Development and Effectiveness of an Anesthesia Preoperative Evaluation Clinic in a Teaching Hospital

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THE preoperative evaluation of the surgical patient enhances the anesthesiologist's awareness of a patient's medical condition and facilitates the plan of intra- and postoperative care. It was proposed that anesthesiologists are the perioperative medicine specialists because of the extent and quality of their comprehensive approach to the surgical patient. This approach begins with the preoperative evaluation.

The concept of an anesthesia-based outpatient clinic originally was proposed 47 yr ago. A review of the literature reveals limited information on the organizational strategies, utilization, and effectiveness of an anesthesia preoperative clinic.

In this article, the development and implementation of such a clinic at Stanford University Hospital is described. Specific problems and concerns are presented, along with the methods Stanford chose to approach these issues. The resulting Anesthesia Preoperative Evaluation Clinic (APEC) provides a comprehensive service for referring physicians and their presurgical patients. All consultations, physical evaluations, educational resources, laboratory and electrocardiographic services, and hospital admissions and registration are available in one centralized location.

Two studies are reported that help assess the efficiency and cost-effectiveness of the APEC during its first 24 months of operation.

Development of the Anesthesia Preoperative Evaluation Clinic at Stanford

In the past 5 yr, outpatient and same-day admissions at Stanford for anesthesia and surgery more than doubled (fig. 1). Nationally, it is estimated that 70–80% of surgical patients enter the hospital on the day of surgery. At Stanford, 72% of University surgeries are performed on outpatients or to-be-admitted patients.

The development of the APEC represents a collaboration between hospital administration and the Departments of Anesthesia and Nursing. To define the APEC requirements and evaluate potential difficulties, preliminary interviews with patients, housestaff, anesthesiologists, nursing staff, and ancillary personnel were performed. Also, interviews with each surgical chief and department chair revealed specific concerns and problems their services encountered with preoperative assessment (table 1).

Establishment of the APEC required a financial commitment, changes in support resources, intradepartmental teamwork, and cooperation of hospital administration with operational changes. A timeframe for the accomplishment of reasonable goals was clearly defined. The operational goals of the APEC are summarized in table 2.

Implementation Strategies and Organizational Changes

Surgical Specialties. Initially, many surgeons were reluctant to send patients to the APEC. There appeared...
to be an unclear understanding of the procedures and importance of an anesthesia preoperative medical evaluation. Also, a misconception existed that if the primary care physician or consultant had "cleared" the patient for surgery, the patient could automatically be assumed to be suitable for anesthesia and surgery.

Our hypothesis was that we could reduce the surgeon's hesitation to send patients to the APEC by identifying for them a clinical advantage.

To reduce the reluctance to refer patients to the APEC, we structured an "informal assurance" that, if a patient was evaluated by and deemed medically stable and appropriate in the APEC, the case would proceed to surgery without cancellation or delay by the anesthesiologist. The only exception would be the patient who experiences an adverse medical event or illness between the time of evaluation and the time of the planned surgery.

If a special anesthesia need or a concern regarding a patient's medical condition was evident preoperatively, the APEC director would contact the assigned anesthesiologist directly, to discuss the case in terms of proceeding with surgery. In addition, if a patient's medical condition could potentially benefit from an anesthesiologist with enhanced skills (such as advanced regional techniques), this individual would be contacted and requested to do the case. This practice minimizes delays caused by misinformation or questionable patient suitability and reduces the number of cancellations on the day of surgery, as subsequently reported.

The results demonstrate a positive response, from the surgeons to the enhanced patient care in the APEC and to the decrease in surgical delays and preoperative cancellations (as subsequently reported), with a significant increase in patient referrals.

