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DEVELOPMENT AND TESTING OF TOOLS TO DETECT AMBULATORY SURGICAL ADVERSE EVENTS

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Abstract

Objectives—Numerous healthcare systems in the U.S., including the Veterans Health Administration (VA), use the National Surgical Quality Improvement Program (NSQIP) to detect surgical adverse events (AEs). VASQIP sampling methodology excludes many routine ambulatory surgeries from review. Triggers, algorithms derived from clinical logic to flag cases where AEs have most likely occurred, could complement VASQIP by detecting a higher yield of ambulatory surgeries with a true surgical AE.

Methods—We developed and tested a set of ambulatory surgical AE trigger algorithms using a sample of fiscal year 2008 ambulatory surgeries from the VA Boston Healthcare System. We used VA Boston VASQIP-assessed cases to refine triggers, and VASQIP-excluded cases to test how many trigger-flagged surgeries had a nurse chart review-detected surgical AE. Chart review was performed using the VA electronic medical record. We calculated the ratio of cases with a true

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surgical AE over flagged cases (i.e., the positive predictive value (PPV)), and the 95% confidence interval for each trigger.

Results—Compared to the VASQIP rate (9 AEs, or 2.8%, of the 322 charts assessed), nurse chart review of the 198 trigger-flagged surgeries yielded more cases with at least one AE (47 surgeries with an AE, or 6.0%, of the 782 VASQIP-excluded ambulatory surgeries). Individual trigger PPVs ranged from 12.4% to 58.3%.

Conclusions—In comparison with VASQIP, our set of triggers identified a higher rate of surgeries with AEs in fewer chart-reviewed cases. Because our results are based on a relatively small sample, further research is necessary to confirm these findings.

INTRODUCTION

As advances in medicine and technology shift care out of the inpatient setting, the prevalence of ambulatory surgery is increasing. Complex inpatient surgeries can now be accomplished using minimally invasive surgical techniques that drastically reduce the level of trauma to the patient. Once the surgical procedure is deemed safe enough to perform in the outpatient setting, the risk of an adverse event (AE) is perceived to be low.^{1–6} Subsequently, few studies have examined ambulatory surgery outcomes, including harm to patients and increased use of postoperative medical services. Assessment of quality of care and benchmarking efforts have focused on inpatient surgery; the development of methods to detect and identify AEs in ambulatory surgery lag far behind. Accurate and reliable detection of ambulatory surgical AEs is critical to facilitating targeted quality improvement.⁷

The Veterans Health Administration (VA) developed the Veterans Affairs Surgical Quality Improvement Program (VASQIP; formerly the National Surgical Quality Improvement Program), which is considered the flagship method of surgical AE detection and quality improvement.^{7–10} Its methodology has been adopted and is being increasingly used in the private sector by the American College of Surgeons (ACS-NSQIP).^{11,12} VASQIP detects AEs by targeting high-volume, complex surgeries for nurse chart review using a defined list of postoperative AEs. Based on the sampling framework, VASQIP reviews approximately 25% of all surgeries performed in the VA.¹³ The VASQIP methodology was developed at a time when most surgeries occurred in the inpatient setting;³ the sampling framework was not designed to target ambulatory surgeries, nor was the list of postoperative complications intended to detect AEs that may occur as a result of techniques exclusively used in ambulatory surgical procedures.^{14,15} As a result of VASQIP methodology and the relative infrequency of ambulatory surgical AEs, VASQIP alone may not detect many of the AEs that occur in VA ambulatory surgical care.

Trigger tools present an opportunity to complement VASQIP's methodology to improve detection of ambulatory surgical AEs. Triggers are surveillance algorithms derived from clinical logic that use automated data to flag cases with a high probability of having an AE.^{14–20} We recently completed a study developing and testing triggers for ambulatory surgical AE detection.²¹ The set of five triggers varied in predictive validity with positive predictive value (PPV) estimates ranging from 6.0% to 62.0% when compared with medical

record data.²² Although the PPV estimates were not high enough to justify using triggers alone to detect ambulatory surgical AEs, we hypothesized that using triggers to identify surgeries for VASQIP chart review may increase the yield of ambulatory surgical AEs detected. The current study builds on our previous research by: 1) adapting the ambulatory surgery trigger algorithms to the VA, 2) estimating the predictive validity of the triggers in detecting AEs in a sample of ambulatory surgeries excluded from VASQIP review, and 3) exploring the types of AEs that are likely to occur in ambulatory surgical care based on independent chart review.

