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The Impact Of An Anesthesiology-Centered Preoperative Testing Protocol On Hospital Expenses And Adverse Events: A Before And After Retrospective Cohort Study

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ABSTRACT

Background

With the United States' healthcare system shifting towards a performance- and outcomes- based delivery model, attention must be turned towards improving patient experiences and population health while reducing costs and expenditures. The Perioperative Surgical Home model, led by the American Society of Anesthesiologists, aims to achieve these goals for patients during the perioperative period. We introduced this concept at our institution through establishing an Anesthesiology-centered preoperative evaluation program for patients undergoing elective urologic procedures. In doing so, we hypothesized that preoperative testing procedures and their associated expenses would be significantly reduced while surgical outcomes and adverse events would not be affected.

Methods:

We performed a single institution retrospective chart review of all patients who were evaluated at the preoperative anesthesia clinic in preparation for elective urologic surgery in the year before and after implementation of our preoperative evaluation program (February 1, 2012). Testing and procedures obtained after this time for pre-operative evaluation were individually guided by patients' history, symptoms, and extent of surgery.

Results:

One thousand and twenty patients (504 patients before and 516 after program implementation) were identified and reviewed. There was a statistically significant reduction in the quantity of laboratory, radiologic, and electrocardiographic studies performed with an associated financially significant decrease in associated hospital charges. No differences were seen between the groups for surgical outcomes, adverse events, and hospital efficiency measures.

Conclusions

The implementation of an Anesthesiology-centered preoperative evaluation program decreased the quantity of testing procedures and their associated hospital charges without negatively affecting surgical outcomes, adverse events, or hospital efficiency measures. While our experience only focuses on the preoperative phase, our results suggest that the Perioperative Surgical Home concept can lead to better patient experiences, improve outcomes, and reduced expenditures.

Key words: preoperative management; cost reduction in healthcare; urologic surgical procedures

TEXT

Introduction

In the changing landscape of our healthcare system, emphasis must be placed on shifting efforts towards performance- and outcomes-based delivery from the current fee-for-service model. To this end, the Institute for Healthcare Improvement Triple Aim has set forth the following objectives: improving the individual experience of care, improving the health of populations, and reducing per capita costs of care.[1,2] The Perioperative Surgical Home (PSH) is a patient-focused, physician-led, and multidisciplinary team-based coordinated care concept spearheaded by the American Society of Anesthesiologists (ASA).[3,4] In the PSH model, the anesthesiologist becomes the "perioperativist" and is positioned at the forefront of surgical management throughout the preoperative, intraoperative, and postoperative phases. Through this effort, the PSH aims to enhance overall patient experiences, promote perioperative safety, and improve outcomes while reducing systemic costs.[5]

Reports from early adoption of the PSH concept have started to realize these goals.

Garson et al described their institution's experience with implementing a total joint replacement PSH program and demonstrated the model's feasibility and positive effects on patient experiences and outcomes.[6] At our institution, we sought to introduce the PSH model through an anesthesia-centered preoperative evaluation program for patients undergoing elective urologic surgery. We hypothesized that we would significantly reduce the quantity of preoperative testing and its associated hospital charges while not affecting patient outcomes or healthcare delivery efficiency measures. A retrospective cohort study was performed to evaluate our experience 1 year before and after program implementation, and our results are discussed in this manuscript.

Methods:

On February 1, 2012, our anesthesia department at a tertiary, level 1 trauma hospital, piloted an anesthesia-centered preoperative evaluation program entitled "orders per anesthesia" in collaboration with the University of South Florida Morsani College of Medicine Department
of Urology. The four urologic surgeons agreed to cancel their standard laboratory and test orders (complete blood count, comprehensive metabolic panel, prothrombin time/international normalized ratio, activated partial

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thromboplastin time, electrocardiogram, and chest radiograph) and allow the preoperative anesthesia clinic providers to determine the necessary preoperative labs for surgical clearance; with the exception of urology specific labs (urinalysis and bloodtyping and crossmatching). The purpose of this program was to reduce redundancy and the ordering of unnecessary labs and to streamline and personalize patient care. Tests and procedures were ordered individually only based on history and extent of surgery. The following were indications for testing:

1. Complete blood count (CBC) for patients with history of anemia, hematuria, or cases where extensive blood loss is expected
2. Basic metabolic panel (BMP) for patients with history of hypertension, renal disease, or electrolyte abnormalities
3. Comprehensive metabolic panel (CMP) for patients with liver disease
4. Prothrombin time (PT)/partial thromboplastin time (PTT)/international normalized ratio (INR) for patients on anticoagulant therapy or patients with liver disease
5. Chest x-ray only on patients with current respiratory infection
6. EKG on patients with recent symptoms of chest pain, shortness of breath, or on patients unable to complete > 4 METs of activity.