Table 1. Problems Encountered with the Traditional System of Preoperative Evaluation of Surgical Patients at Stanford University Hospital

<table>
<thead>
<tr>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate facilities, equipment, and patient lounge (overcrowded and uncomfortable)</td>
</tr>
<tr>
<td>Lengthy patient waits of up to 2-3 h, caused by:</td>
</tr>
<tr>
<td>Lack of a scheduling system</td>
</tr>
<tr>
<td>Uneven flow of patients (high volume in mid-afternoon)</td>
</tr>
<tr>
<td>Subsequent triaging of patients without evaluation</td>
</tr>
<tr>
<td>Limited availability of anesthesia residents</td>
</tr>
<tr>
<td>Lack of on-site anesthesia faculty attending</td>
</tr>
<tr>
<td>Absence of medical records at time of evaluation</td>
</tr>
<tr>
<td>Absence of surgical history and physical examination results in chart</td>
</tr>
<tr>
<td>Lack of on-site phlebotomy or electrocardiography support</td>
</tr>
<tr>
<td>Limited educational services for patient and family</td>
</tr>
<tr>
<td>Excessive preoperative testing</td>
</tr>
<tr>
<td>Unnecessary use of costly subspecialty consultations</td>
</tr>
<tr>
<td>Unexpected day-of-surgery cancellations and delays</td>
</tr>
<tr>
<td>Marginal cost-containment</td>
</tr>
<tr>
<td>High patient and surgeon dissatisfaction with the process</td>
</tr>
</tbody>
</table>

Fig. 1. Increasing volume of preoperative outpatients and same-day admits during the past 5 yr at Stanford. ASA physical status 3 of these patients also increased since 1992.
Marketing of the Anesthesia Preoperative Evaluation Clinic

Our hypothesis was that marketing of the APEC would enhance visibility and viability of the APEC because of an increased awareness of the anesthesiologist's expertise in preoperative evaluation. We proposed that the APEC marketing would generate financial and political support and also increase patient referrals.

We contacted the Hospital Media and News Bureau. They published several hospital articles that described the APEC and its focus on efficient services, cost-containment, and improved patient care. The marketing department also sought participation of benefactors and other outside sources of financial funding, especially regarding the preoperative patient educational center. The results were a positive hospital response to the APEC concept, an increase in surgeon participation and patient volume, and a commitment to financial support.

In addition, we postulated that increased education and communication with the surgeons would result in further acceptance and referral to the APEC. Presentations were made at surgical grand rounds in each subspecialty. These presentations emphasized reduced costs, enhanced communication, increased patient and surgeon satisfaction, and the potential for fewer cancellations and delays on the day of surgery. Results of a recent surgeon survey of anesthesiologist services indicated a high satisfaction with the APEC. Although not mandatory, currently, 98% of university surgeons have their patients evaluated in the APEC preoperatively.

Hospital Administrative Support. Hospital administrative support and a financial commitment were essential for the successful development of the APEC. Our hypothesis was that the improved operation of preoperative services would decrease day-of-surgery cancellations and delays that, in turn, would enhance resource utilization and revenues. In addition, we proposed that the appropriate use of laboratory tests and other diagnostic studies preoperatively would reduce hospital costs. Our method was to demonstrate a financial advantage of the APEC and to secure funding needed for development.

The APEC gained support of Stanford's Operating Room Medical Committee, which approved a policy that "all preoperative laboratories and diagnostic tests are to be reviewed by the Anesthesia Preoperative Evaluation Clinic and medically unnecessary labs/tests will be cancelled." This was accomplished by presenting to the committee a 6-week pilot study on the ordering patterns of preoperative testing by the surgeons and primary care physicians. As subsequently reported, the results indicated substantial hospital cost savings when the anesthesiologist ordered the preoperative diagnostic studies.

Using written protocols and clinical pathway guidelines, the anesthesiologist currently orders the preoperative diagnostic studies previously ordered by the surgeons and primary care physicians at Stanford. The APEC uses published studies on the efficacy of preoperative testing and specialized tools such as the computerized "HealthQuiz" questionnaire (Nellcor, Pleasanton, CA) to suggest which tests to consider.

The APEC also determines whether a patient requires additional consultations with other departments, such as cardiology, medicine, or pulmonary services. Previously, the surgeon might order a consultation, anticipating that it could be required by the anesthesiologist before the intended surgery could proceed.

Our hypothesis was that transferring this determination to the anesthesiologist would reduce the number of questionable consultations observed a decrease of 73% of questionable consultations when the anesthesiologist decided to order consultation services. Costs were decreased by reduction and subsequent diagnostic services and care risk review data has been delayed or cancelled medical consultation for an incident of adverse patient care secondary to the use of clinical pathways.

Time management has increased during the past year, thereby reducing overhead costs. Evidence of reduced patient care resulted in the support by hospital administration of the facility, staff salaries, and equipment.