METHODS

Data Sources

We used one year of data from the Boston VA Healthcare System (HCS) from fiscal year (FY) 2008 (Oct. 1, 2007 – Sept. 30, 2008). We obtained data on ambulatory surgeries from the Boston VA HCS local VASQIP office. VASQIP surgical clinical nurse reviewers (SCNRs) abstract postoperative data from a random sample of surgeries according to the VASQIP sampling framework: every 8 days, the first 36 consecutive surgeries are reviewed, with limitations on how many high-volume, low-risk procedures are assessed.^{8,13,23} For example, only the first three breast lumpectomy procedures are included in each 8-day review cycle.¹³ VASQIP postoperative complications include 20 specific AEs categorized as Wound, Respiratory, Urinary Tract, Central Nervous System (CNS), and Other Complications. Our VASQIP data extract was limited to patient identifiers, ambulatory surgical specialty and surgical procedure, as defined by Current Procedural Terminology (CPT), VASQIP assessment status, and postoperative complications. We removed cases with an eye procedure using CPT codes 65091-68899 because of VASQIP's eye procedure-based exclusion criteria.

We obtained administrative discharge data from the Patient Treatment File (PTF) and outpatient data from the Outpatient Care (OPC) file. Data were linked using patient identifiers (i.e., social security numbers). The PTF includes ICD-9-CM diagnosis and procedure codes, and the OPC includes visit date, provider type, and CPT codes.²⁴ We used FY 2008 PTF and OPC data, and added two quarters from FY 2009 to capture inpatient data for patients who had an ambulatory surgery in FY 2008 but were not discharged until FY 2009.

Using patient identifiers, we matched VA administrative data to patients that had an ambulatory surgery in FY 2008, based on the VASQIP dataset. Chart review was performed using the VA electronic medical record (EMR) VistA.²⁵ We did not collect any provider-level information. The VA Boston HCS and Bedford VA Institutional Review Boards approved this study.

Development of VA-specific Trigger Algorithms

In previous work, we developed a set of ambulatory surgical triggers designed to utilize administrative and electronic medical record (EMR)-derived clinical data. We established trigger face validity through a modified-Delphi process,²¹ and tested trigger predictive

validity using data from three large healthcare systems.²² Four of the triggers relied only on utilization of medical services postoperatively (i.e. visits or hospitalizations) and were suitable for further testing using VA administrative data. We also tested an additional administrative data-based trigger that our project clinicians (KI, HK) thought might perform well in the VA despite poor consensus in our Delphi process. Table 1 presents the definitions and clinical rationale of the five administrative data-based ambulatory surgery triggers developed previously and considered for further testing in this study: the Emergency Department (ED) trigger, the Admission trigger, the Length of Stay (LOS) trigger, the Procedure trigger, and the Clinic trigger.²²

We first adapted the triggers for use with VA administrative data, and then tested variations of the trigger algorithms using FY 2008 Boston VA HCS VASQIP-assessed chart review data as the gold standard. The variations in trigger algorithms were based on clinical judgment (e.g. timing for a postoperative AE), or characteristics of VA healthcare (e.g. VA urgent care departments often provide emergency care). We evaluated the flag rate, sensitivity and specificity, and used these results to determine which algorithms were good candidates for subsequent predictive validity testing. For each trigger, we selected the algorithm variation that: 1) maximized detection of AEs identified by VASQIP, and 2) minimized the number of flagged cases without an AE. We excluded triggers from further testing if none of the algorithm variations showed good discrimination in identifying AEs (i.e., they had low sensitivity and specificity).

