.[2,3] Adherence to these protocols promotes efficiency by streamlining decision making and minimizing unnecessary consults and costly diagnostic testing. We have demonstrated this concept, as we have previously described,[3] by referring only 4% of our patients with medical issues requiring further information (0.5% overall) to a consultant. This process also provides pathways to provide education and helps to assure alignment between staff in the clinic evaluating the patient and staff in the operating room providing care during the procedure. This is important in view of our previous work where we demonstrated that little educational support has been given to the preoperative process,[10] where most anesthesiologists did not feel comfortable making decisions. We believe that it is essential to train anesthesia attending physicians and residents in perioperative risk assessment to improve communication with surgeons and consultants. This is likely to give anesthesiologists more credibility as the final decision-making physician during the perioperative period.

Effective preoperative evaluation before the day of surgery also allows the implementation of protocols that may improve patient outcome. In the current study, 60 patients were identified as candidates for perioperative β blockade, and this protocol was started. Although the data are not conclusive regarding the optimum time to start β blockade before a surgical procedure, in one of the more important studies showing benefit, the β blockade effect was optimized 1 week before surgery.[11] As a result of our study, we have developed a protocol that allows initiation of perioperative β blockade in the clinic and transmission of this information to the anesthesiologists, surgeons, and primary care providers caring for the patient, so that this regimen can be continued for a minimum of 30 days postoperatively. In addition, we have developed hospital-specific guidelines for perioperative anticoagulation that streamline the perioperative process.

In the current study of preoperative patients with newly diagnosed or unresolved medical problems at the time of presentation to the preoperative clinic, we confirmed our hypothesis that the preoperative and intraoperative management was directly affected in a significant proportion of cases (17.6%). However, this number is likely to underestimate the value of the preoperative evaluation. At our institution, we have a number of clerical systems in place to ensure a large percentage of needed information is obtained before as well as on the day of the patient's visit. The results of the preoperative testing center visit will invariably impact the perioperative management of the patient, because the patients' medical conditions will influence the decisions made by the anesthesiologist taking care of the patient in the operating room. In patients with problems requiring further evaluation, management changes by the operating room team independent of any recommendations by the preoperative testing center were not recorded. For these reasons, this number is likely an underrepresentation of the various ways in which a thorough evaluation of a patient's medical conditions affects anesthetic management in the operating room. Therefore, in addition to the formal recommendations in the preoperative testing center evaluation, the effective and thorough communication of relevant medication information in the preoperative center report will favorably impact anesthetic and postoperative management.

For a large percentage of surgical patients, the preoperative visit is their first visit to a medical provider within our institution before the day of surgery. Patients with known medical conditions often had previous evaluations at outside institutions that were not routinely available in the preoperative clinic at the time of the patient visit, and we routinely obtain these records. Although this does decrease the number of unnecessary additional

workups performed, it requires staff dedicated to the process. This study would suggest that if there were a way to target patients with cardiac testing and have this information available at the time of the visit, a significantly greater percentage of evaluations could be considered complete at the time of the visit without additional resource use. One way that this could be accomplished is by use of the Internet.[12] We have developed an interactive Web site‖ that allows patients to enter information that is securely transmitted to the preoperative clinic before the patient's visit. We are currently working on system development to allow retrieval of information from other institutions that are reported through these Internet submissions.

Our results are limited by being retrospective and relying on preoperative visit and anesthesia records to track changes in management. Some may argue that a large proportion of our changes relate to the perioperative use of β blockers and a change in the anesthetic plan. Although surgery would be unlikely to be cancelled just to start β blockers, it can be argued that knowing the risk of coronary artery disease ahead of time would allow for cardiac testing and medical consultation if deemed necessary. Furthermore, other changes in anesthetic plan, such as the use of a transesophageal echocardiogram, may impact anesthesia scheduling because they necessitate the use of providers with special expertise and it may take longer than average to get the case under way. Another limitation of our study is that because we did not have a control group or follow these patients postoperatively, it is difficult to track most of these interventions and their impact on patient morbidity and mortality. However, randomized double-blind trials to examine the impact of diagnostic testing on perioperative management are few[13] and may be difficult to justify if not in adherence with current standards of care. In addition, the implementation of protocols has been demonstrated to improve patient outcomes and assist anesthesiologists in clinical decision making.[14] Of note, in accord with a recent study demonstrating that there is no significant difference in outcome for patients with coronary artery disease undergoing vascular surgery regardless of receiving either preoperative medical or surgical interventions,[15] most of our recommendations were for medical management. Therefore, further investigations should concentrate on the benefits of implementing new interventions in a preoperative test center such as β-blocker protocols and Web-designed preoperative consultations.

Our preoperative testing center has been developed to optimize perioperative care, increase efficiency, and decrease operating room costs. By identifying the type of information needed, we sought to develop improved preoperative systems to ensure the presence of necessary information at the time of the preoperative anesthetic evaluation. This study confirmed our hypothesis by demonstrating that a preoperative center can identify the type of medical issues that could potentially cause delay or cancellation of the case on the day of surgery because of incomplete information. Providing standards and guidelines will streamline assessment, allow implementation of protocols that may improve outcome, and increase operating room efficiency. The cost savings to the hospital, as a direct result of the work of the clinic, is significant.

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