A business plan was presented and initiated. The plan contained a description of the goal setting plan, and a discussion of the changes that would be made in availability of medical care. The plan was also that availability of the plan was necessary.
of questionable consultations (table 3). Results demonstrated a decrease of 75% in preoperative consultations when the anesthesiologist was involved in the consultation decision process. In addition, hospital costs were decreased by reducing unnecessary consultations and subsequent diagnostic studies. From quality assurance and care risk review data, no operating room case has been delayed or cancelled secondary to an unobtained medical consultation by the APEC, nor has an incident of adverse patient outcome been reported.

The use of clinical pathways, protocols, and improved time management has increased efficiency in the APEC during the past year, thereby reducing personnel and overhead costs. Evidence of cost reductions and improved patient care resulted in a commitment of financial support by hospital administration for redesign of the facility, staff salaries, and purchases of capital equipment.

A business plan was presented to the hospital administration. The plan contained a financial analysis, a description of the clinical goals and objectives, a marketing plan, and a discussion of the proposed operational changes that would be necessary.

**Availability of Medical Records.** Our hypothesis was that availability of the patient's medical record in the APEC would increase clinical productivity and enhance the evaluation of the patient's medical status. In addition, we proposed that the review of the medical record would reduce cost to the hospital if it were done in the APEC rather than on the day of surgery, possibly delaying or cancelling a case. Our method was to obtain a policy from hospital administration that availability of the medical record would be given STAT priority, and the record would be delivered to the APEC before the patient’s appointment. This is accomplished by faxing to medical records, 24 hr in advance, a patient list of scheduled anesthesia appointments for the following day. In addition, there is a dedicated phone line from the APEC to medical records to enhance communication and priority. If a surgical clinic has a patient’s medical record, it is located and hand-delivered to the APEC by the medical record staff. Currently, the APEC receives 90% of the requested medical record charts before the patient's preoperative evaluation.

Results demonstrate that clinical time with the patient in the APEC was reduced approximately 40% when the medical record was present during evaluation.

**Renovation of the Facility.** Long-term renovation of the facility, with capital equipment expenditures, was important to centralize services and to increase efficiency. The facilities of the APEC at Stanford are listed in table 4.

**Daily Structure and Activities**

Currently, the APEC evaluates 35—40 adult patients daily, Monday through Friday, 9 AM to 5:30 PM. Approximately 70% of these patients undergo surgery the following day, and 28% undergo procedures 2–7 days after evaluation. During 1995, the Anesthesia Preoperative Evaluation Clinic evaluated 8,972 adult patients.

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**Table 4. Facilities of the Anesthesia Preoperative Evaluation Clinic at Stanford University Hospital**

| Five combination office and examination rooms |
| A patient and family education room (preoperative teaching) |
| A patient-centered media and video room |
| A phlebotomy and electrocardiography room |
| An on-site office for the Anesthesia Preoperative Medical Director |
| A registration and reception area |
| On-site restroom facilities |
| A large, comfortable patient lounge |
| An area for admitting and financial services |
| Facilities are approximately 2,200 square feet |

* All areas are accessible to wheelchairs.
for surgery and consultation. Twelve percent were ASA physical status 1, and 29% were ASA physical status 2. Fifty-four percent were ASA physical status 3, and fewer than 5% were ASA physical status 4. Currently, anesthesia services for pediatric patients are separate from those for adults.

When patients (approximately 20%) are from outside the hospital area or out-of-state, often they cannot return before surgery for an APEC appointment. The anesthesia scheduling system, subsequently described, has five open appointments throughout each day to accommodate these patients the same day as their initial surgical assessment. If needed, the patient’s primary care physician is contacted by phone, and pertinent medical information is faxed to the APEC for review.

Inpatients are not evaluated in the APEC, but are assessed by the assigned anesthesiologist the evening before surgery. If requested by the surgeon, the Anesthesia Preoperative Consultation Service (subsequently described) will evaluate an inpatient as long as several days before surgery to determine whether the patient’s condition is appropriate to proceed. Recommendations may be suggested to the surgeon to improve the patient’s preoperative medical status for anesthesia and surgery.