Testing Positive Predictive Value of Triggers

We tested the positive predictive value (PPV) of the final set of triggers using the sample of FY 2008 Boston VA HCS ambulatory surgeries that were excluded from VASQIP review. Trigger performance was evaluated both individually and as a set. We confirmed the occurrence of a postoperative AE by performing nurse chart review on trigger-flagged ambulatory surgeries using patient data from VistA. We used the same chart abstraction tool as in our ambulatory study. This was based on VASQIP guidelines with additional items specific to the ambulatory setting.²² Nurses abstracted information on VASQIP-defined AEs and an additional five AEs that occur frequently in ambulatory surgery: Post-operative Ileus, Iatrogenic Pneumothorax, Intraoperative Iatrogenic Injuries, Wound Hematoma, and Persistent Nausea/Vomiting.^{1,6,15,26–29} We expected that other less well-defined AEs would also occur in ambulatory surgeries; therefore, we asked nurse chart reviewers to identify these “other” AEs based on their clinical judgment.

We calculated the PPV of each trigger as the ratio of true events over flagged events, and defined true events as either a “specific” or “other” AE. We used SAS software version 9.1 to perform all analyses and calculated the 95% confidence intervals for all test characteristics.^{30,31}

Evaluation of Events Detected by Triggers

We used our chart review results to evaluate the number and types of AEs that occurred in VASQIP-excluded surgeries. We also examined the data on “other” AEs and grouped them

into the categories used by VASQIP to define complications (e.g. wound complications). The categorization of “other” AEs was reviewed by a clinician on the project (KI).

RESULTS

Our final sample of merged administrative and VASQIP data included 1,104 ambulatory surgeries (1,002 patients) performed during FY 2008, 782 (71%) of which were excluded from VASQIP review. Table 2 presents the number of ambulatory surgeries by surgical specialty for the VASQIP-assessed and excluded cases. The majority of VASQIP-assessed cases were orthopedic, urologic, and general surgeries (35.1%, 18.0%, and 28.9% respectively), whereas VASQIP excluded surgeries from all surgical specialties. Although we removed surgeries with a primary procedure on the eye using CPT codes, we still found 127 ophthalmology surgeries (16.2%) in our VASQIP-excluded sample. These cases were primarily dermatology or plastic surgery procedures.

VA-specific Trigger Algorithms

Of the 322 surgeries assessed, VASQIP nurses detected nine surgeries with AEs (2.7%): three superficial surgical site infection (S-SSI) AEs, three urinary tract infection (UTI) AEs; two pneumonia (PN) AEs; and one deep vein thrombosis/thrombophlebitis (DVT) AE. We used these cases to test variations in trigger algorithms, shown in Table 3, and selected four triggers for further testing. One of the VASQIP-detected pneumonia (PN) events was not flagged by any trigger; when we examined the medical record for this patient we learned from the PTF that the ambulatory procedure occurred during an active admission—there appeared to be coding errors in either the PTF or the OPC to generate this result. The other PN case would have been flagged by the ED trigger except the patient visited an ED outside of the Boston VA (the patient was flagged by the Admission trigger).

The Procedure trigger was recommended in the modified-Delphi consensus process, but at best it flagged such a high percentage of the VASQIP-assessed cases (85.7%) and had a specificity of only 13.4% that we decided against including it. The Clinic trigger was not recommended in our prior study; however, we obtained an acceptable flag rate and sensitivity in one of the trigger variations to merit predictive validity testing with VASQIP-excluded cases.

The final four trigger algorithms we selected, ED, Admission, LOS and Clinic, flagged 26.4% of the 322 VASQIP-assessed ambulatory surgeries and detected five of the nine VASQIP-detected AEs. Using the VASQIP-assessed data as the gold standard, individual trigger sensitivities ranged from 0% to 22.2%; specificities ranged from 86.9% to 98.4%. The set of triggers together had a sensitivity of 55.5% (95% CI: 21.2–86.3%), specificity of 75.7% (95% CI: 70.6–80.4%), and a PPV of 5.9% (95% CI: 1.9–13.2%).

Trigger Positive Predictive Values

We estimated the PPV of the four triggers using nurse chart review to identify AEs among the 782 ambulatory surgeries VASQIP excluded in FY 2008. Table 4 shows the flag rates and PPVs for each of the four triggers and for the triggers as a set. Individual triggers flagged between 1.9–14.5% of the VASQIP-excluded ambulatory surgeries; PPVs ranged

from 6.3% to 33.3% in detecting “specific” AEs, and 6.2% to 25.0% in detecting “other” AEs. PPVs ranged from 12.4% to 58.3% for the detection of any AE.