We hypothesized that the implementation of the program would significantly reduce the number of labs and test ordered while at the same time maintaining surgical outcomes.

After approval from the University of South Florida Institutional Review Board, we obtained the medical records of patients whom visited the preoperative anesthesia clinic in preparation for an elective, outpatient urologic surgery in the year prior to (February 1st, 2011 through January 31st, 2012) and the year after implementation of the program (February 1st, 2012 through January 31st, 2013). We excluded all patients who did not visit the preoperative anesthesia clinic prior to surgery (including preoperative phone evaluations). A waiver of informed consent was granted by the Institutional Review Board.

Using our inclusion and exclusion criteria, a list of patients was generated from our electronic medical record system. The following data were extracted from the medical record: age, gender, body mass index (BMI), principal procedure, admitting diagnosis, past medical and surgical history, history of anesthesia- and surgery-related adverse events (without factoring of severity), number of surgery delays and cancellations, and the quantity of preoperative testing performed. We also identified postoperative data including: return to the operating room within 24 hours, adverse events (inclusive of respiratory events, cardiac events, central nervous system injury, unplanned ventilation, and death) within 48 hours, and unplanned or prolonged hospital and/or intensive care unit admissions within 48 hours.

Additionally, all identified patients were analyzed by our institution's finance department. The total number of patient encounters, units of service, and associated hospital charges were summarized in order to determine the financial impact after implementation of our "orders per anesthesia" protocol. Patient groups were further analyzed on the basis of intended inpatient and outpatient procedures to identify any trends while analyzing the units and charges per encounter.

All data were analyzed using SPSS 17.0 (SPSS Inc., IL) to represent outcomes before and after implementation of our protocol. The normality and variance of the group distributions for continuous variables was first assessed using the Kolmogorov-Smirnov test and comparisons were completed using the Mann-Whitney U test. Categorical variables were analyzed using either chi-square or Fisher's exact tests. Results were expressed as mean ± standard deviation (medians for non-parametric data) for continuous variables and as frequencies and percentages for categorical variables. A p-value of < 0.05 was considered statistically significant.

Results:

Patients

During the study period, 1020 patients were identified with 504 in the "before" and 516 in the "after" implementation groups. The groups were similar in gender distribution, BMI, admitting diagnosis, and history of anesthesia- and surgery-related adverse events. Statistically significant differences were found with age and procedures performed (table 1).

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Table 1 . Patient Demographics

	Before (n = 504)	**After (n = 516)**	**P Value**
Gender (male/female)	323/181	343/173	0.424
Age (yr): mean ± SD	62.2 ± 14.7	65.6 ± 12.5	<0.001
Body mass index (kg/m^2): mean ± SD	29.3 ± 6.2	29.1 ± 6.1	0.740
Principal procedure: n (%)			0.034
Cystoscopy	210 (41.3)	200 (38.8)	
Extracorporeal shock wave lithotripsy	21 (4.1)	11 (2.1)	
Radical cystectomy	49 (9.7)	55 (10.7)	
Retrograde pyelogram	16 (3.2)	16 (3.1)	
Transurethral resection of the prostate	7 (1.4)	20 (3.9)	
Transurethral resection of bladder tumor	39 (7.7)	57 (11.1)	
Other procedures	166 (32.7)	157 (30.4)	
Admitting diagnosis: n (%)			0.412
Bladder cancer	74 (14.6)	61 (11.8)	
Erectile dysfunction	37 (7.3)	49 (9.5)	
Incomplete bladder emptying	32 (6.3)	44 (8.5)	
Nephrolithiasis	36 (7.1)	31 (6.0)	
Prostate cancer	17 (3.4)	25 (4.8)	
Urethral stricture	20 (3.9)	23 (4.5)	
Urinary incontinence	65 (12.8)	67 (13.0)	
Other diagnoses	227 (44.7)	216 (41.9)	
Percentage of patients with a history of anesthesia and/or surgery-related adverse events	2.6	2.1	0.640

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Laboratory Evaluation and Testing

The quantity of laboratory evaluations and tests performed per patient was significantly lower after enacting the "orders per anesthesia" protocol (table 2).