Each subspecialty surgical clinic has a scheduling computer for appointments in the APEC. This allows patients to be evaluated in an efficient and timely manner. Previously, patients would arrive in high volume during the mid-afternoon and would often have to wait as long as 2–3 hr for assessment. ASA physical status 1 and 2 patients are scheduled for 25-min appointments. ASA physical status 3 and the occasional ASA physical status 4 patients have 35-min appointments. Currently, 62% of patients have scheduled appointments. The APEC is flexible and evaluates patients without appointments for urgent surgical decisions.

After initial registration, patients fill out a brief anesthesia questionnaire to list their medications, previous surgeries, and medical history. To standardize many of the medical questions and increase efficiency, each patient also answers the ‘HealthQuiz’ questionnaire, given by means of a small, laptop computer device.

ASA physical status 1 and 2 patients are evaluated by a registered nurse practitioner (RNP). The role of the RNP is discussed later. The anesthesia resident evaluates patients of all ASA classifications. The APEC director consults on all pertinent medical questions and complexities. The responsibilities of the APEC director are listed in Table 5.

The anesthesia staff, cross-trained from the operating room services, then telephone, the evening before surgery, all preoperative patients not evaluated within 24 h, to ensure compliance with instructions, to confirm arrival time, and to answer questions. Any patient concerns or changes in medical status are referred to the attending anesthesiologist. This process, which requires approximately 1 h each evening, avoids day-of-surgery delays and potential cancellations, as subsequently reported.

A triage system may be implemented as patient volume/acute increase further and if staff resources become limited. The patient’s medical questionnaire and HealthQuiz printout will be reviewed by the APEC director. ASA physical status 1 and then ASA physical status 2 patients will be triaged to an anesthesia consultation that consists of laboratory tests and assessment of medical stability. It is called the evening before surgery to allow the anesthesiologist to discuss concerns with the patient’s proposed plan of care.

Perioperative Quality Assurance
Each patient’s operating room log is a quality assurance form attached to the patient’s chart. The logs are entered into a database and evaluated for etiologies of operating room complications, system problems.

Role of the Nurse Practitioner
When the volume of outpatient patients increased sharply, logsheet information occurred. Anesthesia nurse practitioners (NPs) were assigned to the APEC and were not available for the APEC.

The Departments of Anesthesiology and Surgery began an alliance that would use RNPs to provide anesthesia services. The APEC has two full-time RNPs, one as a quality assurance evaluator. Anesthesia education includes an introductory observation of various technics. This experience helps NPs understand the relation between education and the potential efficacy of RNP services. The RNPs present and consult with the APEC director. The responsibilities of the APEC director are listed in Table 5.

Anesthesia Preoperative Evaluation Clinic
The APEC is an interdisciplinary group that provides financial benefits by being reported to the Department of Hospital Administration for resource auditing and admitting personnel. The APEC’s cost-center fund transfers to a nurse educator. The APEC’s cost-center funds provide to provide services to other areas.
2 patients will be triaged to a “fast-track” evaluation that consists of laboratory tests (if needed) and a brief assessment of medical stability. Patients would be called the evening before surgery by the anesthesiologist to discuss concerns further and inform the patient of the proposed plan of anesthesia.

Perioperative Quality Assurance
Each patient’s operating room anesthesia record has a quality assurance form attached, which categorizes unexpected or adverse events. This information is entered into a database and evaluated for preoperative etiologies of operating room delays, cancellations, or system problems.

Patient satisfaction and communication is vital. A method of evaluating the APEC objectively (e.g., by means of a suggestion box in the waiting lounge) improves operations and staff performance.

Role of the Nurse Practitioner
When the volume of outpatients and to-be-admitted patients increased sharply, long patient waits for evaluation occurred. Anesthesia residents and attending physicians were assigned to the operating rooms and were unavailable for the APEC.

The Departments of Anesthesia and Nursing formed an alliance that would use RNPs to help evaluate patients. The APEC has two full-time RNPs as independent evaluators. Anesthesia education is provided, including intraoperative observation of various anesthesia techniques. This experience helps to identify, for the evaluators, the relation between a patient’s medical condition and the potential effects of an anesthesia procedure. The RNPs present any questions and concerns to the APEC director. The responsibilities of the RNP in the APEC are listed in table 6.

Anesthesia Preoperative Evaluation Clinic Funding
The APEC is an “interdisciplinary collaboration,” and provides financial benefit to the hospital, as subsequently reported. This collaborative concept resulted in a sharing of costs of the APEC, rather than as a direct expense to the Department of Anesthesia.