As a set, the ED, Admission, LOS, and Clinic triggers flagged 198 of the VASQIP-excluded ambulatory surgeries (25.3%), and nurse abstraction identified 28 ambulatory surgeries with “specific” AEs (14.1%, 95% CI: 9.6–19.8%), and an additional 19 surgeries with “other” events (9.6%, 95% CI: 5.9–14.6%). Most of the ambulatory surgeries were flagged by only one trigger (157 of the 198 flagged, or 79.3%); where there was overlap, only four surgeries were flagged by more than two triggers. ED and Clinic triggers had the highest overlap (18 surgeries, or 9.1%). There was also high overlap between ED and Admission (15 surgeries, or 7.6%).

Compared to the VASQIP rate (9 AEs, or 2.7%, of the 322 charts assessed), our nurse chart review of the 198 trigger-flagged surgeries yielded more cases with at least one AE (47 surgeries with an AE, or 6.0%, of the 782 VASQIP-excluded ambulatory surgeries).

Evaluation of Events Detected by Triggers

The majority of “specific” AEs detected for each of the triggers were wound complications (52.6%) (see Table 5). The ED and Admission triggers found more than twice as many AEs as the LOS and Clinic triggers. Many of the AEs detected by the ED trigger were also detected by the Admission trigger suggesting that many of the patients who presented to the ED with an ambulatory surgical AE were subsequently admitted. This was the case for three SSI cases, four pneumonia cases, one unplanned intubation case, two UTIs, one of the cases of cerebrovascular accident (CVA)/stroke, one case of systemic sepsis, and one case of postoperative ileus. Six of the 38 “specific” AEs detected (15.8%) were not on the VASQIP list of post-operative complications: one post-operative ileus, four wound hematomas, and one case of persistent nausea/vomiting.

In the sample of VASQIP-excluded surgeries flagged by the four triggers, half of the 76 AEs detected were for “other” AEs that were not specifically defined in chart review guidelines (Table 6). The ED and Admission triggers detected the majority of the “other” AEs, but did not have as much overlap as with the “specific” AEs. The LOS trigger detected only one “other” occurrence. Nurse reviewers organized the “other” AEs according to the VASQIP postoperative complications categories, and we found that most of the AEs were wound and urinary complications (23.7% and 26.3% respectively), although the majority could not be categorized (31.6%). Many of the urinary complications were related to urinary retention, whereas the wound complications were seromas that did not meet the “specific” wound complication definitions. Rashes were common AEs in the Other Complications category.

Discussion

We adapted four administrative data-based triggers for use in assessing VA ambulatory surgical care and evaluated the triggers as a complement to VASQIP in detecting AEs. We identified 76 different AEs in 47 ambulatory surgeries that were excluded from VASQIP review. Six of the “specific” AEs detected were postoperative complications common in ambulatory surgery but not included in VASQIP’s chart-review protocol. In comparison

with VASQIP, the triggers as a set identified a higher rate of surgeries with AEs in fewer chart-reviewed cases. Our results suggest that detection of ambulatory surgical AEs in the VA is limited and that triggers can improve and complement detection efforts more efficiently than by simply increasing the number of surgeries VASQIP is required to review.

Our data on the type of events detected suggests that VASQIP's current list of postoperative complications may not be broad enough to detect AEs prevalent in ambulatory surgery. Other studies looking at specific diseases, such as cancer, have also found that the list of VASQIP postoperative complications is not broad enough to detect all relevant AEs.³² A recent study of surgical AEs in the VA determined that the majority occurred in ophthalmology, and 20% of the AEs detected affected the eye.³³ VASQIP's definition of eligible surgeries excludes many ophthalmology surgeries, and all dermatology and dental procedures. These types of surgeries may pose safety risks that warrant further investigation, particularly since these procedures are being done more frequently in the outpatient setting. Increasing the efficiency of AE detection may enable VASQIP to expand the definition of eligible surgeries to include ambulatory procedures in all surgical specialties.