Table 2. Quantity of Labs & Tests Ordered

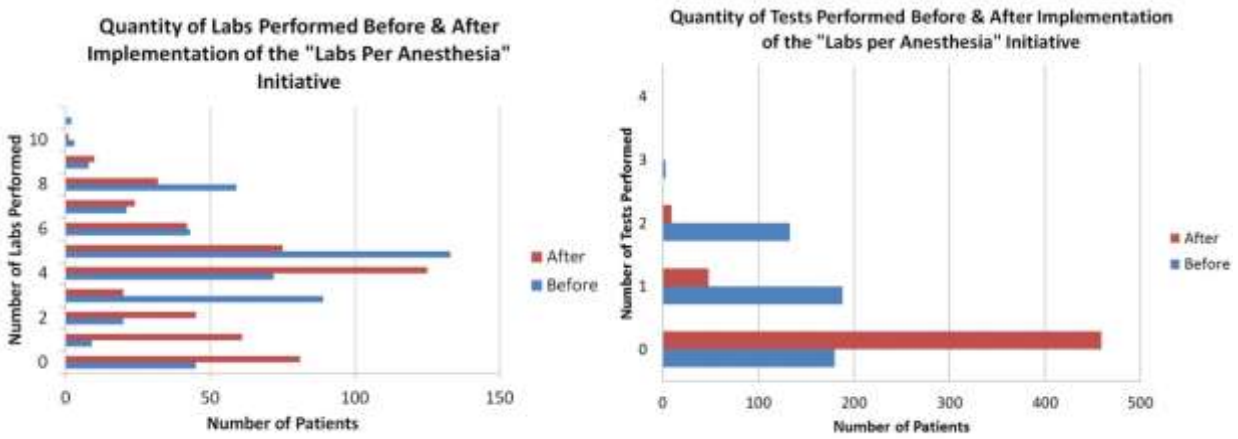
	Before (n = 504)	**After (n = 516)**	**P Value**
Number of labs per patient	5 (0-11)	4 (0-10)	<0.001
Number of radiologic tests and EKGs per patient	1 (0-3)	0 (0-2)	<0.001

Data are reported as median (range). P values of <0.05 are considered statistically significant based on the Wilcoxon Rank Sum Test.

Sixty-five percent of patients received a radiologic or electrocardiographic test as part of the preoperative evaluation prior to protocol implementation while only 10 percent of patients received one of these tests afterwards. The number of patients that did not require a pre-operative laboratory evaluation nearly doubled after implementation of our program (figure 1).

Figure 1. Quantity of laboratory and testing procedures performed before and after implementation of our protocol.

The graphs illustrate the frequency of ordered laboratory, radiologic, and electrocardiographic procedures in the years prior to and following the adoption of our "orders per anesthesia" protocol.



Patient Outcomes

Adverse events were defined as any unexpected or unplanned outcome occurring during the entire perioperative period through 48 hours post-procedure and divided into 5 categories: respiratory events, cardiac events, central nervous system injury, unplanned ventilation, and death (table 3).

Table 3. Patient Outcomes

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Outcome Measures	Before (n = 504)	After (n = 516)	P Value
Respiratory events: Pulmonary aspiration requiring intervention or new onset of pneumothorax in the perioperative period requiring an intervention or sustained arterial oxygen saturation < 90% for > 3 minutes.	1	2	1
Cardiac events: A cardiac-related event requiring advanced cardiovascular life support resuscitation measures.	0	0	N/A
Central nervous system injury: New onset of a central nervous system injury.	0	0	N/A
Unplanned ventilation: Unanticipated prolonged ventilation or tracheal intubation after extubation at the end of or immediately following a procedure that is directly related to anesthesia.	1	1	1
Death: Death precipitated by a non-cardiac event.	0	0	N/A

The adverse event timeframe was defined as the entire perioperative period through 48 hours after the end of the procedure.