Hospital administration provides funding for the registration and admitting personnel, for phlebotomy staff, and for maintenance of facilities. The Department of Nursing cost-center funds the RNPs and the perioperative nurse educator. The APEC staff are cross-trained to provide services to other areas of the operating room during time of reduced patient volume. The APEC director receives financial support from hospital administration and the Department of Anesthesia. Ninety percent of the APEC costs are for staff salary support.

Other Services Provided
Anesthesia Medical Consultation. The APEC provides outpatient and inpatient anesthesia medical consultations. Inpatients are evaluated in their rooming area. The purpose is to determine whether the condition of the patient is appropriate and sufficiently stable for anesthesia and surgery. This type of consultation may initiate diagnostic and/or therapeutic management of a specific problem.

The consultation service has enhanced the awareness of the surgeon regarding the anesthesiologist’s perioperative medical expertise. Faculty-to-faculty phone contact is important when a consult is complete. In addition, a written report is placed in the patient’s chart.

Personal communication between the anesthesiologist and the assigned anesthesiologist ensures that any questions or concerns regarding the appropriateness of the patient’s condition are discussed. This avoids day-of-surgery delays and potential cancellations, secondary to questionable patient suitability. Consultations also facilitate the intraoperative plan of anesthesia management and monitoring requirements.

The number of referrals in the last year for anesthesia consultations of medically complex patients has increased. We currently receive three consultations daily for the outpatient and to-be-admitted population and
four inpatient consults weekly. These consultations are no different than any surgeon-requested consultation to a medical specialty; they are CPT (current procedural terminology) coded, a professional fee is submitted, and reimbursement is requested. There is no charge for routine preoperative evaluation.

Preoperative Patient Education Program. The goal of preoperative education is to increase awareness and comfort of the patient by decreasing anxiety and fear. The Preoperative Teaching Center is a specific site in the APEC that provides individualized education for the patient and family. The personal interaction provided by a perioperative nurse educator allows each patient to discuss concerns and asks questions about their anesthesia and surgery. This center has anatomic models, charts, brochures, epidural catheters, joint prostheses, and other items that help patients gain more information and a better understanding.

Anesthesia and surgery teaching protocols were developed and written for each surgery. They focus on perioperative events, including options for postoperative pain management. The perioperative nurse educator reviews all preoperative instructions, provides an overview of the events on the day of surgery and the expected postoperative course, and discusses any family or social issues of concern.

The multimedia room has two videocassette player/television stations where patients and families can privately view a 60-min videotape called "The Stanford Hospital Anesthesia/Surgical Experience." This patient-oriented tape tours the procedures of hospital registration and preoperative assessment, the operating room and anesthesia, and the recovery room. The tape also discusses pain management and the maintenance of privacy. Also available for patients are 10-min tapes that focus on specific surgical procedures. These videos use language and graphics that are patient oriented and easy to understand.

Resident Education

Each day, anesthesia residents have didactic educational sessions in preoperative assessment and case management. Clinical research opportunities are available for anesthesia residents in the APEC.

In affiliation with the Department of Medicine, a senior resident in internal medicine is assigned to the APEC three afternoons a week to learn preoperative assessment from the anesthesia medical perspective.

The medical resident participates in educational sessions and preoperative patient evaluations with the anesthesia resident and APEC director. There is a sharing of clinical issues and perspectives on the patient's medical complexities as it relates to anesthesia and surgery. A small library, a reprint center for academic publications, and a MEDLINE computer terminal are available in the APEC to reference preoperative topics.

Cost-effectiveness of the Anesthesia Preoperative Evaluation Clinic at Stanford

Cost reductions have become a primary focus of healthcare institutions as a means to enhance profitability. Several authors reviewed the economic principles and issues involved in healthcare cost analysis. Our hypothesis was that the APEC could reduce preoperative testing, surgical cancellations, and hospital costs, compared with the previous system of evaluating patients.