Although the development of quality measures in ambulatory surgery is still at an early stage, recent studies present evidence of deviations from recommended practices that may negatively impact patient safety.^{34,35} Approximately 1.5% of patients are hospitalized for a complication related to ambulatory surgery resulting in significant costs to the healthcare system.³⁶ VASQIP and ACS-NSQIP data have been useful in targeting inpatient quality improvement efforts;³⁷ these data could also be used to improve the quality of ambulatory surgery provided there was a sufficient volume of AE data available. Other studies have also attempted to increase the volume of AEs detected by VASQIP through tools that screen clinical data.^{38,39} Our results show that by applying triggers to VA administrative data to target cases for chart review, the yield of surgeries with an AE detected doubled.

While the results suggest a potential role of ambulatory surgical AE triggers in conjunction with VASQIP, our study has several limitations. We used one year of ambulatory surgery data from one VA facility. As a result, our sample of surgeries was small and our PPV estimates had wide confidence intervals. Chart review guidelines for VASQIP postoperative complications underwent rigorous testing to ensure reliable AE detection; however, "other" AEs were not defined prior to nurse review and the additional ambulatory surgical AEs we included had only general guidelines. Surgeries were reviewed by one of two nurses using the VASQIP and general chart review guidelines, and, as such, we could not test nurse inter-rater reliability. The validity of the "other" events detected has not yet been established.

Despite this, the study sample was ideal for exploring how the previously developed ambulatory surgery triggers might complement the VASQIP methodology in detecting surgical AEs. We were able to obtain relevant local and current VASQIP data efficiently in order to adapt the triggers for a VA population, modify algorithms to maximize sensitivity and specificity, and measure the predictive validity of the triggers in detecting a variety of postoperative AEs. The triggers identified surgeries with many AEs, such as wound hematomas, that VASQIP does not currently detect in their structured chart review. We also

detected a number of “other” AEs that may be useful in developing future ambulatory surgery outcome measures.

Our results lay the foundation for future work testing ambulatory surgical AE triggers with national-level data. Improved detection of AEs in the ambulatory surgery setting is critical to ensuring high-quality surgical care both in the VA and the private sector.

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Table 1

Administrative Data-based Ambulatory Surgery Triggers Proposed for Further Testing in the VA Boston HCS *

Trigger Name	Trigger Rule Applied to Patient-Level Data	Clinical Rationale
Emergency Department (ED)	Ambulatory surgery AND subsequent ED visit 21 days	ED visits within 21 days of an ambulatory surgery are likely to include visits due to complications of surgery
Admission	Ambulatory surgery AND admission to hospital 30 days	Hospital admissions within 30 days of an ambulatory surgery may be due to complications from surgery.
Length of Stay (LOS)	Ambulatory surgery AND same day admission with length of stay > 24 hours	Patients with an ambulatory surgery that are hospitalized on the same day have a higher probability of complications.
Procedure	Ambulatory surgery AND procedure (interventional radiological OR urological OR cardiac OR gastroenterological) OR re-operation 30 days	Reoperation and certain procedures ambulatory surgery are indicative that a complication may have occurred.
Clinic *	Occurrence of 2 postoperative clinic visit within 30 days from surgical procedure	Multiple visits to a clinical specialist related to surgery indicate a complication may have occurred.

* All triggers except the clinic trigger were recommended in a modified-Delphi process (Kaafarani, 2010).

Table 2

List of FY 2008 Boston VA HCS VASQIP-Assessed and Excluded Ambulatory Surgeries by Specialty

Surgical specialty	VASQIP Assessed n (% of total)	VASQIP Excluded n (% of total)
General surgery	93 (28.9%)	72 (9.2%)
Gynecology	2 (0.6%)	25 (3.2%)
Ophthalmology	-	127 (16.2%)
Oral surgery	2 (0.6%)	16 (2.0%)
Orthopedics	113 (35.1%)	122 (15.6%)
Otorhinolaryngology	28 (8.7%)	135 (17.2%)
Plastic surgery	17 (5.3%)	54 (6.9%)
Podiatry	9 (2.8%)	89 (11.4%)
Urology	58 (18.0%)	142 (18.1%)
TOTAL FOR ALL SPECIALTIES:	322	782

Table 3

Development of Ambulatory Surgical AE Triggers using FY08 VASQIP-Assessed Chart Review Data (N=322)