Five complications were identified in the entire study population with 2 prior to and 3 after protocol adoption. In the before group, 1 patient suffered a respiratory event and 1 patient required unplanned prolonged ventilation. Two patients had respiratory events and 1 patient underwent prolonged ventilation in the after group. There were no statistically significant differences between groups for respiratory events and unplanned ventilation. No patients from either group experienced cardiac events, central nervous system injuries, or death.

Hospital Efficiencies

Hospital efficiency measures were classified as procedures delayed secondary to medical clearance, procedures cancelled secondary to medical clearance, return to the operating room within 24 hours, unplanned hospital admission, and unplanned intensive care unit admission (table 4).

Table 4. Hospital Efficiency Measures

Efficiency Measures	Before (n = 504)	After (n = 516)	P Value
Procedures delayed secondary to medical clearance	0	0	N/A
Procedures cancelled secondary to medical clearance	0	0	0.37
Return to the operating room within 24 hours of the principal procedure	0	0	1
Unplanned hospital admission exceeding a previously planned outpatient recovery or 23 hour stay but not to an intensive care unit	3	0	1

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Unplanned intensive care unit admission as opposed to a previously planned outpatient recovery, 23 hour stay, or admission to a unit of decreased acuity	1	1	0.451

No statistically significant differences were seen for any hospital efficiency measures between the groups. Unplanned hospital admissions occurred in 3 patients before and no patients after protocol implementation. Each group had 1 unplanned intensive care unit admission.

Financial Outcomes

Protocol implementation resulted in financially significant reductions in hospital charges for all testing procedures (table 5).

Table 5. Change in Units of Service and Hospital Charges Per Encounter Between Periods

	Decrease in Units of Service per Patient Encounter (Percent Change)	**Decrease in Hospital Charges per Patient Encounter (Percent Change)**	**Decrease in Total Charges**
Inpatient: Laboratory Procedures	8.5 (-37.0%)	$1,303 (-28.9%)	$157,708
Inpatient: Radiologic Procedures	0.5 (-42.6%)	$207 (-32.4%)	$25,034
Inpatient: Electrocardiograms	0.2 (-50.0%)	$80 (-51.1%)	$9,687
Outpatient: Laboratory Procedures	2.9 (-64.7%)	$544 (-61.4%)	$230,611
Outpatient: Radiologic Procedures	0.5 (-65.4%)	$226 (-57.3%)	$95,962
Outpatient: Electrocardiograms	0.3 (-84.7%)	$130 (-85.0%)	$55,096

These differences were maintained when patients were further analyzed within inpatient and outpatient surgery groups.

Discussion:

In this study, we found a significant decrease in the number of laboratory tests, radiologic studies, and electrocardiograms ordered after implementation of our "orders per anesthesia" protocol. Consequently, associated hospital charges were reduced by $574,098 in the year after adopting the program, equating to an average savings of about $1,112 per patient. Despite reducing the amount of preoperative evaluations performed, there were no significant differences in negative surgical outcomes or hospital efficiency measures between the two time periods. The implementation of only one preoperative aspect of the PSH model allowed our hospital to significantly reduce costs and need for patient testing while maintaining surgical outcomes and perioperative efficiency.

The incidence of surgical procedures continues to increase in the United States. At the same time, payers are moving towards value-based purchasing plans emphasizing quality and efficiency. With the advent of this new healthcare delivery model, patients, administrators, and providers are becoming more aware of the unnecessary, inefficient, and potentially detrimental care caused by a fragmented perioperative process. The PSH concept of the "perioperativist" seeks to enable the anesthesiologist to care for patients throughout the perioperative, intraoperative, and postoperative phases. Accordingly, the PSH concept aims to improve surgical outcomes, patient experiences, and economic efficiencies by shifting our current, disjointed perioperative approach to a continuum of care model.

While our institution's protocol only addressed one component of the preoperative period, our experience supports the view that the PSH model can help meet the goals of improving patient outcomes and experiences while reducing costs and inefficiencies.[7] This is done by limiting the number of low-value preoperative tests that

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are ordered by physicians. In 2002, the ASA issued a Practice Advisory stating "…preoperative tests should not be ordered routinely, but on a selective basis for purposes of guiding or optimizing perioperative management." This protocol was able to put this advisory into action.

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