Table 7. Etologies of Day-of-Surgery Cancellations before and after Development of the Anesthesia Preoperative Evaluation Clinic at Stanford

<table>
<thead>
<tr>
<th>Condition/abnormality</th>
<th>Before Clinic (Mar 92–Feb 93)</th>
<th>After Clinic (Mar 93–Feb 94)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients (n)</td>
<td>6,722</td>
<td>7,485</td>
</tr>
<tr>
<td>Cardiovascular (angina, CHF, valvular, CAD)</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>Hypertension</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Respiratory (asthma, pneumonia)</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Upper respiratory tract infections</td>
<td>21</td>
<td>4</td>
</tr>
<tr>
<td>Endocrine (diabetes, thyroid)</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Gastrointestinal (crude, elevated LFT results)</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Neurologic (TIAs, CVAs, bruits)</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Renal (UTIs, acute renal failure)</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Dialysis (unstable condition)</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Presence of gastric contents</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory abnormalities</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td>Miscellaneous medical reasons</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Total cancellations</td>
<td>132</td>
<td>16</td>
</tr>
</tbody>
</table>

CHF = congestive heart failure; CAD = coronary artery disease; LFT = liver function test; TIAs = transient ischemic attacks; CVAs = cerebrovascular accidents; UTIs = urinary tract infections.

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Operating Room Cancellations
To determine whether the APEC’s enhanced assessment of patients had affected operating room cancellations, we conducted a 2-yr retrospective study that involved 14,207 adult outpatients and to-be-admitted patients. We evaluated all cancellations that occurred on the “day of surgery.” Approximately 90% of the cancellations occurred just before the patient entering the operating room. To assess the use of staff resources and the potential financial impact to the hospital of a vacant operating room, we determined “downtime” for each unexpected cancellation. At Stanford University Hospital, operating room turnover time averages 31 min between cases. For the 148 unexpected cancellations during this 2-yr study, an additional 1 h, 37 min (average) of downtime occurred.

For every cancellation, we assessed whether the cause potentially could have been identified before the day of surgery, during a preoperative evaluation. Each patient’s medical record was reviewed. Patients who had rescheduling of surgery (as a patient or surgical convenience) or any change in condition that made surgery unnecessary were eliminated from the study. Etiologies for the day-of-surgery cancellations are listed in Table 7.

Results show a 87.9% decrease in day-of-surgery cancellations in the year after implementation of the APEC (Fig. 2).

Preoperative Diagnostic and Laboratory Tests
Indiscriminate ordering of preoperative laboratory and diagnostic studies is costly and inappropriate.5,7-20,d Unnecessary testing is believed to increase risks to the patient, with a potential increase in medicolegal liability for the physician.8 To determine whether the ordering of preoperative testing by the anesthesiologist was cost-effective, we retrospectively evaluated 7,889 adult outpatients and to-be-admitted patients.

All preoperative tests ordered by surgeons and primary care physicians for a 6-month period were entered into a clinical database (Table 8). We compared these data with the 6-month period that occurred 1 yr after development of the APEC and the transfer of ordering preoperative studies to the anesthesiologist. The results demonstrate a 35.1% decrease in tests ordered. No operating room cancellations, delays, or adverse patient events were reported secondary to this change.

Using hospital cost data from Stanford’s integrated hospital cost management and decision support software (Transition Systems, Boston, MA), the cost of each preoperative diagnostic test was determined. Results demonstrate a hospital cost-reduction of 59.3%, or $112.09 per patient (Table 9).

In 1995, the APEC evaluated 8,972 outpatients and to-be-admitted patients. A $112.09 per patient decrease in preoperative testing during this year at Stanford has a potential cost-reduction to the hospital of $1.01 million.

Future Developments
The Department of Anesthesia is currently developing a curriculum for an anesthesia-based fellowship in perioperative medicine. This additional year of training emphasizes the management and clinical aspects of

Fig. 2. Day-of-surgery cancellations for the 1-yr period before establishment of the Anesthesia Preoperative Evaluation Clinic (March 1992 through February 1993) and the 1-yr period after establishment of the APEC (March 1993 through February 1994). Use of the APEC decreased the number of day-of-surgery cancellations at Stanford University Hospital by 116 patients, or 87.9%.