		Variations of Trigger Algorithm	Flag Rate N (%)	Sensitivity % (95% CI)	Specificity % (95% CI)	Ambulatory Surgeries with AE Detected by VASQIP (X=Trigger flag)								
						AE #1 (S-SSI)	AE #2 (S-SSI)	AE #3 (S-SSI)	AE #4 (UTI)	AE #5 (UTI)	AE #6 (UTI)	AE #7 (DVT)	AE #8* (PN)	AE #9† (PN)
ED		Emergency Department (ED) visit 21 days	16 (5.0%)	11.1 (2.8–48.3)	95.2 (92.2–97.3)						X			
		ED OR urgent care visit 21 days	27 (8.4%)	11.1 (2.8–48.3)	91.7 (88.1–94.5)						X			
		ED OR urgent care visit 30 days	32 (9.9%)	22.2 (2.8–60.0)	90.4 (86.6–93.4)			X			X			
ADMISSION		Hospital admission 1–30 days	7 (2.2%)	22.2 (2.8–60.0)	98.4 (96.3–99.5)						X		X	
		Hospital OR rehabilitation facility admission 1–30 days	7 (2.2%)	22.2 (2.8–60.0)	98.4 (96.3–99.5)						X		X	
LOS		Hospital admission on day of surgery with length of stay (LOS) > 24 hours	17 (5.3%)	0	94.6 (91.5–96.8)									
		Hospital OR rehabilitation facility admission on day of surgery with LOS > 24 hours	17 (5.3%)	0	94.6 (91.5–96.8)									
PROCEDURE		Procedure (radiological OR urological OR cardiac OR gastroenterological) OR re-operation 30 days	307 (95.3%)	77.8 (40.0–97.2)	4.2 (2.2–7.0)	X	X	X	X	X	X	X		
		Procedure (urological OR cardiac OR gastroenterological) 30 days	307 (95.3%)	77.8 (40.0–97.2)	4.2 (2.2–7.0)	X	X	X	X	X	X	X		
		Procedure (urological OR cardiac OR gastroenterological) 30 days AND no evaluation/management visits	276 (85.7%)	77.8 (40.0–97.2)	14.1 (10.4–18.4)	X	X	X	X	X	X	X		
CLINIC		2 post-operative primary OR specialty care visits 30 days	105 (32.6%)	55.6 (21.2–86.3)	68.1 (62.6–73.2)		X	X	X	X		X		
		2 post-op primary care visits 30 days	9 (2.8%)	0	97.1 (94.6–98.7)									
		2 post-op specialty care visits 30 days	60 (18.6%)	22.2 (2.8–60.0)	81.5 (76.7–85.6)		X	X						
		1 post-op primary care visit AND 1 post-op surgical specialty visit 1–30 days	43 (13.4%)	22.2 (2.8–60.0)	86.9 (82.7–90.4)				X			X		

NOTES:

Italicized trigger algorithms were recommended by Delphi panelists (Kaafarani, 2010) with the exception of the Clinic trigger.

Bolded trigger algorithms were selected for further testing in this study (with the exception of the Procedure trigger).

* Patient may have been flagged by the ED trigger; however, the ED visit took place outside the VA Boston HCS.

† Patient may have been flagged by the LOS trigger; however, administrative data showed the surgery occurred during an active admission.

S-SSI=Superficial surgical site infection

PN=Pneumonia

DVT=Deep vein thrombosis/thrombophlebitis

UTI=Urinary tract infection

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Table 4
Ambulatory Surgical AE Trigger Results Based on FY08 VA Boston HCS VASQIP Ambulatory Surgery Data