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Mar-May</th>
<th>Jun-Aug</th>
<th>Sep-Nov</th>
<th>Dec-Feb</th>
<th>TOTAL YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases Canceled</td>
<td>Mar 92 - Feb 93: 39 of 1646</td>
<td>32 of 1563</td>
<td>27 of 1763</td>
<td>34 of 1750</td>
<td>132 of 6722 (1.96%)</td>
</tr>
<tr>
<td>Cases Canceled</td>
<td>Mar 93 - Feb 94: 5 of 1991</td>
<td>4 of 1800</td>
<td>3 of 1859</td>
<td>4 of 1835</td>
<td>16 of 7485 (0.21%)</td>
</tr>
</tbody>
</table>

* 147 cancellations if volume matched 7485 patients
* Significantly (p < 0.0001, chi square) different from before clinic.
Table 8. Reduction in Preoperative Testing July through December 1994 by the Anesthesia Preoperative Evaluation Clinic after Transferring Responsibility for Ordering Preoperative Studies to the Anesthesiologist

<table>
<thead>
<tr>
<th>Previous Method of Ordering Preoperative Tests</th>
<th>Anesthesiologist Ordering Preoperative Tests</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>(July-Dec 1993)</td>
<td>(July-Dec 1994)</td>
<td></td>
</tr>
<tr>
<td>Patients (n)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3,576</td>
<td>4,313</td>
<td></td>
</tr>
<tr>
<td>Laboratory tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete blood count</td>
<td>3,417 (95.6)</td>
<td>17.7</td>
</tr>
<tr>
<td>Platelets</td>
<td>3,207 (97.5)</td>
<td>32.3</td>
</tr>
<tr>
<td>PT/PTT</td>
<td>2,703 (75.6)</td>
<td>62.3</td>
</tr>
<tr>
<td>Urinalysis</td>
<td>2,489 (69.6)</td>
<td>89.7</td>
</tr>
<tr>
<td>General survey panel</td>
<td>2,199 (61.5)</td>
<td>69.4</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>1,775 (49.6)</td>
<td>65.5</td>
</tr>
<tr>
<td>Renal panel</td>
<td>1,402 (39.2)</td>
<td>39.5</td>
</tr>
<tr>
<td>Total laboratory tests</td>
<td>17,192</td>
<td>4.74</td>
</tr>
<tr>
<td>Electrocardiograms</td>
<td>2,202 (61.6)</td>
<td>48.7</td>
</tr>
<tr>
<td>Chest x-rays</td>
<td>2,510 (70.2)</td>
<td>66.1</td>
</tr>
<tr>
<td>Total preoperative tests</td>
<td>21,904</td>
<td></td>
</tr>
<tr>
<td>Per patient tests (individual/panel tests)</td>
<td>6.13</td>
<td>55.14</td>
</tr>
</tbody>
</table>

PT/PTT = prothrombin time/partial thromboplastin time; LFTs = liver function tests; General survey panel = renal panel, LFTs, glucose, calcium, albumin, magnesium, and uric acid.
*Significantly (P < 0.001, chi-square) different from previous method of ordering preoperative tests.

Conclusions

This article is a description of the first 24 months of operational challenges, cost-effective outcomes, and continued growth of the Anesthesia Preoperative Evaluation Clinic at Stanford. The APEC has become a center for perioperative services, including the anesthesia preoperative medical evaluation.

We are extending the availability of all preoperative services, including the Anesthesia Preoperative Consultation Service for the medically complex patient, to the private surgeons and primary care physicians who use Stanford Hospital.

A continuing medical education symposium is under development that would focus on the medical evaluation and management of the preoperative patient, with emphasis on the medically compromised individual.

The Department of Surgery has requested an educational opportunity for surgical residents, similar to that currently available for internal medicine residents, to spend time in the APEC.

A clinical database was developed to provide an extensive repository of preoperative data, diagnostic tests, patient demographics, and the intra- and postoperative patient course. This "Anesthesia Information System" will facilitate outcome studies and evaluate the effectiveness of preoperative assessment. The anesthesia preoperative evaluations will be scanned electronically into the hospital-wide clinical database and viewed online.

The Department of Anesthesia is negotiating with the hospital administration to provide incentive income to the department for clinical cost savings generated by the APEC. In addition, hospital services increase under capitation and managed care, an opportunity exists for the department to obtain additional income through the entry and sharing of the hospital capitation risk pool revenues. The APEC's protocols and enhanced preoperative patient management may influence hospital savings, and thereby enhance the share of risk pool revenue.