Trigger Name and Algorithm	VASQIP-Excluded Cases (N=782)				VASQIP Reviewed and Excluded Cases (N=1,104)			
	Cases Flagged N (%)	PPV % (95% CI)			Cases Flagged N (%)	PPV % (95% CI)		
		Specific AE	Other AE	Any AE		Specific AE	Other AE	Any AE
Emergency Department (ED): Ambulatory surgery and 1 or more visits to an ED or urgent care clinic 30 days	79 (10.1%)	19.0 (11.0–29.4)	15.2 (8.1–25.0)	34.2 (23.9–45.7)	111 (10.0%)	15.3 (9.3–23.6)	10.8 (5.8–18.3)	26.1 (18.4–35.6)
Admission: Ambulatory surgery AND admission to hospital 1–30 days	36 (4.6%)	33.3 (18.6–51.0)	25.0 (12.1–42.2)	58.3 (40.8–74.5)	43 (3.9%)	32.6 (19.1–48.5)	20.9 (10.0–36.0)	53.5 (37.7–68.8)
Length of Stay (LOS): Ambulatory surgery AND subsequent admission with length of stay > 24 hours	15 (1.9%)	33.3 (11.8–61.6)	6.7 (0.2–32.0)	40.0 (16.3–67.7)	32 (2.9%)	15.6 (5.3–32.8)	3.1 (0.1–16.2)	18.8 (7.2–36.4)
Clinic: Ambulatory surgery AND 1 clinic visit to a primary care specialty and 1 clinic visit to a surgical specialty 1–30 days	113 (14.5%)	6.2 (2.5–12.4)	6.2 (2.5–12.4)	12.4 (6.9–19.9)	156 (14.1%)	5.8 (2.7–10.7)	4.5 (1.8–9.0)	10.3 (6.0–16.1)
All triggers	198 (25.3%)	14.1 (9.6–19.8)	9.6 (5.9–14.6)	23.7 (18.0–30.3)	283 (25.6%)	11.3 (7.8–15.6)	6.7 (4.1–10.3)	18.0 (13.7–23.0)

* Specific AEs were detected using chart review guidelines; Other AEs were detected based on nurse clinical judgment.

Table 5
Frequency of “Specific” AEs Detected by Trigger in Chart Reviewed Ambulatory Surgeries (N=198)

Specific Adverse Events*	Number of AEs Detected by Trigger				Total AEs Detected by Trigger Set N (%)**
	ED	Admission	LOS	Clinic	
WOUND COMPLICATIONS					
Superficial Incisional Surgical Site Infection (SSI)	4	4	1	1	7
Deep Incisional SSI		1			1
Organ/Space SSI	1		1		2
Wound Disruption	1	2	1	2	6
Wound Hematoma	2		1	2	4
Total Wound AEs	8	7	4	5	20 (52.6%)
RESPIRATORY COMPLICATIONS					
Pneumonia	5	4			5
Unplanned Intubation	1	2	1		3
Total Respiratory AEs	6	6	1	0	8 (21.1%)
URINARY TRACT COMPLICATIONS					
Urinary Tract Infection	3	2		2	4
Total Urinary Tract AEs	3	2		2	4 (10.5%)
CENTRAL NERVOUS SYSTEM (CNS) COMPLICATIONS					
Cerebrovascular accident (CVA)/Stroke	1	2			2
Total CNS AEs	1	2	0	0	2 (5.3%)
OTHER COMPLICATIONS					
Graft/Prosthesis/Flap Failure	1			1	1
Systemic Sepsis	1	1			1
Postoperative Ileus	1	1			1
Persistent Nausea/Vomiting			1		1
Total Other AEs	3	2	1	1	4 (10.5%)
TOTAL “SPECIFIC” AES DETECTED	21	19	6	8	38

* “Specific” AEs were determined using clinical guidelines developed by VASQIP and by clinicians on the project team (italicized).

Some AEs were detected by more than one trigger. This column represents the total AEs detected if all four triggers were used.

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Table 6

Frequency of “Other” AEs Detected by Trigger in Chart Reviewed Ambulatory Surgeries (N=198)

Types of “Other” Adverse Events Detected*	Number of AEs Detected by Trigger				Total AEs Detected by Trigger Set N (%)**
	ED	Admission	LOS	Clinic	
Wound Occurrences	6	1		4	9 (23.7%)
Respiratory Occurrences	1	2			2 (5.3%)
Urinary Tract Occurrences	8	5		4	10 (26.3%)
CNS Occurrences	1	2			2 (5.3%)
Cardiac Occurrences	2	3		1	3 (7.9%)
Other Occurrences	9	8	1	2	12 (31.6%)
TOTAL “OTHER” AES DETECTED	27	21	1	11	38

* “Other” AEs were determined by nurse clinical judgment.

** Some AEs were detected by more than one trigger. This column represents the total AEs detected if all four triggers were used.