Table 9. Comparison of Hospital Cost-Reduction in 11 Surgical Specialties for Preoperative Laboratory and Diagnostic Tests before and after Transferring Responsibility for Ordering Studies to the Anesthesiologist

<table>
<thead>
<tr>
<th>Previous Method of Ordering Preoperative Studies (July-Dec 1993)</th>
<th>Anesthesiologist Ordering Preoperative Studies (July-Dec 1994)</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedics</td>
<td>219 (502)</td>
<td>93 (488)</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>215 (353)</td>
<td>81 (291)</td>
</tr>
<tr>
<td>General operating room</td>
<td>212 (663)</td>
<td>71 (580)</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>201 (212)</td>
<td>68 (265)</td>
</tr>
<tr>
<td>Gynecology</td>
<td>198 (266)</td>
<td>87 (280)</td>
</tr>
<tr>
<td>Vascular</td>
<td>193 (169)</td>
<td>101 (242)</td>
</tr>
<tr>
<td>Gastro-urology</td>
<td>188 (346)</td>
<td>70 (511)</td>
</tr>
<tr>
<td>Podiatry</td>
<td>174 (228)</td>
<td>40 (57)</td>
</tr>
<tr>
<td>Otolaryngology</td>
<td>157 (287)</td>
<td>85 (266)</td>
</tr>
<tr>
<td>Plastic and hand surgery</td>
<td>153 (546)</td>
<td>42 (552)</td>
</tr>
<tr>
<td>Thoracic</td>
<td>149 (326)</td>
<td>112 (361)</td>
</tr>
<tr>
<td>Total costs ($) per patient</td>
<td>$188.91</td>
<td>$76.82</td>
</tr>
<tr>
<td>Hospital cost-reduction</td>
<td>$112.09 per patient</td>
<td>59.3%</td>
</tr>
</tbody>
</table>

Values are costs ($) with numbers of cases in parentheses.
*Significantly (P < 0.01, t test) different from previous method of ordering preoperative tests.

References


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recognized for consistent quality, increased efficiency, performance standards, and consumer satisfaction.

As it exists at Stanford, the APEC may not be suitable in its entirety for all academic departments, private individuals, and groups that administer anesthesia. However, not all of the concepts and changes seen at Stanford need to be implemented to improve the overall system and cost-effectiveness of preoperative evaluation. In addition, certain advantages do accrue to the anesthesiologist and department of anesthesia when such an APEC is established.

A successful Anesthesia Preoperative Evaluation Clinic can demonstrate significant clinical advantages, improve quality and value for customers, and provide visible leadership in responding to rapidly changing healthcare demands.

The author gratefully acknowledges the support and advice of Dr. Donald Stanski, Professor and Chairman, Department of Anesthesia, Stanford University.

References

1. Saidman LJ: The 33rd Rovenstine Lecture: What I have learned from 9 years and 9,000 papers. Anesthesiology 1995; 83:191-7

Footnotes
FISCHER


21. The APEC may benefit from having as medical director an individual who has enhanced knowledge of contemporary medicine and skills, acquired, perhaps, through focused continuing medical education courses or additional training in medicine.


CASE REPORTS

Tolerance to Propofol

Mary A. Setlock, M.D., F.A.C.A.

DEEP sedation or general anesthesia is required for small children with ing daily high-voltage radiation therapy. Propofol can be administered as a bolus dose, continued as an infusion for many weeks during these procedures. However, it is suggested that tolerance to propofol may be repeated administration and the drug or addition of other drugs over the course of treatment. In support of this, a report from New York and the case of a 2-year-old child indicates that the use of propofol during radiation therapy. Others, in retrospective studies, have not found tolerance to be reported in patients previously treated with propofol.

* Associate Professor, Department of Radiation Medicine, Children’s Hospital of Wisconsin, Milwaukee, Wisconsin, 1993. Accepted for publication in part at the annual meeting of the Section of Anesthesiology, Denver, Colorado, 1993. Address correspondence to Dr. Setlock MA, Palmwoods BW. Tolerance to propofol during long-term sedation. Anesth Analg 1992; 74:5278.

Received from the Departments of Radiation Medicine, Children’s Hospital of Wisconsin, Milwaukee, Wisconsin, 1988. Accepted for publication in part at the annual meeting of the Section of Anesthesiology, Denver, Colorado, 1993. Address correspondence to Dr. Setlock MA, Palmwoods BW. Tolerance to propofol during long-term sedation. Anesth Analg 1992; 74:5278.

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